Living with Nonstandard Work Schedules:

Wellbeing Challenges for Australian Parents

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Originality Statement

This thesis is submitted to The Australian National University in fulfilment of the Doctor of Philosophy degree. The thesis is, to the best of my knowledge, a presentation of my original work except as acknowledged in the text. I hereby declare that I have not submitted this material, either in full or in part, for another degree at this or any other institution.

The data used in this research is from the Families at Work survey and the Longitudinal Study of Australian Children. The Families at Work survey was funded by LaTrobe University and conducted in partnership between La Trobe University and The Australian National University. The Longitudinal Study of Australian Children, also known as *Growing up in Australia*, is an ongoing study funded by the Australian Government and conducted in partnership between the Australian Government Department of Social Services, the Australian Institute of Family Studies and the Australian Bureau of Statistics. The conceptual development, the data analyses, and the writing up of all chapters in this thesis were the principal responsibility of me, the candidate. My supervisors provided guidance and feedback on the conceptual development and the statistical plan, and also assisted with proof reading and copy editing. Copy editing was also provided by Dr Anne Isaac.

Chapter 2 includes part of the content from a peer-reviewed published journal article. The full content of that paper is attached in Appendix 1. The content in Chapter 4 has also been published as a journal article in a peer-reviewed journal (see published paper in Appendix 2). Chapter 5 is under preparation for submission to a peer-reviewed journal. These articles were written as part of my PhD research and I am the first author on all of them. I analyzed the data for these papers and drafted the text, and the drafts were then circulated for review amongst the co-authors listed. The co-authors (including my supervisors, as well as Dr Amanda Cooklin and Dr Alice Richardson) provided conceptual and technical advice on these papers.

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The data used in current thesis is adopted from the *Growing up in Australia*, Longitudinal Study of Australian Children survey, and the Families at Work survey. I would like to extend my most serious gratitude to everyone involved in the two surveys. I am truly grateful for the survey team's and participants' time and effort, which provided me with treasured insights into the issues relevant to this thesis.

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Abstract

Shift work is prevalent and has the potential to impact workers' mental health and wellbeing. However, existing research regarding an association between shift work and wellbeing is mixed, and there is a paucity of research examining particularly the wellbeing impacts of shift work for working parents. The overarching goal of this thesis is to clarify to what extent shift work is associated with wellbeing for parents (mothers and fathers) specifically, focusing on the challenges shift work might bring to negotiating work and family responsibilities. Parental wellbeing is explored using three indicators: psychological distress, work-family conflict and couple relationship quality. While shift work is primarily positioned as an "adverse exposure", the dynamic, bi-directional nature of the relationships is explored. Three interrelated studies were conducted:

Study 1 is a cross-sectional study of 1208 employed parents who participated in the Families at Work nationwide survey. Using moderated-mediation analyses, Study 1 investigated the association between shift work and psychological distress, whether work-family conflict explained this association, and gender differences. The findings show some evidence that working irregular shifts was associated with greater work-family conflict in connection with higher levels of distress, with fathers at greater risk. Working regular shifts was associated with greater distress (largely for mothers), but was not related to work-family conflict, suggesting other mechanisms are likely to be involved.

Study 2 investigated a possible causal link between working shifts and workers' parental wellbeing (i.e. psychological distress, work-family conflict and couple relationship quality). The study used five waves of longitudinal data (n=1915 couples) taken from a nationally representative sample of dual-earner parents – The Longitudinal Study of Australian Children (LSAC). Positioning shift work as an occupational exposure, this study adopted a hybrid analysis model to identify within-individual changes in wellbeing connected to changes in shift work (separate from time-invariant differences between individuals). Changes in shift work were found to be linked to changes in fathers' (but not mothers') couple relationship

quality, and this association could not be attributed to shift working fathers' personal or work-related characteristics.

Study 3 was conducted as a complement to Study 2, but the reverse causal direction was tested to explore whether health selection might drive any association between shift work and wellbeing. Taking a sample from the LSAC data largely comparable to that used in Study 2, population-average logit models investigated whether parents' wellbeing predicted a subsequent transition into or out of shift work. The results showed that mothers with higher psychological distress were more likely to move into shift work. No other significant associations were found. The findings suggest caution is needed when assuming the causal direction of associations found between shift work and mental health, especially in cross-sectional studies.

Overall, the findings from this thesis provide some evidence that shift working parents in Australia have poorer wellbeing than non-shift working parents. However, the findings differ somewhat for mothers and fathers, may depend on the type of shift work undertaken and the wellbeing indicator measured. Further research is needed to clarify the nature of these relationships and thus to inform family-friendly policy and practices to support shift working parents.

Table of Contents

List of Figures

List of Tables

Chapter 1 Thesis overview

1.1 Thesis topic overview

Paid work is central to both people's lives and how society functions, in the way that it brings both tangible or material resources (e.g. income) and latent benefits (e.g. time structure, credibility) to promote a sense of purpose and wellbeing (Jahoda, 1981). Employment generally has positive effects for individuals in terms of their economic and social resources and their health and wellbeing (Dooley et al., 1996). But, of course, not all employment is equal; and not all workers in the workplace are equally free (or unconstrained) to reap the benefits from being employed. The current thesis draws together a specific employment condition (shift work) and a specific constrained population of workers (parents), to examine how parents' wellbeing might be affected by working nonstandard hours. Shift working parents' ability (or inability) to manage their work and family demands is a particular focus and is explored as both an indicator of parental wellbeing and as a potential mechanism for the connection between nonstandard work hours and wellbeing.

The movement towards a "24/7" economy has brought about a growing demand for services (and workers) to be available at all hours of the day (Presser, 2003), and as such, shift work or irregular work is commonplace: approximately 16% of employees work shifts in Australia (ABS, 2012a); ~15% in the UK (Office for National Statistics, 2011); ~29% in the US, (Alterman et al., 2013). Shift work, also known as "nonstandard work schedules", points to a range of working time arrangements, but the term generally implies that a considerable proportion of work hours fall outside the typical 8/9am to 4/5pm, Monday to Friday schedule (Li et al., 2014; Presser, 2003). Importantly shift work is not the same as "overtime" or "extended hours" (Fenwick & Tausig, 2004; Presser, 2003). Shift workers work at night or weekends because it is part of their prescribed work schedule, while overtime is often undertaken by choice (i.e. to catch up on job tasks). This is a significant distinction, as the prescribed requirement to work outside "normal" paid work hours can create critical and ongoing difficulties for how shift workers schedule their non-work activities (e.g. sleep,

exercise, social and family activities, and home duties). The potential for disrupted work and non-work routines (relative to the rest of the regular working-time population), has led to concerns about the impacts of shift work on workers' health and wellbeing. Considering the high prevalence of shift work, these impacts are potentially widespread and might affect a significant proportion of the population.

To date, a considerable body of research has investigated the effects of shift work on physical health, and a link between the two is now well established (Kecklund & Axelsson, 2016). In contrast, the association between shift work and mental health and wellbeing has been studied less comprehensively (Vogel et al., 2012). Mental health problems are acknowledged as a major public health issue. The 2007 National Survey of Mental Health and Wellbeing showed that in Australia, the prevalence of any mental disorder in a 12-month period was 20%, with anxiety and affective disorders most common (14.4%; 6.2%) (Slade et al., 2009). The significant prevalence of mental health problems and associated social and economic burden (Whiteford et al., 2013) makes it vital to explore and identify the potential drivers, including the potential contribution of nonstandard work schedules.

There are numerous pathways that could potentially link nonstandard work schedules to poorer mental health and wellbeing. In the specific context of shift working parents, shift work may potentially disrupt parent wellbeing via a reduced ability to manage family routines and functioning. These compromises in family functioning are likely to co-occur with and/or lead to the experience of higher work-family conflict, reduced relationship quality (for those partnered), and also poorer mental health. All of these factors could be considered as signs of a disrupting effect of shift work on parental wellbeing and are a focus within the current thesis.

1.2 General research aim, conceptual model and methodological approach

The overarching goal of the research conducted in this thesis is to clarify to what extent shift work (i.e. nonstandard work schedules) is associated with and impacts wellbeing *for parents specifically*, with a particular focus on the challenges shift work might bring to successfully negotiating both work and family responsibilities. The research questions posed and analyses undertaken have been restricted to this specific cohort in the work force – working parents (with children aged under 18). Working parents face unique challenges, seeking to have active involvement in both their work and family responsibilities, and warrant specific investigation given that a large proportion of shift workers are parents (as described further in Chapter 2). It is also important to note that the current thesis includes a gender lens – exploring how the associations between shift work and wellbeing might be different for mothers and fathers given the gendered nature of work and care within Australia and globally (as explained further in Chapter 2) (Craig & Powell, 2011; Cha, 2010).

Figure 1.1 depicts the conceptual model adopted within the current thesis. While shift work is primarily positioned as a potentially adverse exposure in this thesis, the dynamic, bi-directional nature of the relationships explored is acknowledged and sought to be understood more clearly (see bi-directional arrows in Figure 1.1). Figure 1.1 also shows that parental wellbeing is explored using three indicators relevant to family life – psychological distress, work-family conflict and relationship quality. While this conceptual model shows how these core variables are theoretically proposed to be interrelated, not all of the pathways between these variables were able to be thoroughly tested within this thesis. In addition, while family routine and functioning are assumed to be one of the core conceptual pathways to parental wellbeing, their role is not tested explicitly in this thesis.

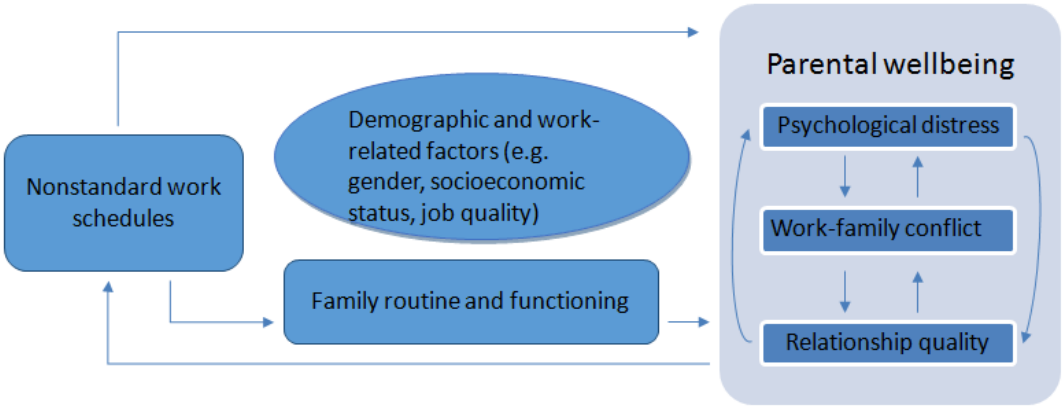


Figure 1.1 A conceptual model of nonstandard work schedules in association with parental wellbeing

Whilst not made explicit in Figure 1.1, this thesis explores work-family conflict as both a potential mediator (explanatory factor) for the association between shift work and psychological distress (Study 1 in Chapter 4) and as a wellbeing outcome in and of itself (Study 2 in Chapter 5). Poor relationship quality is also examined as a potential outcome of shift work (Study 2 in Chapter 5), as relationship quality can also be viewed as an indicator of wellbeing within dual-parent families. Since both work-family conflict and relationship quality have been found to be closely related to mental health and psychological distress in previous studies (Cooklin et al., 2016; Borgmann et al., 2019; Yucel & Fan, 2019; McTernan et al., 2016; Nigatu & Wang, 2018; Proulx et al., 2007; Goldfarb & Trudel, 2019), the current research focuses on the associations for all three of these indicators of parental wellbeing with shift work. While there is some prior research suggesting that shift work complicates the temporal nature of family life, resulting in higher levels of stress and psychological distress for parents, this research is somewhat inconsistent (Presser, 2003). However even more scarce, is existing evidence specifically regarding an association between shift work and work-family conflict, and also between shift work and relationship quality. Thus, this thesis aims to provide solid evidence on contemporary issues and research questions that remain somewhat unexplored.

The thesis takes a population-level perspective and uses quantitative data from general population samples to examine the association between shift work and parental wellbeing, (i.e. its impacts on psychological distress, work-family conflict and relationship quality), on a national level. Both cross-sectional and longitudinal methodological designs have been adopted in the research. The thesis uses cross-sectional data to examine the concurrent association between different types of shift work schedules and mental health, and whether this association might be mediated by work-family conflict (Study 1). The cross-sectional dataset adopted uniquely includes large numbers of parents working different types of shift work schedules (e.g. regular shift work, rotating shift work and irregular shift work), allowing exploration of how different shift work schedules might impact on work-family conflict and mental health. Longitudinal data is then used to explore more causative research questions, including the extent to which changes in shift work schedules are associated with changes in parental wellbeing over time (Study 2), and the extent to which health selection might play a role in any association – i.e. how changes in parental wellbeing might lead to transitions into and out of shift work over time (Study 3). By testing the associations in different directions, the research aims to gain insight into the casual relationship between shift work and parental wellbeing. In addition, a number of theoretically relevant demographic and work-related factors are included in the analyses to minimize their potential confounding effect and more closely identify any independent association between shift work and parental wellbeing.

1.3. Aims and overview of specific chapters

Chapter 2 Literature review

This chapter begins by reviewing the literature surrounding the association between shift work and mental health, with a focus on measures of psychological distress. First, the questions, "What is shift work?" and "Who is undertaking shift work?" are addressed. The prevalence of shift work in Australia and globally is described, highlighting the potential for large-scale impacts on workers', and in particular working parents', wellbeing. The chapter

continues with a review of the existing findings of population-level, quantitative studies on the association between shift work and mental health (again with a focus on psychological distress), including research restricted to parent populations. The findings of this literature review suggest that overall, there is reasonable evidence that shift work is associated with poorer mental health across occupation types, particularly for women. However, there is a lack of consistency and less evidence when studies are categorized into specific shift work types, when focusing specifically on working parents, and when comparing mothers and fathers. The review also reveals that despite inconsistencies between different shift work schedules regarding their association with mental health, it is a common practice among existing studies to adopt a broad binary measure of shift work (and compare non-shift workers with workers in any type of shift work schedule). Therefore, to remain consistent with the bulk of the literature, and to avoid over-complicating the analyses, a similar broad binary measure of shift work is adopted in the longitudinal studies in this thesis (Study 2 and Study 3). Additionally, the issue of differences in the effect of shift work on mental health across different schedules is investigated in cross-sectional analyses undertaken in Study 1. Following this first part of the literature review, several theoretical perspectives explaining the proposed associations between shift work and psychological distress are discussed.

The second half of Chapter 2 comprises a review of the literature regarding two additional indicators of parents' wellbeing that may be impacted by shift work, namely work-family conflict and relationship quality. These two factors are explored both as outcomes associated with shift work, and in the case of work-family conflict, as a potential mechanism or pathway through which shift work could be linked to psychological distress. The chapter explores the close relationships between psychological distress, work-family conflict and relationship quality. In addition, the chapter also reviews a series of other sociodemographic and work-related factors relevant to the current research project. These are frequently adjusted for as covariates in subsequent analyses to examine the independent contribution of shift work to parental wellbeing. The literature review chapter concludes by outlining the specific aims to be tested in the subsequent three analysis chapters.

Chapter 3 Methodological overview

This chapter provides a brief description of the methodological approaches used in the three studies included in this thesis. First, there is a description of the two quantitative datasets, the Families at Work Survey and the Longitudinal Study of Australian Children (LSAC), from which the survey samples were drawn. A brief overview of the measures included in each study is also provided (with further detail within each analysis chapter). Finally, the statistical models adopted to analyse the data in the three studies are explained.

Chapter 4 Study 1 analysis

This chapter reports the findings from Study 1. This cross-sectional study of employed parents (n=1208) used moderated-mediation analyses to investigate the association between types of shift work schedules and psychological distress, whether work-family conflict explained these associations, and whether the pathways differed between genders. Figure 1.2 below depicts the conceptual pathways explored (indicated by bold lines). The sample included 756 mothers and 452 fathers participating in the Families at Work survey, an online nationwide community-based survey of employed parents. The findings highlight the complex interplay between parents' work schedules, work-family conflict and psychological distress. They show some evidence that working irregular shifts was associated with increased work-family conflict in connection with higher levels of psychological distress, with fathers at greater risk. Working regular shifts was associated with greater psychological distress (an association that was stronger for mothers), but this was not related to increased work-family conflict, suggesting other mechanisms are likely to be involved in driving this relationship.

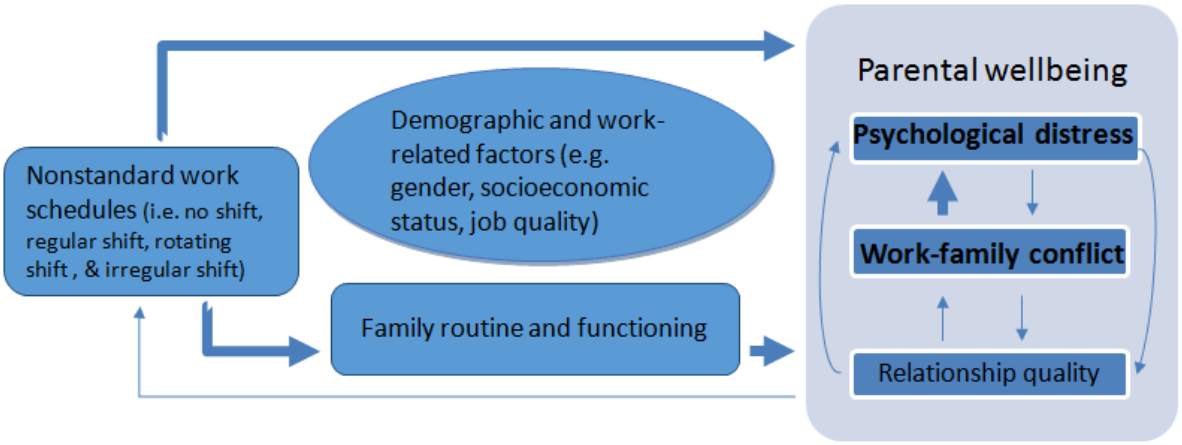


Figure 1.2 The conceptual model with the pathways and variables tested in *Study 1* highlighted

Note: While the highlighted pathways propose a causal link it is important to note that Study 1 used cross-sectional data (and the limitations of this are described within the analysis chapter).

Chapter 5 Study 2 analysis

This chapter reports the findings from Study 2, which aims to extend and add clarity to the existing research literature by further exploring a causal link between working shifts and workers' parental wellbeing using prospective longitudinal data. More specifically, the study used five time-points of data from a nationally representative sample of dual-earner parents (i.e. the LSAC) to examine the association between shift work and workers' psychological distress, work-family conflict and relationship quality over time – positioning shift work as an occupational exposure for parents and effects on wellbeing as the outcome (see Figure 1.3 below for the conceptual pathways explored). The three parental wellbeing indicators were chosen because they have each been found to be reflective of healthy family functioning, as detailed in Chapter 2. This study adopted a hybrid analysis model to identify within-individual changes in wellbeing in association with changes in shift work (i.e. time-varying associations), as well as between-individual differences (i.e. time-invariant differences between those who do and do not work shifts). Moreover, by including data from both parents within a couple and including a wide range of family-related and work-related factors in the analyses, the study aimed to gain insight into the extent to which there is an independent relationship between shift work and parents' wellbeing.

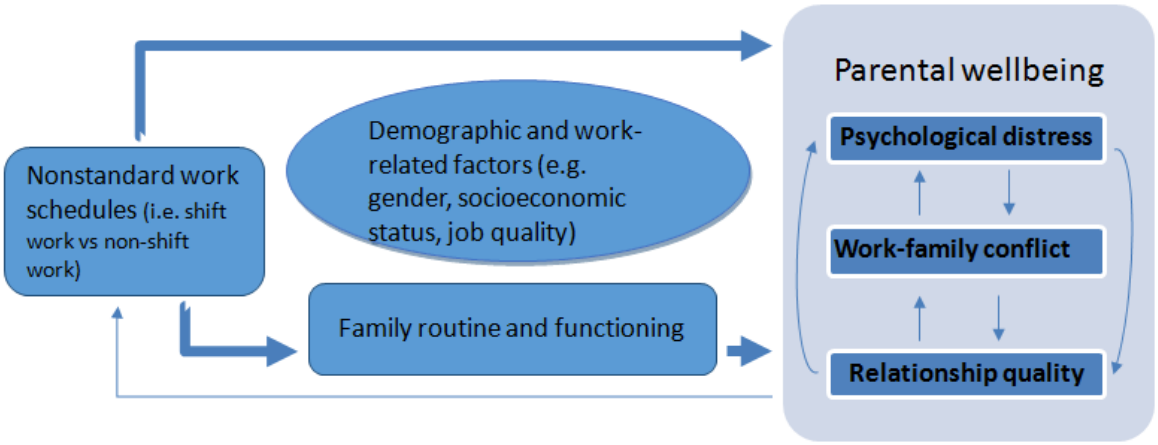


Figure 1.3 The conceptual model with the pathways and variables tested in *Study 2* highlighted

The results demonstrated that shift work had different connections to wellbeing for mothers and fathers. No associations between shift work and psychological distress were found for either mothers or fathers. With regard to work-family conflict, there were indications that shift working mothers experienced less work-family conflict and shift working fathers experienced more, but this was most likely because of differences in the job and family characteristics that exist between shift workers and non-shift workers (i.e. between-individual differences and/or covariates). The main finding from this study was the significant, and potentially casual, association between shift work and lower relationship quality for fathers – as working fathers experienced worse relationship quality when working shifts compared to when not working shifts (i.e. within-person effect), and this could not be attributed to shift working fathers' personal or other work-related characteristics.

Chapter 6 Study 3 analysis

This chapter reports the findings of Study 3. This study was conducted as a complement to Study 2, but the reverse direction in pathways was tested. Using a study sample that was largely comparable to Study 2, the analyses investigated whether or not parents' wellbeing (i.e. psychological distress, work-family conflict and relationship quality) at one time-point might predict their actions to move into or out of shift work at a subsequent time-point (see Figure 1.4 below for the conceptual pathways explored). In other words, the analyses examined

whether the association between shift work and mental wellbeing might be the consequence of the healthy worker effect, where health selection is thought to drive employment decisions or outcomes. The results showed that mothers with higher psychological distress were more likely to move into shift work. No other significant associations were found. The findings of this study suggest that some caution is needed when interpreting the significant associations previously found between shift work and mental health (regarding assumptions that shift work is the causal driver of these associations), especially with regards to cross-sectional studies (Dockery et al., 2009; Park et al., 2016), including Study 1 in this thesis (Zhao et al., 2020).

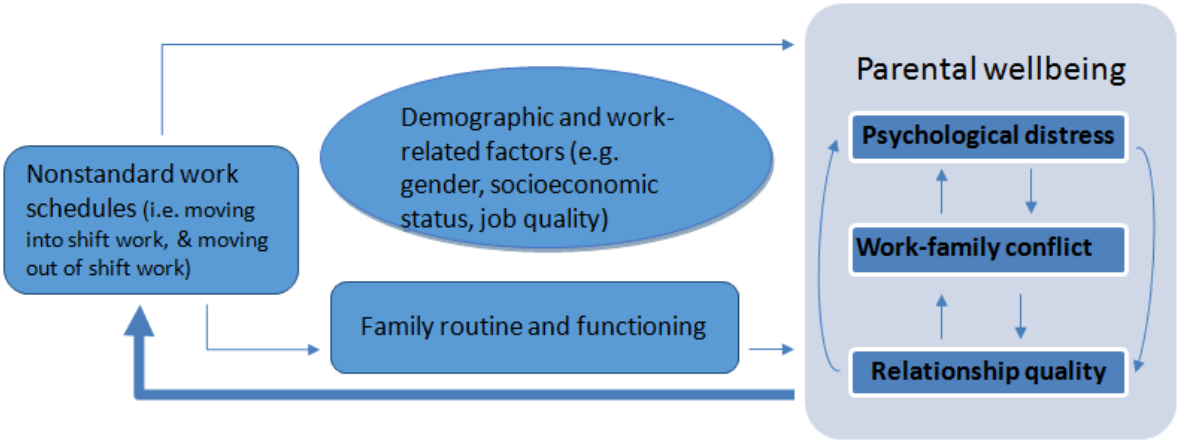


Figure 1.4 The conceptual model with the pathways and variables tested in *Study 3* highlighted

Chapter 7 Final discussion, implications and conclusions

The final chapter summarises the findings of the three studies conducted within the current research thesis. The chapter concludes that while the findings are complex and at times inconclusive, overall, the thesis provides evidence to suggest that shift work has a detrimental effect on parental wellbeing, but that the effect varies across types of work schedules, different wellbeing indicators, and between mothers and fathers. The final chapter reveals that overall, there was more evidence that fathers are vulnerable to the negative impacts of shift work on indicators of parental wellbeing than mothers (potentially via increases in work-family conflict and poor relationship quality). The connections of these findings with

existing research are highlighted within the chapter and the strengths and limitations of this thesis are further explored. Based on the findings of the current thesis (and on its acknowledged limitations), directions for future research are considered. Finally, the implications of the current research findings for policy and practice are discussed.

1.4 The importance of the present research

At present, the labour force is becoming increasingly fractured, in part demonstrated by the increasing variety and complexity of working arrangements and by the growing flexibility in the ways in which jobs are undertaken (Matilla-Santander et al., 2020). The substantial prevalence of shift work (i.e. nonstandard work schedules) is one noticeable example of this trend (as discussed further in Chapter 2). However, as mentioned previously, many questions related to these new working time arrangements remain unanswered, especially regarding their impacts on mental health and wellbeing. Understanding whether shift work is associated with workers' wellbeing and considering the mechanisms behind any association is critical to informing efforts to build a physically and mentally healthy work force.

This thesis focuses specifically on the potential impacts of shift work on workers' family functioning and examines the association between shift work and a series of wellbeing indicators closely related to family life. Because of the focus on family life, the research is conducted among a specific cohort in the work force who generally shoulder more family responsibilities compared to other workers – working parents with children aged under18. The findings of this research provide evidence that shift work is related to parental wellbeing for working parents in Australia – particularly for fathers, who have often been neglected in discussions around family-friendly work, and particularly when shifts are irregular or unpredictable. The thesis provides valuable insights for policymakers, employers and workers themselves to consider how shift work might be managed or mitigated at a policy level, in the workplace and also at home. For example, the significant association between shift work and work-family conflict means that developing family-friendly working arrangements and

policies is especially important to improving workers' wellbeing in jobs requiring shift work – and not only for mothers, but also for fathers. In addition, work and working-time have become even more fractured recently as a result of the COVID-19 pandemic (e.g. many people are working from home and many parents are juggling work and family responsibilities concurrently), and it is quite possible that job options may shrink in coming years due to an increase in unemployment (ABS, 2020). For these reasons, it is critical that research into the impacts on parental wellbeing of nonstandard work schedules, as well as of other precarious work arrangements, be continued in an effort to understand these critical and contemporary issues.

Chapter 2 Shift work and parent wellbeing: Theory and research

2.1 Summary

The current chapter reviews the literature and theory concerning an association between shift work and parent wellbeing. This association is explored for three domains of parent wellbeing – mental health (or more broadly, psychological distress), work-family conflict and relationship quality. The chapter begins by describing the term shift work and its prevalence in the general labour force and specifically among parents. The chapter then reviews the empirical literature examining the potential association between shift work and mental health, with a focus on parent populations, after which the theoretical frameworks that align with expecting an association between shift work and higher psychological distress are explored. The final two sections of this chapter describe the existing literature linking shift work with work-family conflict and couple relationship quality. Finally, the aims of each study conducted in this thesis are described.

2.2 Background: Shift work in Australia and around the world

The introduction of the electric lighting system in the nineteenth century has undoubtedly been recognized as one of the greatest inventions in history, as it brought about widespread changes to societies around the world, including changes to the way people live and work. One of the most remarkable changes was the emerging possibility of expanding economic activities from daytime to evening and night. Since then, this trend has continued and increased, in part due to demographic changes in the labour force (e.g. women's workforce participation), as well as the overall shift towards globalization. In recent decades, these changes have led to what has been described as a 24/7 economy within present-day society (Presser, 2003). This means that, today, it has become increasingly common for businesses to operate around the clock.

To fulfil the requirement for around-the-clock productivity, shift work has equally become an increasingly normal working time arrangement (Presser, 2003). It is difficult, and indeed not possible, to use a single definition to neatly capture the working hours of all shift workers. As the demand for service occurs across variable hours and different industries, occupations, and even organizations, the exact hours or times that shift workers work also vary. There has been no single, agreed-upon, definition of the specific employment conditions that constitute "shift work" (Zhao et al., 2019), but shift work is commonly defined as regular, scheduled work outside the traditional 9-to-5, Monday to Friday schedule (Sparks et al., 2001; Presser, 2003). The practice of defining shift work as "not regular hours/schedules of work" has assisted researchers to more simply categorize and compare the economic, social and health differences between shift workers and non-shift workers. Many studies investigating shift work classify all participants' work schedules into two groups: a standard schedule (i.e. non-shift work), which refers to a regular daytime, weekday schedule; and a nonstandard schedule (i.e. shift work), which refers to all other schedules including (but not limited to) regular morning, afternoon and night/evening shifts, weekend shifts, rotating shifts, irregular shifts, split shifts and being on-call (Carlson et al., 2011; Dockery et al., 2009). The terms "nonstandard schedule" and "shift work" are often interchangeable in the research literature, as is the case throughout this thesis. While research, particularly quantitative research, often combines shift workers into one group representing nonstandard work schedules, it is important to remember that shift work encompasses a wide variety of working arrangements and that there may be differences between different shift work types.

Shift work is common and is worked in a variety of contexts. Today, there are numerous industries requiring 24/7 coverage, hence requiring shift work. For example, undertaking shift work is a typical occurrence in emergency services, such as policing, firefighting, and emergency medical services. Workers who regularly change time zones, such as pilots and other air crew members, also typically perform shift work. Other examples concern employees in occupations where constant monitoring is important, e.g. in the military, meteorology and public utilities. Workers in the hospitality and entertainment industries are

also often asked to undertake shift work. There are some differences between the occupations of male versus female shift workers. According to Australian data from 2012 (ABS, 2012a), the highest proportion of male shift workers are in mining (47%), while most female shift workers are employed in accommodation and food services (33%) and health care and social assistance (30%). The fact that shift work is somewhat scattered across numerous industries and occupations can obscure the large number of shift workers in the labour force. In fact, shift work is more common than many people think. For example, ABS data shows that around 16% of employed people in Australia usually work shifts, and this proportion has remained stable for the last 10 years (ABS, 2012a; ABS, 2019a). Furthermore, in the last five years (2015-2019), only 50% of employees solely worked Monday to Friday (ABS, 2019a). This higher figure suggests that working nonstandard hours occurs at least some of the time in many people's jobs. Similarly, the Office for National Statistics in the UK reported that across 1999-2009, about 15% of employees worked shifts "most of the time" (Office for National Statistics, 2011). The proportion is even greater in the US, where data from the 2010 US National Health Interview Survey showed that 29% of employees did not work a regular daytime schedule (Alterman et al., 2013).

Interestingly, shift work seems to be even more common among a specific population – working parents. A nationally representative sample in Australia, drawn from the Longitudinal Study of Australian Children (LSAC), showed that in 2008, among families with at least one child under age 5, 28% of working mothers and 21% of working fathers were working nonstandard schedules – both higher proportions than the 16% national level (calculated using Wave 3 of the baby cohort of LSAC). In addition, ABS data showed that in 2007, about half of all dual-earner families with children in Australia had one or both parents working variable hours or "on call" (ABS, 2009). Research by Cooklin et al. (2015) on Australian working fathers' postpartum mental health, also based on LSAC, found that 69.4% of these new fathers worked at weekends and 66.8% worked at night– although this high figure represented both overwork (fathers working long hours) and shift work. The idea that shift work is common in families with children is also reflected in the US, where a national study found that in

dual-earner families, the presence of children, particularly children under the age of 5, increased the likelihood of at least one spouse working a nonstandard schedule (Presser, 2003). Furthermore, when asked why they undertook shift work, the most common reason, given by 40% of mothers with children ≤ 5 was "better child care arrangements" (Presser, 2003, p. 71), suggesting that being a parent and undertaking shift work are interrelated.

In fact, Presser (2003) has argued that the growing popularity of shift work could be partly attributed to the growth of maternal employment and the rise of dual-earner families. Currently in the US, among around 64% of married-couple families with children have both parents employed (U.S. Bureau of Labor Statistics, 2019). Similarly in Australia, in 2019, in nearly 60% of couple families with children aged 0-4 years, both parents were employed, and for those families with children aged 5 or above, this proportion rose to over 70% (ABS, 2019b). In addition, a growing number of parents are working full-time instead of part-time – indeed, the proportion of families with children younger than 5 here both parents work full-time rose seven percentage points in the last decade, reaching 21% in 2019 (ABS, 2019b).

This trend of dual-parent employment has presented families with fresh challenges about how to balance work and fulfil family needs, and may have driven increases in shift work in interesting ways. Firstly, for some dual-earner parent families, shift work may present as a possible solution to managing work and care responsibilities. For example, research suggests that some couples decide to work at different hours to adopt a childcare strategy described as "tag-team parenting", where one spouse/partner takes care of the children while the other is working (Pagnan et al., 2011). This means that at least one parent in these families (most likely mothers) works nonstandard hours to fit around the other parent's work schedule. This ensures that both parents are able to work and at the same time at least one of them is available to care for the children. A second possible consequence of the increase in families where both parents work (and of the commonness of full-time and long work hours) is that these parents and families face growing time pressure and difficulty fitting in essential and leisure activities. The fact that many people are time pressured (with jam-packed schedules)

has boosted the demand for services to be available at variable hours – driving the overall need for shift workers. For example, a family with both parents working may only have time to eat out and go shopping at nights and at weekends, requiring restaurants and shops to be open at nights and at weekends (Presser, 2003).

All in all, in the present day, there are indications that the high prevalence of shift work and the growth in combined maternal and paternal employment impact one another. They seem to go hand in hand in shaping both work and family life, with impacts for the whole of society. Given that parenthood and work are cornerstones of the way we live and how society functions, comprehensively studying the ways in which these factors concurrently impact multiple aspects of life is complex. As such, this thesis directs its focus to one specific impact, namely, how shift work is associated with **parental wellbeing (in particular, mental health, but also work-family conflict and relationship quality)**, in the context of employed parents as a dominant group in the labour force.

2.3 Shift work and mental health problems

The next section focuses on a review of the empirical evidence for an association between shift work and mental health (to provide some background knowledge about what is and is not already known about this relationship). The review begins by summarising the literature specifically concerning shift working parents and then expands to studies that have focused more broadly on all workers. Following this review of the literature, this section then outlines the conceptual reasoning and theories that support the proposition that shift working parents have poorer mental health than parents who work regular daytime schedules.

2.3.1 Current empirical findings for a quantitative association between shift work and mental health

When initially examining the literature that explores the potential association between shift work and mental health, it became apparent that while several relevant empirical studies

examine this possibility, they provide inconsistent evidence in terms of whether their results support an association between shift work and mental health problems. Thus, as part of this thesis, a systematic review was conducted to provide a comprehensive summary of the quantitative research that has directly tested the association between shift work and mental health. The review focused on research that has been conducted at a general population level with non-occupation-specific samples. Only the main findings of the review are presented in this chapter. However, a detailed description of the review methodology and findings is provided in Appendix 1 (and in Zhao et al. 2019).

From the results of the systematic review, it is clear that the existing research on shift work and mental health varies greatly in both the methodology adopted and the statistical findings. The definition of shift work adopted in the studies reviewed varied widely, including a broad binary measure of shift work (i.e. with all workers classified into two groups: shift work or non-shift work), as well as more specific measures of night/evening work, weekend work, irregular/unpredictable work schedules, and other types of work schedules. In contrast, the review also showed that the measurement of mental health problems was relatively consistent across studies, focusing mostly on psychological distress and/or depression using well-validated self-report measures such as the Kessler Psychological Distress Scale, the Short form General Health Survey (SF-12 and SF-36), the 12-item General Health Questionnaire, and the Centre for Epidemiological Studies Depression Scale (CES-D) (see Appendix 1 for more details). Despite the consistency in mental health measures, combining findings across studies was made challenging by the wide variation in shift work measures, sample sizes, covariates included in the modelling, and the mix of cross-sectional and longitudinal research. Hence, while the results described below provide a useful summary of the existing research and of some trends in the findings, further investigation is needed to more robustly conclude the extent to which shift work is associated with mental health.

Of the 33 studies included in the systematic review, only nine were conducted specifically with general community samples of parents. Six of them showed significant associations between shift work and mental health problems. For instance, Dockery et al. (2009) found

that among both fathers and mothers with adolescent children, those who worked nonstandard schedules had worse mental health. Grzywacz et al. (2016) focused on mothers of infants and found that those who worked more irregular schedules across the child's first year of life had higher depressive symptoms, while night work was not found to be linked to mothers' depressive symptoms. A study conducted by Cooklin et al. (2015) focusing on fathers of infants did not find a direct link between fathers' psychological distress and night or weekend work; however, shift work was potentially indirectly linked to psychological distress via higher work-family conflict. Three studies with a general sample of parents considered both parents' joint work schedules. Their findings are all different. In cross-sectional research by Rosenbaum and Morett (2009), both parents had significantly higher depression levels when one or both of them worked a non-day shift, whereas in Strazdins et al. (2006), parents had significantly higher depressive symptoms only when they and their partners both worked nonstandard schedules. On the other hand, no cross-spouse effect (i.e. the impact from one spouse's shift work on the other spouse's depression levels) was found in Perry-Jenkins et al. (2007), the only longitudinal study examining couple's work schedules. On balance, while there are some indications in the existing research that shift work is associated with parents' mental health, overall the evidence appears insufficient and without any consistent pattern. To understand the effects of shift work on parents' mental health, it is clear that further research is still required.

To place the findings regarding parents in a broader context, it is also useful to consider research with general samples (including both parents and non-parents). With regard to the association between shift work and mental health in the general population, the findings of the systematic review suggested that the association between shift work and mental health is likely to be different across types of shift work. However, the evidence is strongest for a combined. broad binary (*Yes* vs *No*), general measure of shift work. Twelve of the 33 studies included in the review adopted a broad binary indicator, and seven found a significant association between shift work and mental heatlh. Moreover, the studies with a more rigorous methodology had a higher chance of obtaining significant results. The results of the

longitudinal studies were synthesized in a meta-analysis. The meta-analyatic result showed that those who reported being in shift work were 32% more likely to experience depression and/or psychological distress than those who reported not being in shift work. The systematic review also showed that there was some evidence that irregular/unpredictable work in particular was associated with poorer mental health. Nine out of the 13 studies that measured irregular schedules reported that they were significantly associated with increased psychological distress – although it is worth noting that most of these studies were cross-sectional. In contrast, the evidence reviewed showed no clear association between mental health and night/evening work, weekend work, and other types of work schedules.

In addition, the systematic review showed mixed findings in terms of gender differences. Seventeen studies examined women and men separately – 11 of them reported similarities between genders, while one (Niedhammer et al., 2015) reported a significant impact on mental health among men only, and three (Bildt & Michelsen 2002; Driesen et al., 2011; Takada et al., 2009) only among women. In two studies that adopted multiple measures of shift work type (Bara & Arber, 2009; Llena-Nozal, 2009), there was no clear pattern as to which schedule (i.e. irregular work or night work) was more likely to affect women or men. Of the five single-gender studies, only Grzywacz et al. (2016) found a significant association between mothers' working irregular schedules and depressive symptoms. While overall, the balance of all the extant research suggests that shift work may have a greater association with women's mental health, no conclusions can be drawn without further formal testing. It is also not clear whether specific types of shift work schedules (e.g. night work) have specific or increased effects on women's as opposed to men's mental health.

Overall, the review revealed reasonable evidence in the existing literature to show that shift work is associated with poorer mental health across occupation types (and independent of a range of influential covariates), and potentially more so for women. However, there is a lack of consistency and less evidence when studies are categorized into specific shift work types, when focusing specifically on working parents, and when comparing mothers and fathers. There is also a shortage of longitudinal research, as only one third of the studies included in

the systematic review had measured the association between shift work and mental health over time. The existing longitudinal studies primarily measured participants' work schedules (i.e. shift work or non-shift work) at one time point, and compared wellbeing between shift workers and non-shift workers at a follow-up time point (Bildt & Michelsen, 2002). Other studies compared wellbeing between individuals who had worked shifts for longer versus shorter periods of time (Bara & Arber, 2009; Grzywacz et al., 2016). This approach of comparing wellbeing between individuals is an important starting point, but is limited in terms of building the evidence for a causal link between shift work and workers' wellbeing. Therefore, further longitudinal research using more rigorous approaches is needed to unravel the nature of the association between shift work and mental health, particularly within families where there is a potential for shift work to intensify work-family conflict for mothers and/or fathers.

2.3.2 Reasoning for positing an association between shift work and mental health: Theoretical perspectives

The previous section summarised a review of empirical research conducted to identify the evidence for an association between shift work and mental health. This section turns to theorizing about why we might expect there to be such an association, and the importance of exploring this research area. According to the World Health Organisation (WHO), good mental health is related to mental and psychological wellbeing. WHO's work in improving mental health includes both the prevention of mental disorders and the promotion of mental wellbeing (WHO, 2020). It is now well acknowledged that one's mental health is an integral part of one's health in general. Mental health conditions contribute to poor health outcomes and there can be no health or sustainable development without mental health (WHO, 2019; Prince et al., 2007). Depression and anxiety disorders cause a US$1 trillion loss in the global economy per year. In Australia, $9.9 billion ($400 per person on average) was spent on mental health-related services in 2017-2018, and in 2018-2019, 4.3 million Australians received mental health-related prescriptions (AIHW, 2020). Globally, each year, 800,000 people die from suicide, which is also one of the leading causes of death in young people (WHO, 2019).

The significant social and economic burden on people's lives and on society resulting from mental health problems makes it vital to exert every effort to improve the mental health of all people around the world (Whiteford et al., 2013). Exploring and identifying the potential drivers of mental ill health is crucial to supporting this effort.

Workplace environments and work characteristics have increasingly been investigated as risk factors for poor mental health and mental health conditions. While overall, on average, employment is associated with better mental health than unemployment (due to a range of material and latent benefits – such as higher incomes and access to resources, and giving people a defined social role and purpose) (Jahoda, 1981; Dooley et al., 1996), jobs vary in their physical, psychological, social and economic characteristics, such that some types of jobs (and working conditions) are associated with poorer mental health. For example, working more (i.e. overemployment) or fewer (i.e. underemployment) hours than preferred both have the potential to be linked to poorer mental health (De Moortel et al., 2018; Milner & LaMontagne, 2017). The psychological aspects of work have also been shown to be strongly associated with health outcomes. Adverse psychosocial work conditions such as high job demands, low decision latitude or control, job strain, a lack of social support at work, effort-reward imbalance and job insecurity are well established risk factors for poorer mental health (Michie & Williams, 2003; Siegrist & Wege, 2020; Milner et al., 2019; Harvey et al., 2017). Relatively less research has focused on shift work and its possible association with mental health (Zhao et al., 2019), with little consideration or discussion about how an association between the two might develop from a theoretical perspective. The following section explores the theories or mechanisms that might prompt us to consider why there is likely to be an association. Several theories can be adopted to explain an association between shift work and poorer mental health, such as time scarcity, the job demands-resources model, unhealthy behaviours (e.g. sleep problems, lack of nutrition and/or exercise), and also the healthy worker effect.

2.3.2.1 Time scarcity as way of connecting shift work and poorer mental health

Strazdins et al. (2011) proposed that, like money, time could be viewed as another resource for health, so that a lack of this resource, known as "time scarcity", could lead to health vulnerabilities. As the number of hours each person has in each day is fixed, time scarcity is less about the actual "shortage" of this resource and more about perceptions of time pressure and the dissatisfaction with one's own time allocation (i.e. I don't have enough time to do certain things I would otherwise like to do), often deriving from needing to manage multiple competing demands. There is direct evidence supporting a link between the experience of time pressure and health outcomes especially for mental health (Strazdins et al., 2011). For example, Roxburgh (2004) found that the subjective experience of time pressure is associated with depression for both men and women, and that for women, time pressure also mediates the impact of housework and volunteer roles (e.g. job-related associations, church-related groups, service clubs or school-related groups) on their depression levels. Roxburgh (2004) suggested that the subjective experience of time pressure is one of the pathways linking lived experience to mental health problems.

Time scarcity could also explain the association between work-related factors and health. Working overtime, which is directly related to objective and subjective time pressure, has been found to be linked to poorer health outcomes, such as higher risk for coronary artery diseases, high blood pressure, diabetes, musculoskeletal disorders and increased level of depression and anxiety (Virtanen et al., 2012; Caruso, 2004; Caruso & Waters, 2008; Caruso, 2014; Kleppa et al., 2008). These findings could be attributed to the fact that the long, scheduled work hours required in some workplaces prevent people from a series of activities important for their mental and physical health, such as rest and recovery, doing exercise, spending time with families and friends, eating healthily and even accessing health services (Caruso, 2014; Strazdins et al., 2011). Similarly, shift workers also often find it difficult to conduct these activities due to limits on their time (Zhao & Turner, 2008). Although they are not necessarily working longer hours, their nonstandard working hours often clash with the routines of the majority of people, preventing them from using their available time efficiently.

There may be particular difficulties for people on night shifts, as their work schedules clash not only with other people's schedules, but also the "schedules" of their own bodies. Our physical bodies follow a natural 24-hour cycle (Foster et al., 2013). Therefore, the disruption of circadian rhythms – to be awake at night when it is natural to sleep and sleep in the daytime when it is natural to be awake – has the potential to lead to adverse health consequences. The existing research has identified a series of emotional, cognitive and somatic responses arising from this disruption of circadian rhythms, including exhaustion and increased irritability, reduced concentration and memory, as well as drowsiness and bodily sensations of pain (Foster et al., 2013).

All in all, time scarcity theory supposes that people invest time, like they invest money, in exchange for health (Strazdins et al., 2011). The time pressure experienced by people working overtime can be paralleled to circumstances when people do not have enough money, both of which potentially result in poorer health, because both time and money are needed to invest in health-related activities. Similarly, the time pressure or scarcity experienced by people working shifts can be paralleled with a situation where people enter one country but only have currency available from another country (i.e. their time availability is incongruent with everyone else's), and thus they are not able to trade their time to promote their health and wellbeing in the same way that others can.

2.3.2.2 The job demands-resources (JD-R) model as way of connecting shift work and poorer mental health

The JD-R model classifies all work conditions into two broad categories: job demands and job resources (Demerouti et al., 2001). While the model was originally developed to explain the mechanism of burnout, it is now taken as an explanation of various indicators of employee wellbeing, including mental health and in particular psychological distress (Bakker & Demerouti, 2017). Job demands are defined as "the physical, social, or organizational aspects of the job that require sustained physical or mental effort and are therefore associated with certain physiological and psychological costs", and include factors such as physical workload, time pressure and unfavourable shift work schedules (Demerouti et al., 2001, p. 501). Job

resources are those "physical, psychological, social or organizational aspects of the job that may be functional in achieving work goals, reduce job demands at the associated physiological and psychological costs, or stimulate personal growth and development". Examples of job resources include feedback, rewards, job control and supervisor support (Demerouti et al., 2001, p. 501).

Generally speaking, job demands lead to more mental strain (e.g. exhaustion, job-related anxiety and health complaints), while job resources lead to more motivation (e.g. work engagement, commitment and flourishing) (Bakker & Demerouti, 2017). Based on the job demands-resources model, mental health problems are more likely to occur when resources are limited and the psychological demands imposed by work are high, circumstances which commonly characterize the work and non-work environments and situations of shift workers. Compared to other workers, their nonstandard working hours are likely to require them to make extra efforts to adapt to their working conditions, when in fact, their resources may be relatively limited. Also, as noted above, shift workers may follow a sleep-wake pattern which is against their natural 24-hour cycle and therefore good rest may be a missing resource. Moreover, as their time spent with families and friends may be limited, social support (which is one of the most important psychological resources), may similarly be limited. The combination of high job demands and limited resources could lead to poor mental health for shift workers (Wittmer & Martin, 2010).

2.3.2.3 Unhealthy behaviours as way of connecting shift work and poorer mental health

It is also possible that unsociable work schedules bring about unhealthy lifestyles, which can impact on mental health. A disrupted sleep-wake pattern is one example of how an unhealthy or disrupted lifestyle might result from working at night. Notably, sleep problems may last even after workers stop working night shifts. Research has found that nurses either currently or previously working at night experienced more insomnia than nurses with no night work experience (Øyane et al., 2013). Insomnia has been found to be associated with numerous mental illnesses, including depression, anxiety disorders, bipolar disorder and suicide (Pigeon et al., 2017). Nutrition is another health behaviour which may connect shift work with mental

health. The nutritional intake of shift workers appears to be less healthy, compared to that of non-shift workers. Research shows that working shifts significantly influences employees' intake of starches, alcoholic drinks and sweets (de Assis et al., 2003; Zhao & Turner, 2008). Over-consumption of unhealthy food could in turn be associated with poorer mental health, as increasingly, inadequate nutrition is believed to play a role in depression (Bodnar & Wisner, 2005). Other behaviours such as smoking, which is more prevalent among shift workers, have also been found to be linked to poor mental health (Zhao & Turner, 2008; Wong et al., 2012).

2.3.2.4 Healthy worker effect as way of connecting shift work and poorer mental health

The healthy work effect, also known as the "health selection effect", is a hypothesis that looks at the association between shift work and mental health from a different perspective. The three theoretical perspectives discussed above could be seen as aligned with the "social causation hypothesis" in public health research, which posits that job circumstances that bring about more resources (including a higher socio-economic position) are more beneficial to health than job circumstances that result in reduced resources (Kröger et al., 2015). The social causation hypothesis posits that shift work brings about a series of adverse side-effects, such as poor job quality, time pressure, unhealthy behaviours and disrupted circadian rhythms, which subsequently lead to compromised health outcomes.

The health selection hypothesis, on the other hand, claims that differences in health can lead to differences in opportunities and resources (including one's socio-economic position), and the type of work people are employed in. Healthy people achieve more favourable positions in society than less healthy people (Kröger et al., 2015). From an occupational health perspective, this means that healthy individuals are more likely to gain and remain employed in good quality work than those with health problems. In fact, poor health may even prevent individuals from seeking and gaining employment (Baillargeon et al., 1998). Therefore, people with poor health may have to accept unfavourable working conditions, such as shift work, as their opportunities to be employed are limited. In other words, shift work is associated with poor mental health, but this is not because of shift work, instead, it is because people with poorer mental health are more likely to undertake shift work. Related also to the

healthy worker effect, is the possibility that the negative effect of shift work on subsequent mental health is underestimated, because when workers become mentally unhealthy, they may leave their shift work jobs. This leads to a range of difficulties and biases in examining the social causation hypothesis accurately, since, if this happens, those people who stay in shift work will be the ones who cope better with the downsides of shift work (and they will thus reflect a population group with better mental health than those who leave this type of work). In short, the healthy worker effect is one of the major selection biases in occupational health studies, and it will affect the association between shift work and mental health in two ways: 1) the healthy worker effect may lead to unhealthy people being more likely to undertake shift work; and 2) this effect may also lead to people who suffer from the negative impacts of shift work being more likely to exit these jobs.

In short, it is evident from the above discussion that shift work may be associated with poorer mental wellbeing, and that there are various plausible conceptual pathways connecting these two factors. All four models/mechanisms provided above – *time scarcity*, *job demands-resources*, *unhealthy behaviours*, and the *healthy worker effect*, may be a part of the story about how shift work might be linked to poorer mental health outcomes. While this thesis focuses largely on searching for a direct link between shift work and parental wellbeing rather than on testing the above four mechanisms in detail, it is clearly important to acknowledge these mechanisms are likely to play a role in any associations discovered.

2.4 Shift work and other wellbeing indicators (work-family conflict and relationship quality)

As stated above, both preventing mental health problems and promoting mental wellbeing are equally important to improving mental health (WHO, 2020). Thus, in order to develop successful interventions to protect shift working parents' mental health, it is important to not only identify associations between shift work and psychological distress, but also to identify other wellbeing indicators related to shift work. The focus of this research thesis is on the

successful integration of work and family life. More specifically, the thesis includes two further key variables – work-family conflict and relationship quality – in addition to parents' psychological distress, to reflect on the extent to which shift working parents' wellbeing might be impacted. The sections below provide an outline of these two wellbeing factors and existing research regarding their potential association with shift work.

2.4.1 Shift work and work-family conflict

2.4.1.1 What is work-family conflict?

Work and family are two of the most important domains in adult life, yet they are not always in alignment. Work-family conflict (or work-family interference) refers to the circumstances when individuals struggle to balance their work and non-work responsibilities. The concept was first proposed by Kahn et al. (1964), who defined work-family conflict as a form of inter-role conflict which emerges when the role pressures from the work domain and the family domain are mutually incompatible (Duxbury & Higgins, 1991). Since then, extensive research has been conducted to further understand what work-family conflict is and how it emerges. Greenhaus and Beutell (1985) identified three major sources of work-family conflict: when the time devoted to, strain created by, and specific behaviours required by one role makes it difficult to fulfil the requirements of the other. These factors in turn lead to three unique but interrelated forms of work-family conflict: time-based, strain-based and behaviour-based. Time-based work-family conflict is when one of the roles requires excessive time commitments, such as working overtime, irregular shift work, or raising a child. Inflexible work schedules also produce more time-based work-family conflict. Strain-based work-family conflict is associated with the strain symptoms produced by role responsibilities in work or family, such as high demands and/or a lack of support. Behaviour-based work-family conflict refers to the different behavioural expectations in different roles. The constructs of time-based and strain-based work-family conflict have received general support from researchers (Netemeyer et al., 1996). These researchers defined work-to-family conflict as a form of inter-role conflict in which the general demands of, time devoted to, and strain created by, the job interfere with performing family-related responsibilities, and vice versa for

family-to-work conflict. The general demands are "the responsibilities, requirements, expectations, duties and commitments associated with a given role" (Netemeyer et al., 1996, p. 401).

Clark (2000) viewed the relationship between work and family from a different perspective and proposed a new theory to explain the complex interactions between work and family – "border theory". Borders are socially constructed lines separating the work domain and family domain, defining the point at which domain-relevant behaviours begin or end (Clark, 2000; Allen et al., 2014). Borders have three forms: physical, temporal and psychological. Physical borders define *where* the domain–relevant behaviours occur (e.g. at workplace or at home). Temporal borders, such as work hours, define *when* the domain-relevant behaviours occur. Psychological borders are largely self-created, defining *when thinking patterns, behaviour patterns and emotions* are appropriate for one domain but not for the other (Clark, 2000; Allen et al., 2014). Border theory suggests that individuals are border-crossers, who cross the borders between the work domain and family domain every day. The extent to which work-family balance can be achieved depends on the extent to which individuals can successfully cross these borders. However, individuals' ability to cross these borders is not "set in stone"; instead it may be fluid and influenced by other work, familial and societal contexts. There is reason to suggest that the increasing overlap (or boundary blurring) between work and family in recent years has made crossing between them successfully more difficult, leading to more work-family conflict. For example, developments in telecommuting technology have encouraged more individuals to work from home, which for many people blurs the border between the work domain and family domain, and makes work-family conflict more possible. In addition, the emerging trend of flexible work schedules also has the potential to shift the borders between work and family, and impact, both positively and negatively, on work-family conflict (Allen et al., 2014).

In addition to the diversity in the forms of work-family conflict, it is also important to understand that work-family conflict is a bidirectional concept – consisting of the degree to which participating in the work role makes participating in the family role more difficult (i.e.

work-to-family conflict), and the degree to which participating in the family role makes participating in the work role more difficult (i.e. family-to-work conflict). The existing evidence suggests that the two are distinct concepts as they have different antecedents – i.e. the factors leading to work-to-family conflict are not always predictors of family-to-work conflict, and vice versa (Michel et al., 2011). However, in practice, it is also acknowledged that work-to-family conflict and family-to work conflict are highly correlated (see Westrupp et al., 2016). As such, many research studies (including the measures in the current thesis) often measure work-family conflict using a combination of items that tap into difficulties with work disrupting family and difficulties with family disrupting work.

Work-family conflict is a common experience for employed parents in contemporary society. Taking Australia for example, in 2017, around 65% of working fathers and around 60% of working mothers reported medium to high levels of work-family conflict (Lass, 2019). It may come as a surprise that it is fathers who experienced higher levels of work-family conflict in this study, given that it is mothers who typically undertake more domestic work in the family (Lass, 2019; Shockley et al., 2017). The researchers provided two potential reasons that might explain this gender finding. First, fathers spent more time in paid work and that limited their time available for family life (generating work-family conflict). Second, the working conditions of fathers and mothers were different in terms of their impacts on the work-family balance. It is possible that fathers' working conditions (e.g. less flexibility at work) are more likely to impede the balance between work and family, while mothers' working conditions are more likely to facilitate it (Lass, 2019).

2.4.1.2 Linking work-family conflict to shift work and parental wellbeing

A number of factors in the work domain, including the amount of time devoted to work, have been identified as predictors of work-family conflict (Michel et al., 2011). Regarding the association between shift work and work-family conflict, the evidence to date appears to be inadequate and inconsistent overall. The earliest evidence is from Staines & Pleck (1984), whose research provides support for the hypotheses that working nonstandard schedules compromises the quality of family life. More recently, Jansen et al. (2003) examined a series

of potential antecedents and consequences of work-family conflict and found that the association between shift work and work-family conflict was significant among males but not females. There was also evidence of cross-cultural differences. Working nonstandard schedules and regularly experiencing changes in schedules both increased time-based work-family conflict among dual-earner parents in Finland and Britain, but no such effect was found for their counterparts in Netherlands, possibly due to the differences in welfare systems and regulations (Tammelin et al., 2017). A study in the US (Ammons et al., 2017) focusing on racial/ethnic differences in work-family conflict found working nonstandard schedules had a consistent effect on Black, White and Hispanic men and women. Interestingly, other US research also showed that the association seemed to be affected by marital status, as only cohabiting parents experienced higher work-family conflict when working nonstandard schedules, whereas this was not the case for married parents. The researchers argued that this effect may have been due to the external support available to unmarried parents being relatively limited (Liu et al., 2011). Taken together, the diversity of the existing research findings highlight the necessity to continue conducting research on this topic, among both mothers and fathers and in different cultural contexts with different family structures.

The variety in research findings examining the association between shift work and work-family conflict is likely to be a reflection on the complex influence of shift work on family life. In fact, past research suggests that many people view shift work as a way to accommodate both work and family demands – caring for children and other family members is a common reason for working nonstandard schedules (Presser, 2003). This trend is also reflected by the higher prevalence of shift work among parents of young children – a population that typically has caring responsibilities (ABS, 2009; Presser, 2003). However, in contradiction to the idea that shift work assists with managing work and family roles, existing research also provides numerous reasons to suggest that shift work may impact negatively on the work-family balance. Shift workers usually have to work at nights and/or weekends – the times typically reserved for family life. They may frequently miss out on routine family events, which may bring about more time-based work-family conflict. Furthermore,

time-based work-family conflict usually co-occurs with strain-based work-family conflict (i.e. they are interrelated), as extensive time involvement, in work, family, or any other responsibilities, can bring more stress and generate more strain symptoms (Greenhaus & Beutell, 1985). In addition, working nonstandard hours often leads to sleep deprivation and fatigue (Øyane et al., 2013; Shen et al., 2006), which, in turn, may lead to irritability and strain in family interactions. This may also compromise shift working parents' emotional capacity to fulfil family responsibilities, adding to strain-based work-family conflict (Gassman-Pines, 2011; Shen et al., 2006).

While work-family conflict is a construct which reflects how successfully parents are integrating work and non-work roles and responsibilities, it also provides a snapshot of parental wellbeing. In the existing research, work-family conflict has been consistently linked to various indicators of mental health and wellbeing. General mental health, psychological distress, depressive symptoms, diagnosed mental disorders and also self-reported life satisfaction, as well as other mental health indicators, have all been significantly associated with work-family conflict (Cooklin et al., 2016; Borgmann et al., 2019; Yucel & Fan, 2019; McTernan et al., 2016; Nigatu & Wang, 2018). The results of longitudinal studies show that changes in work-family conflict are strongly related to changes in mental health. For example, research shows that an increase in work-family conflict is accompanied by subsequent increases in psychological distress, and that when work-family conflict is relieved, parents' psychological distress also declines (Cooklin, et al., 2016). Moreover, results from other research have shown that poorer mental health was found to have an impact on the incidence of work-family conflict (Borgmann et al., 2019; Westrupp et al., 2016). This suggests that work-family conflict and mental health have a reciprocal association – described by Demerouti et al. (2004) as a "loss spiral". According to Hobfoll's (1989) Conservation of Resource theory (COR), individuals strive to acquire and maintain resources, such as objects, conditions, personal characteristics and energies, to maintain their wellbeing at a certain level. Stressful environmental circumstances, such as juggling work and family, threaten or cause a depletion of resources and therefore lead to more psychological stress. This loss of resources

also means that individuals will have fewer resources to spend when confronted with further such stressful situations. In other words, it becomes more difficult to balance work and family when individuals experience worse mental health, spiralling into even more work-family conflict (Demerouti et al., 2004; Hobfoll, 1989).

As there is some evidence to suggest that shift work may be associated with work-family conflict, and that work-family conflict also has a significant association with mental health, one possibility is that work-family conflict may mediate the association between shift work and mental health for parents. Both Haines III et al. (2008) and Cooklin et al. (2015) found that shift work indirectly impacted on parents' mental health via increases in work-family conflict. However, these are the only two studies that seem to have examined this potential mediating effect of work-family conflict on the relationship between shift work and mental health among parents, leaving many questions about the nature and strength of this association unanswered, including questions about potential gender differences for mothers and fathers.

2.4.2 Shift work and relationship quality

2.4.2.1 What is relationship quality?

In the present study, relationship quality refers to couple relationship quality – that is the quality and satisfaction of couple relationships (either married or cohabiting). In past decades, marriage has undergone dramatic changes, including a decrease in marriage rates, an increase in the mean age at first marriage, and an increase in divorce rates (Robles et al., 2014). Almost all countries that are members of the Organisation for Economic Co-operation and Development (OECD) have seen a decline in marriage rates during the past half century. In 1970, the average marriage rate within OECD countries was between 8-10 marriages per 1000 people, but this was down to under six in 2017 (OECD family database, 2019). At the same time, the average divorce rate in OECD member states rose from below two divorces per 1000 people in 1970, to between two to three divorces per 1000 people in 2017. However, possibly due to variations in family law, such as the legal status of partners living together or

the length of the divorce process, the trend in divorce rates has been mixed across countries. For example, in the United States, the divorce rate went up from 3.5 to 4.5 (divorces per 1000 people) between 1970 and 1995, but dropped to 3 in 2017. The trend was similar in Australia, where the divorce rate increased from 1 (divorce per 1000 people) in 1970 to 3 (divorces per 1000 people) in 1995, and then fell to around 2.5 in 2017. However, in countries such as Cyprus, Korea, Portugal and Greece, divorce rates have been consistently growing throughout this whole period (OECD family database, 2019).

These population-level changes related to marriage, to a large extent reflect the fact that in the past century, many people have changed their views about what marriage means to them. Nowadays, marriage has become more voluntary in nature instead of an obligation (Li & Fung, 2011), although developing a stable romantic partnership is still considered a major critical life milestone for most people. People are less likely to continue with an unsatisfactory relationship and such relationships/marriages more often end in dissolution (Schoen et al., 2002). Studying relationship quality (or satisfaction) for the purpose of promoting stable couple relationships (including marriages) is important, as relationship quality is highly associated with individual wellbeing and successful family functioning (Brkljačić et al., 2019). It is a misperception to think being in relationship is enough to improve people's mental health, as it is predominantly good-quality relationships that benefit mental health whilst poor-quality relationships are associated with more mental health problems (Leach et al., 2013). The words "relationship satisfaction" and "relationship quality" are often interchangeably used, and while there are differences, both reflect a person's subjective evaluation of the quality of his or her couple relationship/marriage (Chonody et al., 2018).

Relationship quality is often assessed based on an individual's self report about whether and to what extent they are satisfied with his or her relationship overall, or in several dimensions. Some studies have adopted brief, single-item measures, asking participants about their overall satisfaction about their relationship, while others have utilized more psychometrically complex scales (Leach et al., 2013; Weidmann et al., 2017). These scales consist of multiple

items measuring different components of relationship functioning. The current thesis uses a multiple item measure of relationship quality, where high quality is typically defined as high self-reported satisfaction on multiple components, including positive attitudes towards one's partner (e.g. "My partner meets my needs"; "I love my partner"), and low levels of hostile and negative attitudes and behaviours (e.g. "I thought my marriage might be in trouble"; "I wish I hadn't got into this relationship") (Robles et al., 2014; Presser, 2003, p. 86; Hendrick, 1988).

2.4.2.2 Linking relationship quality to shift work and parental wellbeing

In the same way that disruptions to the temporal nature of family life via nonstandard work schedules might impact on work-family conflict, such disruptions might also be associated with workers', and their partners', relationship quality. The amount of time partners within couples spend with each other is essential in enhancing their bonding and boosting their relationship quality (Presser, 2003; Shanafelt et al., 2013). In Presser (2003), quality time was taken as one of the central dimensions of marital quality – participants were asked about how often they and their partners' were able to spend time alone with each other. The less quality time couples had, the lower their marital quality. For people in paid work, this quality time is often limited by the time they spend in their workplace. Consequently, their work time may have impacts on their relationship quality (Glorieux et al., 2011).

Very few studies have directly examined the association between shift work and relationship quality, despite some studies focusing on the impact of work-related factors, including work time, on relationships. For example, research has explored maternal employment and its association with marital outcomes. The rise in divorce rates in past decades was accompanied by an increase in the labour force participation rates of women, including those who had children (OECD family database, 2019; OECD, 2017; Knop, 2019), and this therefore led to concerns that women's employment was destabilizing marriages, potentially via a reduction in family time. This claim attracted considerable criticism, with several research studies demonstrating that this was not the case and that the situation is actually more complex. For

example, a study conducted by Schoen et al. (2002) concluded that wives' employment did not increase the risk for marital disruption when marital quality was high; however, the association between wives' employment and higher risk for marital disruption was significant when both partners were unhappy about their marriage. Although this study distinguished relationship status and relationship quality, it did not directly examine the association between wives' employment and relationship quality. The above-mentioned study by Glorieux et al. (2011) provided some evidence that women's employment was not a threat to relationship quality as there was no considerable difference regarding how much time the couple spent together between single-earner couples and dual-earner couples.

The study by Glorieux et al. (2011) also highlighted the possibility that work time could affect relationship quality, as the researchers found work time was the decisive factor influencing the amount of together time – long working hours, off-scheduled working hours and non-overlapping work schedules all affected the couple's quality time together. Therefore, there is reason to assume that shift workers spend less time with their partners, as they usually work nonstandard hours and have non-overlapping work schedules with their partners. Furthermore, several studies have investigated the effect of the tag-team parenting strategy commonly adopted by shift workers (as described earlier in this chapter), and have found that this strategy has mixed effects: despite the fact that tag-team parenting has the potential to maximize the time a child spends with each parent, particularly fathers, who traditionally do less childcare, there is also evidence to suggest that many couples who tag-team do not spend enough time together (Hattery, 2001; Liu et al., 2011; Presser, 2003; Wight et al., 2008). Another example is a US national study conducted among partners of physicians, which found the participants' relationship satisfaction was significantly associated with the physicians' number of nights on call per week – the more nights on call the physicians had, the more dissatisfied their partners felt about their relationship and were more likely to have considered divorce seriously (Shanafelt et al., 2013).

In addition to a lack of quality time together, these physicians' chronic fatigue was also identified as a stressor for family life in Shanafelt et al. (2013). Participants reported that their

physician partners often came home irritable or too tired to engage in home activities. Although Shanafelt et al. (2013) did not explicitly link this experience to relationship satisfaction, there are some other existing studies and theories that indicate shift work, fatigue and relationship satisfaction might be associated. Shift workers commonly experience sleep problems and fatigue (Kecklund & Axelsson, 2016; Shen et al., 2006), and these circumstances can be described as "resource loss" in Hobfoll's Conservation of Resources (COR) theory (1989) (see 2.4.1.2). According to this theory, when experiencing resource loss, individuals may withdraw to prevent extra loss – for instance, they may stop engaging in home activities and reduce interactions with their partners, negatively impacting relationship quality.

In addition to the possible link between shift work and relationship quality (as described above), past studies have provided ample evidence that people's relationship quality and mental wellbeing are interrelated. It is well established that better relationship quality is associated with fewer mental health problems and better wellbeing (Proulx et al., 2007; Goldfarb & Trudel, 2019). Therefore, it is reasonable to hypothesise that shift work could be associated with poorer relationship quality, and that this broadly reflects a reduction in parental wellbeing.

2.5 Other contextual factors likely to impact on the association between shift work and parental wellbeing: Introducing important covariates

In order to more accurately ascertain the nature of the relationship between shift work and parental wellbeing, a series of demographic and work-related variables related to shift work and mental health are taken into consideration in the present research. This thesis mainly treats these factors as potential confounders, that is, they may confound the results and obscure efforts to explore the direct and independent effect of shift work itself. But at times these covariates are also briefly explored as mechanisms or conditions under which the impacts of shift work might vary – this is particularly the case with respect to gender which is

conceptualised and explored as an important differentiator. These demographic and work-related variables are outlined in the following subsection.

2.5.1 Demographic characteristics

A number of demographic characteristics related to workers themselves and their family life might impact on parents' shift work decisions and/or their parental wellbeing. These characteristics are summarized below:

2.5.1.1 Gender

Gender is one characteristic that has received much attention relevant to the current thesis. It is very common for studies investigating the association between shift work and mental health to take gender into consideration – either by examining women and men separately (Haines et al., 2008; Niedhammer et al., 2015), or by controlling for gender as a covariate (Park et al., 2016; Kleiner & Pavalko, 2010). There are also some studies with single-gender samples (Cooklin et al., 2015; Grzywacz et al., 2016). As previously mentioned in this chapter, in Australia, shift work has a higher prevalence among mothers compared to fathers, but in the general population, males are more likely to undertake shift work (18% vs 14%, ABS, 2012a). Research studies provide limited information to explain why mothers are more likely to undertake shift work compared to their partners and also women who don't have children..

One important contextual factor is the broader gendered pattern of work and caregiving in Australia. Researchers have found that in a family with children, mothers tend to fit their paid work around their partners' paid work (Cha, 2010). This reflects the fact that, despite the historical increase in mothers' labour force participation, as well as the growing prevalence of dual-earner families, the gender gap in employment still remains in many respects. Notably, mothers still work fewer paid hours than their spouses (Landivar, 2015; OECD, 2017). For example, in Australia, mothers' employment rates and full-time employment rates are both far lower than those of fathers – ABS data from 2012 shows that of all opposite-sex couples with children, less than 70% of mothers were employed and more than half of employed mothers were employed at a part-time level. In contrast, the employment rate among fathers was about

90%, and the proportion of these employed fathers working part-time was less than 10% (ABS, 2012b). Meanwhile, the division of household labour was – and still is – uneven across genders, with mothers shouldering the majority of housework and childcare responsibilities (Cha 2010): Recent data from the OECD shows that in all OECD countries (including non-OECD economies), women spend considerably more time than men on unpaid work (almost twice on average) (OECD stat, 2020).

Taking this broader context into consideration, it is a reasonable assumption that the traditional family model, with fathers as breadwinners and mothers as homemakers, has not kept up with the dramatic increase in women's labour force participation. Although in current society both men and women are seeking to combine their responsibilities as breadwinners and homemakers, the primary focus of fathers is still on "being a breadwinner" while the primary focus of mothers is still on "being a homemaker". This is likely to mean that when responsibilities at work and responsibilities at home clash with each other, fathers are more willing to sacrifice the homemaking role to be a breadwinner, while mothers are more willing to sacrifice the breadwinning role to be a homemaker, and each of the two choices comes with its own costs, respectively. When it comes to the focal "cost" in this thesis, namely, parental wellbeing, fathers potentially endure adverse wellbeing (related to poor job conditions), instead of changing jobs/careers, to fulfil their role as breadwinners and provide financial support to the family, as this responsibility is central to their masculine identity (Cha, 2010). In contrast, mothers may put more value on maintaining successful family functioning as their primary responsibility. Therefore, when family functioning and parental wellbeing is at risk, mothers potentially withdraw from their work, by quitting their jobs, reducing working hours, or fitting their work around their partners' schedules, in an effort to promote family functioning (Cha, 2010). Mothers may also make career decisions based on whether or not they will facilitate their family functioning in the first place (as described in further detail below). As a consequence, it may be less possible to detect a negative impact of paid work (including shift work) on mothers' parental wellbeing, because, compared to fathers, mothers are more vigilant about this negative impact and more likely to take action to prevent

problems developing. This might explain why, as previously stated in this chapter, working Australian fathers have been found to experience higher levels of work-family conflict compared to working mothers (Lass, 2019).

These broad gender difference in how paid work and caregiving decisions are prioritised, could be particularly relevant to shift work, given that it is sometimes adopted as a strategy to accommodate work and family needs (although as explained, it also has the potential to clash with family routines). It is possible that mothers curtail their workforce participation to meet the needs of children and their partners, leading them to working nonstandard hours, while fathers work nonstandard hours out of the requirements of the job and their employers (Cha, 2010; Presser, 2000). These differences (or drivers) for why mothers and fathers undertake shift work (and the type of shift working jobs they then do) might in part explain any gender differences in the association between shift work and parental wellbeing. In other words, the gendered impacts of shift work on parental wellbeing, may be dependent on the drivers for why mothers and fathers undertake shift work (and particular types of shift working jobs) rather than gendered effects/outcomes *specific* to (or *causally* the result of) working shifts. While it is possible (and important) to speculate on gender differences in parents' reasons for undertaking shift work, the lack of direct reports from parents about these reasons prevents researchers from drawing any firm conclusions. To the best of our knowledge, Presser (2003) is the only population-level, quantitative study which directly asked participants (mothers only) about their reasons for doing shift work. The study findings showed that the reasons these mothers undertook shift work were quite varied, including caring for children and other family members, the nature of the job, requirements from employers, and also better pay. Of these reasons, "'better childcare arrangements'"(Presser, 2003 p71) was indeed very important, as it was the most common reason for doing shift work given by mothers with children under 5 years old (39.8% of married mothers and 27.8% of unmarried mothers listed this as the main reason). As the children got older, job-constraining reasons became more common – among married women with children under 5, only 38.8% listed job-constraining reasons (i.e. "'nature of the job'", "'mandated by employers'" and "'couldn't get any other'")

as their main reasons doing shift work, while among married women with children 5-13 years old the proportion rose to 46% (Presser, 2003, p. 71-72).

Presser's study (2003) provides some evidence as to the possibility that mothers undertaking shift work are doing so because of family requirements, but it also highlights the complexity of the reasons behind this decision. While the current thesis keeps this gendered story in mind when interpreting the results of the analyses, due to the limitations of the data available (i.e. the reasons as to why parents undertook shift work are not available), this research thesis does not explicitly use data to explore gender differences in why shift work is undertaken. Despite this, the effect of gender is considered throughout the thesis – in Chapter 4 (Study 1), gender is examined as moderator of the associations between shift work, work-family conflict and mental health, and in Chapter 5 (Study 2) and Chapter 6 (Study 3), mothers and fathers are assessed separately to explore gender differences.

2.5.1.2 Other demographic characteristics

Participants' relationship status is also important to be taken into account. The current research thesis focuses on parents, and it is important to highlight that being a single parent has been found to simultaneously increase the likelihood of undertaking shift work and with greater risk of poor mental health (Presser, 2003; Han, 2008; Kuruvilla & Jacob, 2007). Therefore, parents' relationship status is controlled for in Study 1 as the study included both married and unmarried parents. In Study 2 and Study 3, only dual-earner couples with children were included to minimize the influence of different family structures. However, these married parents were also different from each other, as the work and family experiences of individuals and their partners varies greatly. In couple families, successful family functioning relies not only on each individual's time allocation, but also on how couples jointly allocate time between work and family (Jacobs & Gerson, 2001). Each partner's work and family experiences might have the potential to impact on the other partner's work and family experience (Craig & Brown, 2017; Chait Barnett et al., 2008). Taking this into consideration, the working conditions and wellbeing status of participants' partners are also

controlled for in Study 2 and Study 3, when examining the association between shift work and participants' wellbeing.

Other familial reasons could also influence the association between shift work and parental wellbeing. Having more children or having an infant at home is expected to increase the burden of domestic work and therefore may be related to higher work-family conflict and more mental health problems (Greenhaus & Beutell, 1985; Cooklin et al., 2016). Hence, these factors are both considered in the current research thesis. Additionally, past research has also found that shift work can affect the division of domestic work, including childcare, between the couple, and subsequently their work-family balance (Craig & Powell, 2011). Thus, each partner's share of domestic work is also controlled for when examining the association between shift work and mental health among dual-earner parents.

Socioeconomic status is another important variable to be considered. Past research has shown that people with lower family incomes and lower education levels were overrepresented among shift workers (Presser, 2003), with this likely to be due to their having less competitive skill sets and more limited employment options. People with a lower socioeconomic status are also found to be more vulnerable to mental health problems, potentially due to higher stress levels (Kuruvilla & Jacob, 2007). A recent study recognized that, together with other factors such as work-life conflict, household economic hardship played an important role in explaining the negative association between work schedule insecurity and mental wellbeing (Schneider & Harknett, 2019). Taking these factors into consideration, Grzywacz et al., (2016) examined the association between maternal work schedules, mothers' depressive symptoms, and their infants' mental health among impoverished families. The study found that among these mothers in poverty, working irregular schedules increased their depressive symptoms and subsequently affected infants' mental health. In contrast, the participants in the research reported in this thesis had a relatively higher socioeconomic status (as detailed in the following chapters), and socioeconomic status was also controlled for as a covariate in the research. This approach aims to provide solid evidence regarding the association between shift work and parental wellbeing independent of socioeconomic status.

It is also noteworthy that some of the demographic characteristics may be interrelated with each other; therefore not all characteristics are controlled for in all studies. For example, parents' age is expected to be associated with children's age, hence this is not included in Study 1, although age has been found to be relevant to shift work decisions in existing research – for instance, Presser (2003) found that shift workers were relatively younger than non-shift workers.

2.5.2 Work-related characteristics

As previously stated in this chapter, the job demands-resources (JD-R) model introduced by Demerouti et al. (2001) is one theory that might aid in understanding the association between shift work and reduced parental wellbeing. Shift work is often associated with a series of unfavourable working conditions (e.g. high job demands, low flexibility), and these working conditions may influence the link between shift work and poorer mental health (Vogel et al., 2012; Wittmer & Martin, 2010). To manage this potential influence, existing studies have usually controlled for job characteristics when examining the association between shift work and mental health (De Raeve et al., 2007; Shields, 2002). The current research thesis also follows this trend and controls for work hours (i.e. part-time, full-time or overtime) and job quality (i.e. job flexibility, job security, autonomy and leave access) as covariates, to separate the effect of shift work from other working conditions related to shift work.

Differences across participants' occupations are also accounted for in the current research thesis. Work schedules are often decided by the requirements of the job, and so shift work is more prevalent in some occupations than others. In this thesis, occupational status is controlled for as a covariate, since the focus of the research is to ascertain that any differences in parents' wellbeing are associated with shift work, as opposed to differences attributable to occupations requiring and not requiring shift work.

Another work-related factor important to consider is whether shift workers are employed in permanent positions or on temporary contracts. Compared to a permanent position, precarious employment (e.g. temporary contract, fixed term contracts, causal contracts) may have

damaging effects on workers' health outcomes including parents' wellbeing, as precarious work brings uncertainty and stress (Matilla-Santander et al., 2020). Shift work is often taken as one dimension of precarious employment and therefore could be expected to correlate with other dimensions, such as the security of the contract and minimal control over working conditions (Rönnblad et al., 2019; Llena-Nozal, 2009). When contracts are only temporary or causal, workers may change jobs more frequently, and as a consequence, they may experience more frequent changes in work hours and work schedules. Therefore, to more clearly identify the association between shift work and wellbeing for parents, it is necessary to examine the association independent of other characteristics related to precarious employment.

2.6 The aims of each study

As stated in Chapter 1, the general aim of the research studies in this thesis is to clarify to what extent shift work impacts wellbeing for parents, with a focus on the challenges shift work might bring to successfully negotiating both work and family responsibilities. In keeping with this aim, parental wellbeing is explored using three indicators relevant to family life – psychological distress, work-family conflict and relationship quality. Considering the gender inequity in the work and family domains in current society, gender differences are explored across all three studies in this thesis.

Study 1 is a cross-sectional study exploring the concurrent relationship between shift work and parental wellbeing. The study examines whether shift work is associated with parents' psychological distress, whether this association is mediated by work-family conflict, and whether the links between shift work, work-family conflict and psychological distress are different for fathers and mothers.

Study 2 adopts longitudinal data to further obtain evidence for a causal link between shift work and parental wellbeing. The study positions shift work as an occupational exposure for parents with parental wellbeing (i.e. psychological distress, work-family conflict and

relationship quality) as the outcome, in order to examine the extent to which changes in poor wellbeing might associated with changes in shift work.

Study 3 also adopts longitudinal data and is conducted in the reverse direction (causally) to Study 2. The analyses investigate whether or not workers' mental wellbeing (i.e. psychological distress, work-family conflict and relationship quality) might predict their decisions to subsequently move into or out of shift work. In other words, the study investigates whether there is any evidence that the association between shift work and parental wellbeing can be attributed to a health selection effect.

The three studies are all based on general population-level data, in an effort to confidently quantify the interrelationships between shift work and these parental wellbeing indicators in the general population of Australian parents. Chapter 3 provides an overview of the methodology used in this thesis, including the datasets, the measures of the variables and the analytic approaches.

Chapter 3 Methodology overview

3.1 Summary

Data from two large, community-based surveys was used in this thesis to examine the research questions outlined in Chapters 1 and 2. These surveys are: a) the Families at Work (FaW) cross-sectional survey, and b) The Longitudinal Study of Australian Children (LSAC). This chapter outlines the design aspects of these surveys and their corresponding datasets, including the characteristics of the sample, the data collection design and procedures, and the survey measures adopted. The chapter also includes a brief description of the main statistical approaches utilised in the three studies. More detailed information relating to the study samples, measures, and statistical analyses is provided in the chapters describing each study: Chapter 4 (Study 1), Chapter 5 (Study 2) and Chapter 6 (Study 3).

3.2 Datasets

3.2.1 Families at Work survey

Overview: Data for Study 1 (as presented in Chapter 4) was drawn from the Families at Work (FaW) survey, an online nationwide community-based survey funded by LaTrobe University and conducted in partnership between La Trobe University and The Australian National University. The Families at Work study aimed to identify the strategies adopted by employed parents' to balance their work and family demands. The study also explored whether these strategies, and levels of work-family conflict, were associated with parents' mental health and wellbeing (Bennetts et al., 2019). Eligible participants for the survey were required to: (i) be at least (≥) 18 years; (ii) reside in Australia; (iii) be in paid employment; and (iv) have at least one child aged ≤18. Data was collected on various aspects related to employed parents' working conditions, caring responsibilities and wellbeing (Bennetts et al., 2019). The baseline survey was conducted between August and November 2016. Parents who completed the baseline survey were contacted 6 to 8 weeks later for a follow-up survey (Bennetts et al.,

2019). However, Study 1 in this thesis used only cross-sectional data collected in the baseline survey.

Procedure: The Families at Work survey was conducted online with recruitment predominantly carried out via social media (i.e. Facebook). Participants were recruited in one of two ways: Paid Facebook advertising methods and Free Facebook advertising methods. Paid recruitment primarily involved running 20 Facebook advertising campaigns using Facebook's 'Adverts Manager', until the sample was sufficiently large and diverse. The study was also advertised for a small fee ($200 AUD) on a popular online single parent community (Bennetts et al., 2019). The free advertising was supplementary to the paid advertising. Researchers identified Facebook Pages frequented by Australian parents and contacted Page Managers to seek their support in promoting the survey on these pages. Additionally, an active snowball approach was also used to circulate the survey (Bennetts et al., 2019).

Participants: The recruitment period for the survey continued for 15 weeks. During this time, there were a total of 6653 clicks on the online survey link, resulting in 5378 eligible parents providing their consent to participate in the survey. Of these 5378, 5163 parents participated and answered all, or most of, the survey questions. This included 1675 fathers (32.4%) and 3477 mothers (67.3%). The remaining 11 (0.2%) participants did not disclose their gender or identified themselves as "other". Broad demographic information for the Families at Work Sample is provided in Table 3.1.

Table 3.1 Sample characteristics for the full Families at Work (FaW) sample (n=5163)

		Total (n=5163)	**Fathers** (n=1675)	**Mothers** (n=3447)
		N (%) or Mean (±*SD*)	N (%) or Mean (±*SD*)	N (%) or Mean (±*SD*)
Marital status	Single parents	748 (14.5%)	172 (10.3%)	573 (16.5%)
	Married parents	4415 (85.5%)	1503 (89.7%)	2904 (83.5%)
	Unknown or missing	0 (0.0%)	0 (0.0%)	0 (0.0%)
Number of children	1~2 children	3948 (76.5%)	1236 (73.8%)	2705 (77.8%)
	3 or more children	1215 (23.5%)	439 (26.2%)	772 (22.2%)
	Unknown or missing	0 (0.0%)	0 (0.0%)	0 (0.0%)
Age of youngest child		6.17 (±4.91)	6.09 (±5.10)	6.21 (±4.81)
	Unknown or missing	0 (0.0%)	0 (0.0%)	0 (0.0%)
Weekly income	<$800	958 (18.6%)	132 (7.9%)	823 (23.7%)
	≥$800	4003 (77.5%)	1474 (88.0%)	2523 (72.6%)
	Unknown or missing	202 (3.9%)	69 (4.1%)	131 (3.8%)
Education level	Below Bachelor's	1822 (35.3%)	881 (52.6%)	938 (27.0%)
	Bachelor's or higher	3341 (64.7%)	794 (47.4%)	2539 (73.0%)
	Unknown or missing	0 (0.0%)	0 (0.0%)	0 (0.0%)
Employment type	Permanent position	3733 (72.3%)	1267 (75.6%)	2458 (70.7%)
	Not permanent position	924 (17.9%)	188 (11.2%)	734 (21.1%)
	Unknown or missing	506 (9.8%)	220 (13.1%)	283 (8.1%)
Country of birth	Australia	4213 (81.6%)	1355 (80.9%)	2849 (81.9%)
	Others	948 (18.4%)	319 (19.0%)	627 (18.0%)
	Unknown or missing	2 (0.0%)	1 (0.0%)	1 (0.0%)

Note: The total column includes a small number of participants who identified as "other" (rather than as mothers or fathers).

A methodological paper describing the Families at Work sample (Bennetts et al., 2019) found it to be broadly representative of parents in the Australian population, based on a comparison of demographic characteristics between participants who completed the Families at Work survey and employed parents included in a nationally representative sample of Australian parents – i.e. the Longitudinal Study of Australian Children, Kindergarten (K) cohort. However, the results also showed that the Families at Work survey included more single parents (15% vs 14%, $p<.001$), more tertiary educated parents (65% vs 44%; $p<.001$), and fewer parents born outside Australia (18% vs 23%; $p<.001$). The Families at Work sample also reported greater work-family conflict (mean 3.4 vs mean 2.6, $p<.001$) and greater

psychological distress (mean 11.5 vs mean 10.1; $p<.001$) (Bennetts et al., 2019). Overall, while the sample obtained in the Families at Work survey is useful for exploring employed parents' self-reported work-family conflict and associated wellbeing, some caution is required when generalizing the findings to populations with a more disadvantaged socioeconomic status. One important advantage of the Families at Work survey is the inclusion of a detailed measure of shift work that required participants to provide information about the types of the shift they worked (i.e. regular shift, rotating shift, or irregular shift), resulting in a substantial number of participants in each work schedule category. While this detailed measure is occasionally available in other existing datasets, there are often insufficient numbers within each category of shift work to analyse differences between types of shift work. Because the data collection in the Families at Work study was focused on recruiting parents who were employed (and thus the number of shift workers was boosted), sufficient numbers were available in the current study.

Additionally, in Study 1 (Chapter 4), because the sample included far more individuals who were not shift workers than those who were (as is also the case in the general population), 10% of all non-shift workers (n=343) were randomly selected into the final sample for the analyses. After this random selection, 1431 individuals in total remained in the sample. Of them, 221 (15.4%) were excluded due to missing data on items of interest. This left 1210 (84.6%) individuals, with two individuals who did not disclose their gender also excluded, leaving 452 fathers and 756 mothers in the final sample. More details are provided in Chapter 4.

3.2.2 Longitudinal Study of Australian Children, Baby (B) cohort

Overview: The data used in Study 2 and Study 3 of this thesis was drawn from Waves 3-7 of the Baby cohort (B) of the Longitudinal Study of Australian Children (LSAC). This study, also known as *Growing up in Australia*, is funded by the Australian Government and conducted in partnership between the Australian Government Department of Social Services, the Australian Institute of Family Studies and the Australian Bureau of Statistics, with advice provided by a consortium of leading researchers (https://growingupinaustralia.gov.au). The

study includes a wide range of information about parents' labour force participation, family functioning, and parents' and children's health and wellbeing, aimed at examining the interplay of factors facilitating or impeding children's development. Therefore, it is a rich data source for investigating the effect of work characteristics and experiences at the family level (Sanson & Johnstone, 2004; Gray & Sanson, 2005).

Procedure: The LSAC study design used two-staged clustered sampling based on Australian postcodes and Australia's universal health insurance database (i.e. the Medicare Australia database). Data from parents has been collected via face-to-face interviews (where one primary parent reported data for themselves and their partner) and self-report questionnaires (where each parent self-reported their own data) biennially since 2004 (Wave 1) (Soloff et al., 2005). The LSAC database consists of two cohorts – the B (baby) cohort and the K (kindergarten) cohort. The current research project used data from the B cohort, as it included more parents with children under 18 years old. The study children recruited in Wave 1 (in 2004) of the B cohort were aged 0-1 years old. Thus in Waves 3-7, these children were aged 4-5 (in 2008) to 12-13 years of age (in 2018). Wave 3 was taken as the starting point in this thesis, because it was the first wave when specific information on parents' work schedules was collected.

Participants: The Wave 1 sample of the LSAC B cohort consisted of 5107 children and their families. The attrition rate, as a percentage of Wave 1 response, was 14.1% for Wave 3, 16.9% for Wave 4, 20.0% for Wave 5, 26.3% for Wave 6, and 33.8% for Wave 7 (Usback, 2018). As mentioned above, Wave 3 was taken as the starting point in this thesis. The sample characteristics for the Wave 3 B cohort sample are summarised in Table 3.2.

Table 3.2 Sample characteristics for the full sample of the LSAC Wave 3 B cohort

Sample characteristics (household level) (n=4386)		
Family types	Single parents	486 (11.1%)
	Two parents[1]	3900 (88.9%)
	Unknown or missing	0 (0.0%)
Number of children at home	1~2 children	2564 (58.5%)
	3 or more children	1822 (41.5%)
	Unknown or missing	0 (0.0%)

Having an infant (aged⩽ 2) at home	Yes	1052 (24.0%)	
	No	3334 (76.0%)	
	Unknown or missing	0 (0.0%)	
Household weekly income	<1500$	1856 (42.3%)	
	≥1500$	2387 (54.4%)	
	Unknown or missing	143 (3.3%)	
Sample characteristics (parent level)[2]			
		Fathers [3] (n=3899)	Mothers (n=4375)
Country of birth	Australia	3019 (77.4%)	3487 (79.7%)
	Others	760 (19.5%)	760 (17.4%)
	Unknown or missing	120 (3.1%)	128 (2.9%)
Education level	Bachelor's or higher	1201(30.8%)	1561 (35.7%)
	Below Bachelor's	2689 (69.0%)	2814 (64.3%)
	Unknown or missing	9 (0.2%)	0 (0.0%)
Employment status	Employed (incl. self-employed)	3703 (95.0%)	2841 (64.9%)
	Unemployed	57 (1.5%)	79 (1.8%)
	Not in the labour force	136 (3.5%)	1452 (33.2%)
	Unknown or missing	3 (0.1%)	3 (0.1%)

[1]26 (0.6%) families where the two parents were not partners or did not report on their relationship status were also included.

[2] Parents living elsewhere were not included.

[3] Fathers recorded as female were not included, nor were mothers recorded as male.

Both Study 2 and Study 3 used longitudinal data. In other words, participants were required to be in more than one wave to be included in the analyses. For Study 2, parents were required to have participated in at least two (and up to five) waves of the LSAC, while for Study 3, they were required to have participated in at least two consecutive waves to capture information about shift work transitions.

In this research thesis, only heterosexual parents in dual-earner families were included in Studies 2 and 3, as same-sex parents, single parents, and parents in single-earner families may have different experiences in sharing domestic work and childcare responsibilities, as well as in balancing work and family roles and responsibilities. Therefore, care should be taken when generalising the findings of this thesis to these different family types. However, given that the majority of families with children in Australia now have two working parents (ABS, 2017),

the results of Studies 2 and 3 can still be generally viewed as representative at the national level.

3.3 Measures

Table 3.3 outlines the measures of shift work, parental wellbeing, and also the covariates, included in the three studies in this thesis. Because different measures were available in the datasets used for Study 1 (drawn from the Families at Work Survey) and Studies 2 and 3 (drawn from the LSAC database), this table assists with understanding the similarities and dissimilarities of the measures adopted in each set of analyses.

For instance, Table 3.3 shows some important differences between the studies for both the measures of shift work and parental wellbeing. As previously mentioned, in Study 1 the detailed measure of shift work available and the adequate numbers in each type of shift work schedule allowed differences in shift work schedules to be examined. This is important, as the existing findings reviewed in Chapter 2 suggest that wellbeing outcomes might potentially vary across different types of shift work (see Zhao et al., 2019, in Appendix 1). Therefore, in Study 1, participants were categorized into four groups according to the type of shift work in which they were employed: “Regular shift work”, “Rotating shift work”, “Irregular shift work” and “No shift work”. However, in Studies 2 and 3 these detailed differences in shift work type were not able to be investigated as the longitudinal LSAC data had few parents moving into and out of different types of shift work across different waves. Therefore, a broad binary measure of shift work was adopted in the longitudinal analyses in Studies 2 and 3 to capture more general differences between working shifts and not working shifts.

Table 3.3 also shows that the measures of psychological distress and work-family conflict are largely consistent throughout the three studies; and the only exception is couple relationship quality. Relationship quality was measured in Study 2 and Study 3, but this variable was not available for analysis in Study 1. The rationale for the inclusion of a measure of relationship quality in LSAC is most likely that this study collected household and couple-level data (in

additional to individual-level responses), while the Families at Work survey (and therefore Study 1) was only conducted at the individual-level.

As is also shown in Table 3.3, the covariates controlled for in the three studies were largely consistent, despite some minor differences. For example, parents' age was included in Studies 2 and 3, but not Study 1. This was because parents' age is highly correlated with the age of their children. Therefore, given the age of the youngest child was already included into the analyses, parents' age was not considered in Study 1. Also, the number of children in the household was considered in both Study 1 and Study 2. However, the effect of this variable was found to be limited in each of the two studies, and was thus not included in Study 3, in order to simplify the model. In contrast, although employment type was shown to have a limited effect in Study 1 and was not included in Study 2, it was added to the model in Study 3, since Study 3 focused on changes in work schedules (and this may have a more direct association with employment type, as described in more detail in Chapter 2).

Table 3.3 Summary of measures adopted in each study

		Study 1	**Study 2**	**Study 3**
Shift work		Regular shift work, Rotating shift work, Irregular shift work, *or* No shift work	Shift work, *or* Non-shift work.	Moving into shift work: Non-shift work to Non-shift work, *or* Non-shift work to Shift work. Moving out of shift work: Shift work to Shift work, *or* Shift work to Non-shift work.
Parental wellbeing	Psychological distress	Kessler-10 scale (Kessler et al., 2002)	Kessler-6 scale (Kessler et al., 2002)	Kessler-6 scale (Kessler et al., 2002)
	Work-family conflict	Work-to-family & Family-to-work conflict (Marshall & Barnett, 1993)	Work-to-family & Family-to-work conflict (Marshall & Barnett, 1993)	Work-to-family & Family-to-work conflict (Marshall & Barnett, 1993)
	Relationship quality	Not available	Hendrick relationship quality scale (Hendrick, 1988)	Hendrick relationship quality scale (Hendrick, 1988)
Covariates (demographic)	Gender	Moderator	Sub-group analyses for fathers and mothers	Sub-group analyses for fathers and mothers
	Age	Available but not included	40 years and under; or above 40 years old.	40 years and under; or above 40 years old.
	Single parent status	Single parents, or Married parents.	Single parents not included	Single parents not included
	Socioeconomic status	Pre-tax income. Highest level of education	Z-score for socioeconomic position (i.e. occupational prestige, income and education)	Z-score for socioeconomic position (i.e. occupational prestige, income and education)
	Characteristics of children	Number of children. The age of the youngest child	Number of children. Infant at home	Infant at home
	Share of domestic work	Not available	"I do my fair share"; "I do less than my fair share"; *or* "I do more than my fair share".	"I do my fair share"; "I do less than my fair share"; *or* "I do more than my fair share".
Covariates (work-related)	Occupations	Manager/Administrator, Professional/Associate professional, Trades person, Clerical or service worker, Labourers & related worker, *or* Other	Manager, Professional, Technician, Service worker, Clerical worker or Salesperson, Operator, *or* Labourer	Manager, Professional, Technician, Service worker, Clerical worker or Salesperson, Operator, *or* Labourer
	Job quality	Job flexibility + Job security + Autonomy + Leave access	Job flexibility + Job security + Autonomy + Leave access	Job flexibility + Job security + Autonomy + Leave access

Covariates (work-related)	Work hours	Part-time (i.e. under 20 hours per week); Full-time (i.e. 20~40 hours per week); *or* Overtime (i.e. above 40 hours per week).	Part-time (i.e. under 20 hours per week); Full-time (i.e. 20~40 hours per week); *or* Overtime (i.e. above 40 hours per week).	Full-time (i.e. 20~40 hours per week); *or* Overtime (i.e. above 40 hours per week).[1]
	Employment type	Permanent ongoing position; *or* Fixed term contract/casual/some other basis/ don't know.	Available but not included [2]	Permanent position; Own business; *or* Fixed/casual/other contract.
Covariates (partner-related)	Partner's shift work status	Not available	Shift work, *or* Non-shift work	Shift work, *or* Non-shift work
	Partner's work hours	Not available	Part-time (i.e. under 20 hours per week); Full-time (i.e. 20~40 hours per week); *or* Overtime (i.e. above 40 hours per week).	Part-time (i.e. under 20 hours per week); Full-time (i.e. 20~40 hours per week); *or* Overtime (i.e. above 40 hours per week).
	Partner's wellbeing	Not available	Available but not included (due to potential over-controlling)	Psychological distress Work-family conflict Relationship quality

[1]Part-time workers were excluded in Study 3 (see Chapter 6 for more details).

3.4 Analytic methods and models overview

3.4.1 Study 1 cross-sectional analyses: Simple mediation model, simple moderation model and moderated-mediation model.

Study 1 is a cross-sectional study measuring the association between shift work and mental health in a sample of parents and the extent to which this association is mediated by work-family conflict. The study also explores whether any mediating effect of work-family conflict is moderated by gender. The analytic model used in Study 1 is depicted in Figure 3.1 below.

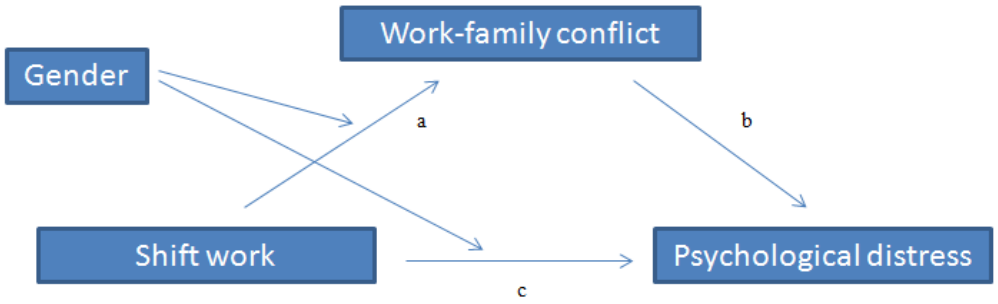


Figure 3.1 The statistical model of *Study 1*

Study 1 hypothesises that the association between shift work and psychological distress is mediated by work-family conflict, either entirely or partially. The proposition is that shift working parents suffer from more psychological distress compared to non-shift working parents because their work-family conflict levels are higher. If this was the case, the effect of shift work on psychological distress would be reduced after controlling for work-family conflict (Hayes, 2013). In addition, the association between shift work and work-family conflict, and the association between shift work and psychological distress, are both hypothesised to be moderated by gender in Study 1. In other words, both associations are expected to show different patterns for mothers and fathers. For example, the association between shift work and psychological distress may be significant among mothers but not fathers. Taking together the mediating and moderating effect, the mechanisms linking shift work and psychological distress are best described by an integration model, known as a "moderated-mediation model" (Hayes, 2013).

Chapter 4 provides further detail on the analytic approaches – including the simple mediation model, simple moderation model and the moderated-mediation model – used in Study 1. The nature of the variables included in the models is also described (e.g. shift work is categorical, while work-family conflict and psychological distress are measured on continuous scales). The strengths and limitations of the analytic approaches adopted are also discussed. All analyses in Chapter 4 were conducted using SPSS 25.0, and statistical significance was set at the $p<.05$ level.

3.4.2 Longitudinal analyses: Studies 2 and 3 population-average model, population-average logit model, and hybrid model

Study 2 and Study 3 are both longitudinal studies aimed at examining the association between shift work and parental wellbeing over multiple time points. The first study utilises the longitudinal data available in LSAC to investigate whether we can observe parents' wellbeing changing in connection with changes in their shift working status. This type of change is often referred to as within-person change, but this is only one type of variance in responses found in longitudinal data. For longitudinal data, there are three types of variance between responses: First, *time-varying, within-individuals*, where the responses of the same individual may be different at different time points. Second, *time-invariant, between-individuals*, where at the same time point, the responses of different individuals may be different. Third, *time-varying, between-individuals*, where the responses may be different between individuals and these differences are potentially varied across time points (Allison, 2009). In the meantime, the variance is usually comprised of two components: the variance could be attributed to the explanatory variables (and also the covariates included) in the equation; or the variance may not be related to those variables included in the equation (Hubbard et al., 2010). The latter is usually treated as "error" in the statistical analyses and described as the effects of unmeasured or unobservable covariates.

Currently, there are several statistical models available for conducting longitudinal analyses. Each of them makes different hypotheses and assumptions regarding where the variance comes from, and then focuses on measuring certain types of variance, while making various efforts to account for others. Usually, determining the types of variance on which to focus is dependent on the aims of the study. In other words, the researchers are required to decide which model is most appropriate based on the study aims (Gardiner et al., 2009).

In this thesis, generally two kinds of longitudinal models are fitted – population-average models and hybrid models. The population-average model describes the differences in the population mean in relation to the differences in covariates, while accounting for the dependency between different responses (at different time points) from the same individuals (this is considered as noise/a nuisance) (Gardiner, 2009; Hsiao, 2003; Hubbard et al., 2010). To be specific, the population-average models in the current thesis show the differences in wellbeing levels between the shift working population and the non-shift working population. The population-average model is based on a linear regression model, and is therefore suitable for continuous outcomes (as are used in Study 2 in this thesis). But in Study 3, when the outcomes are binary variables (coded as transitioning into or out of shift work), population-average logit models based on logistic regression models are fitted to examine whether and the extent to which the likelihood of moving into or out of shift work is explained by differences in wellbeing levels on a population-level.

It is important to recognise that population-average models provide limited evidence in terms of the possible causal link between shift work and wellbeing. It is possible that the associations found in population-average models originate from other unmeasured differences between individuals who *do* and *don't* work shifts, rather than shift work itself (Allison, 2009; Hiilamo et al., 2019). Therefore in Study 2 of this thesis, hybrid models are fitted to separate time-varying, within-individuals changes (i.e. changes in wellbeing levels in association with within-person changes in shift work status), and the time-invariant, between-individual differences (i.e. differences in wellbeing between those who do and do not work shifts). By focusing on changes in wellbeing levels within the same individuals, between-individual differences, observable or unobservable, are controlled for. In addition, the estimates of time-invariant, between-individuals differences provide further information in terms of population-level differences between shift workers and non-shift workers. While isolating within-person wellbeing in association with within-person changes in shift work brings more confidence that the two are causally related, there are still questions about the direction of the association and related endogeneity. Nevertheless, compared to cross-sectional results or the broad, population-level results generated from population-average models, the hybrid longitudinal models conducted in Study 2 take us a step closer towards understanding if there is likely a causal relationship between shift work and wellbeing.

Chapters 5 and 6 (Study 2 and Study 3) describe the longitudinal models in further detail, including information about the nature of the variables (e.g. shift work is binary, while work-family conflict and psychological distress are measured on continuous scales) and the limitations of the models. All analyses were stratified by gender in Studies 2 and 3 to explore gender differences. The analyses were conducted in STATA version 15, and statistical significance was set at the $p<.05$ level.

The first three chapters so far have provided an overview of this thesis, including the thesis topic, the pertinent theoretical perspectives, the existing relevant research that has been conducted, and the methodologies adopted in the analytic chapters to follow. In the next three chapters (i.e. Chapter 4, 5, and 6), the three original research studies conducted within this research thesis are presented; beginning with Study 1 in Chapter 4 – a cross sectional study examining the associations between shift work, work-family conflict and mental health among working parents, as well as the gender differences in these associations.

Chapter 4 Study 1 Parents' shift work in connection with mental health: Examining work-family conflict as a mediator

4.1 Summary

While there is evidence to suggest that shift work might aggravate work-family conflict and in turn psychological distress, findings remain mixed and further research is needed to try and clarify these associations. The current study used moderated-mediation analyses to investigate the association between shift work (either regular shifts, irregular shifts or rotating shifts vs no shift work) and mental health (psychological distress); whether work-family conflict explained this association; and whether the pathways differed between genders. The sample included 756 mothers and 452 fathers participating in the Families at Work survey, an online nationwide community-based survey of employed parents. The findings highlight the complex interplay between parents' work schedules, work-family conflict and psychological distress. They show some evidence that working irregular shifts was associated with higher work-family conflict in connection with higher psychological distress, with fathers at greater risk. Working regular shifts was associated with poorer mental health, but this was not related to higher levels of work-family conflict, and this association was stronger for mothers. As the labour force becomes increasingly fractured, it is critical that the wellbeing impacts of nonstandard work schedules continue to be considered.

4.2 Introduction

The increase in maternal labour force participation and dual-earner families (OECD, 2017) has meant that parents have to find new ways to concurrently balance their work and family responsibilities – and this may be more difficult in some types of jobs. This chapter examines whether being a shift working parent (either working regular, irregular or rotating shifts) is associated with more difficulties balancing work and family than being a non-shift working parent, and whether this is in turn associated with poorer mental health.

The rise in dual earner families has been well documented. Now in most OECD countries, less than 30% of couple families have only fathers working, ranging from 5% in Norway to just under 30% in the US, and greater than 40% only in Chile and Mexico. In Australia, the proportion is just under 25% (OECD, 2017). These figures show that parents are undertaking the practical, emotional and time-intensive aspects of caring for children at a life stage when they are also striving to build and stabilize their careers (Erickson et al., 2010). Active involvement in both work and family are widely viewed as crucial for both wellbeing and quality of life, yet it is often difficult to strike a balance between the two and the conflicts between them are known to be detrimental to individuals and families (Nilsen et al., 2017; Allen et al., 2019).

This growing need to balance both work and family is taking place in a labour force environment that is increasingly requiring services and workers to be flexible and available around the clock, and this includes a growing demand for shift workers (Pagnan et al., 2011; Presser, 2003). Shift work has already been defined and described earlier in this thesis, along with statistics indicating that shift work is highly prevalent among parents. One possible reason for the high rates of shift work amongst parents is that it is sometimes viewed as a way to accommodate both work and childcare responsibilities via tag-teaming - a strategy where one partner takes care of the children while the other works. One of the commonly cited benefits of tag-team parenting is fathers' increased participation in childcare (Pagnan et al., 2011). However, many couples who tag-team do not spend enough time together, which may lead to relationship dissatisfaction and poor wellbeing (Hattery, 2001; Liu et al., 2011; Presser, 2003; Wight et al., 2008). This finding is supported by evidence suggesting that shift work has negative impacts, including on work-family conflict and mental health (Hertz & Charlton, 1989; Joshi & Bogen, 2007; Mills & Täht, 2010; Zhao et al., 2019). To provide additional support for the potential mediating role that work-family conflict might play, the following sections briefly extend the review of the literature presented in the opening chapters of this

thesis regarding the association between shift work and mental health for parents, and the connection between shift work, work-family conflict and mental health.

4.2.1 Shift work and parents' mental health

In contrast to the well-established link between shift work and physical health (Kecklund & Axelsson, 2016), the evidence for an association between shift work and workers' mental health is inconsistent and different across types of shift work (Zhao et al., 2019). Several studies have found that irregular/unpredictable shift work is associated with depression, anxiety, and general mental ill-health (Bara & Arber, 2009; Grzywacz et al., 2016; Niedhammer et al., 2015), while there is less evidence for an association with night/evening shifts, weekend shifts and rotating shifts. Given that poor mental health has in recent decades been acknowledged as a major public health issue globally, and one with an enormous social and economic burden (Whiteford et al., 2013), it is vital that researchers continue to seek to clarify the association between shift work and employees' mental health.

Clarifying the association between shift work and mental health may be particularly important for parents, given that parental mental health is critical to supporting developmental outcomes for children (Gupta & Ford-Jones, 2014). Very few studies have specifically examined shift working parents' mental health, and those that have lack consistency, as summarized in Chapter 2.3.1. For example, Grzywacz et al. (2016) found that working an irregular schedule during a child's first year of life was associated with maternal depressive symptoms. On the contrary, no association was found in the study conducted by Shepherd-Banigan et al. (2016) that also focused on mothers of infants. Even within the same study, results are often different across various types of shift work. For example, Grzywacz et al. (2016) found irregular shifts, but not night shifts, were associated with maternal depression, whereas Perry-Jenkins et al. (2007) found that, night shifts, but not rotating shifts, were associated with parents' depression. The paucity of studies examining the impacts of shift work on parents' mental health, the inconsistency in those studies that are available, and the likelihood that shift work is growing in parent populations, demonstrates the need for more knowledge on this issue.

From a psychosocial perspective, there are multiple explanations for why shift work might be linked with mental health problems. First, factors such as being a single parent or having a lower education level may simultaneously contribute to (or co-occur with) mental health problems and working shifts – in part explaining the association (Han, 2008; Kuruvilla &

Jacob, 2007). Related to these correlated vulnerabilities, individuals who undertake shift work may be more vulnerable to mental health problems (i.e. a health selection perspective). Second, associations between shift work and unfavourable working conditions (e.g. high job demands, low flexibility) may explain the link with poorer mental health (Vogel et al., 2012; Wittmer & Martin, 2010). This potential is acknowledged in a number of studies by controlling for job characteristics (De Raeve et al., 2007; Shields, 2002). Third, and most relevant to parent populations, is the interference of nonstandard work schedules in family routines (Gassman-Pines, 2011), which may harm family relationships and compromise shift workers' mental health. The current study focuses on this third pathway (conflict between work and family responsibilities) as a hypothesis for how shift work impacts on parents' mental health.

4.2.2 Shift work, work-family conflict & parents' mental health

Work-family conflict is defined as a form of inter-role conflict in which the general demands of, time devoted to, and strain created by, a job interfere with performing family-related responsibilities, and vice versa (Netemeyer & Boles, 1996). Shift work may simultaneously increase time- and strain-based work-family conflict. Shift workers usually have to work at nights and/or weekends, times typically reserved for family life, with the result that they may frequently miss out on routine family events. Working nonstandard hours also often leads to sleep deprivation and fatigue (Øyane et al., 2013; Shen et al., 2006), which, in turn, leads to irritability and strain in family interactions. This may compromise shift working parents' emotional capacity to fulfil family responsibilities, which has been found to reflect strain-based work-family conflict (Gassman-Pines, 2011; Shen et al., 2006). Despite parents' perceptions that shift work may help them balance work and family life, a number of studies (Davis et al., 2008; Fenwick & Tausig, 2004; Staines & Pleck, 1984) have demonstrated that working a nonstandard schedule is associated with higher levels of work-family conflict.

While work-family conflict is associated with mental health problems, such as, depression, anxiety, mood disorders and substance abuse (Allen et al., 2000; Wang et al., 2012), little research that has examined the relationship between shift work, work-family conflict and parents' mental health inclusively. Cooklin et al. (2015) showed that for fathers, night work was not directly associated with psychological distress, but did indirectly impact via increases in work-family conflict. In another study (Haines III et al., 2008), shift work was found to have both direct and indirect effects (via work-to-family conflict) on depression. These few

studies indicate there may be important inter-relationships between shift work, work-family conflict and mental health.

4.2.3 Variation in mothers and fathers

In considering the pathways between shift work, work-family conflict and associated poor mental health, the impacts of shift work may differ for mothers and fathers. For instance, research conducted by Cooklin et al. (2016) broadly explored job characteristics most salient for mothers' and fathers' work-family conflict and found that mothers were more vulnerable than fathers when working longer hours (i.e. mothers had lower work-hour thresholds for "entering'" into work-family conflict) and experiencing job insecurity. However, like many other studies, Cooklin et al. (2016) analysed mothers and fathers separately with no formal test of gender differences and did not specifically explore shift work in this study. Overall, very few studies have examined the role played by gender in the association between shift work and work-family conflict. To our knowledge, only Jansen et al. (2003) have investigated gender difference. They found that shift work significantly increased the risk of work-family conflict for men but not women (although this study also analysed men and women separately). In contrast, research that has focused on the association between shift work and mental health suggests this association may be stronger for women (Bildt & Michelsen, 2002; Driesen et al., 2011), although none of this research has explored the role of work-family conflict, and formal tests of gender differences are again rare (see Zhao et al., 2019 in Appendix 1)

Overall, while there is reason to propose that the interrelationships between shift work, work-family conflict and mental health may show different patterns for mothers and fathers, the existing literature is scant. Also, the overarching context is one in which many work- and family-related factors differ between mothers and fathers (see Chapter 2 for a theoretical understanding of the potential impact of gender on the association between shift work and parental wellbeing). Hence, the current study attempts to more confidently identify potential gender differences in shift work and isolate them from related contextual factors by controlling for a range of work and family covariates.

4.2.4 Study 1: Aims, hypotheses, and study design

Some parents assume that working shifts assists their goal of balancing work and family demands, but the disparate evidence available suggests this may not be the case. The analyses conducted in this chapter investigated whether shift work is associated with psychological

distress for parents through the mediation effect of work-family conflict and whether gender moderated these associations. The analyses also explore potential differences based on the type of shift work undertaken (e.g. regular, irregular or rotating shifts), since the research reviewed earlier in this thesis suggests their impacts on mental health may differ.

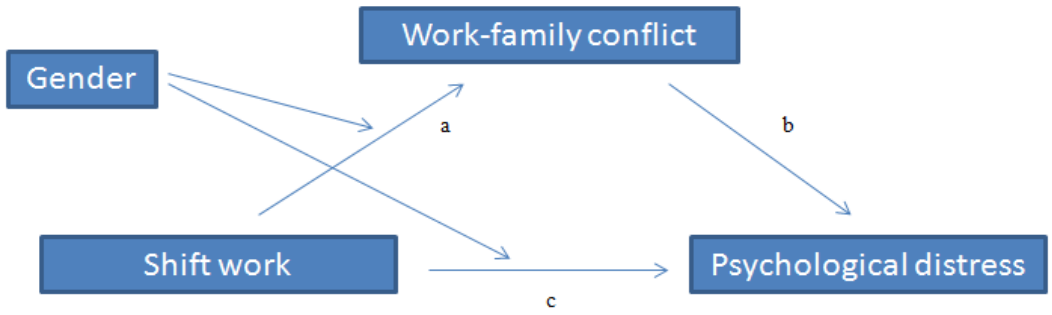


Figure 4.1 The conceptual moderated mediation model

Note: This figure is the same as Figure 3.1.

As illustrated in Figure 4.1, a moderated-mediation model was conceptualized to depict the relationship between shift work, work-family conflict, gender and psychological distress. Path *a* represents the relationship between shift work and work-family conflict; path *b* represents the relationship between work-family conflict and psychological distress; therefore *a* * *b* is the indirect (mediation) effect of shift work on distress. Path *c* represents the direct effect of shift work on psychological distress independent of the effect of work-family conflict. Based on existing studies, the analyses also explore whether gender might moderate the relationship between shift work and work-family conflict (path *a*) and the relationship between shift work and psychological distress (path *c*). However, due to a paucity of evidence, we do not hypothesize whether effects will be stronger for fathers or mothers.

Based on the proposed model, the study reported in this chapter aims to test the following specific hypotheses:

1) Shift work will be associated with higher work-family conflict (i.e. path *a*) and psychological distress (i.e. path *c*) in parents of children ≤18 years of age (associations may differ based on the type of shift work undertaken).
2) The association between shift work and parents' higher psychological distress will be mediated by increased work-family conflict (i.e. path *a* * *b*).

3) Gender will moderate the association between shift work and work-family conflict (i.e. path *a*); and the association between shift work and psychological distress (i.e. path *c*).
4) The indirect effect of shift work on psychological distress transmitted by work-family conflict (i.e. path *a* * *b*) will be moderated by gender.

4.3 Methods

4.3.1 Study context

Data for current study is drawn from the Families at Work (FaW) survey, which has also been described in Chapter 3 of this thesis. Eligible participants for the online, nationwide survey were required to: (i) be ≥18 years; (ii) reside in Australia; (iii) in paid employment; and (iv) have at least one child ≤18 years. Ethical approval for the survey was granted by the La Trobe University Human Ethics Sub-Committee. The data was collected from August-November 2016, with parents recruited using a comprehensive online recruitment strategy (Bennetts et al., 2019). The Families at Work sample was found to be broadly representative of parents in the Australian population based on comparisons with the nationally representative Longitudinal Study of Australian Children (LSAC), although the former included more tertiary educated parents (65% vs 44%; $p<.001$), fewer parents born outside Australia (18% vs 23%; $p<.001$), and the sample lived in less disadvantaged neighbourhoods (SEIFA score mean 1018.7 vs mean 1011.1; $p<.001$) (Bennetts et al., 2019).

4.3.2 The Study 1 sample

The sample included 5163 eligible employed parents. Among them, 5099 (98.8%) answered the question about shift work and 1013 (19.6%) reported they were undertaking some type of shift work – 419 (8.1%) regular shifts, 238 (4.6%) rotating shifts and 356 (6.9%) irregular shifts. Because the sample size included far more individuals who were not shift workers than those who were (as is also found in the general population), 10% of all non-shift workers (n=343) were randomly selected to compare with the three shift worker groups. After this random selection, 1431 individuals in total remained in the sample. Of them, 221 were excluded due to missing data on items of interest. This left 1210 (84.6%) individuals, with two individuals who did not disclose their gender also excluded, leaving 452 fathers and 756 mothers in the final sample. The 221 individuals with missing data were compared to the sample with complete data using univariate analyses. No differences, except for occupation

type, were found between those with and without missing data. There were no differences in levels of work-family conflict (t=.042, p=.967) and psychological distress (t=-.800, p=.424). Additional supplementary analyses comparing the final sample used in this study and parents from the LSAC data showed that samples did not differ on the proportion of single parents, although the current sample included more educated parents (54.3% had a Bachelor's degree compared to 44% in LSAC).

4.3.3 Variables and measures

The measures retained for the present study included: shift work status/type, work-family conflict, psychological distress symptoms, and a series of demographic and work-related variables.

Shift work. Participants were asked: "In a usual week in your job/business, do you work…?" Possible responses were *shift work, regular roster*, *shift work, rotating roster*, *shift work, irregular roster*, and *no shift work.* Participants were categorized into four groups based on their responses: *Regular shift, Rotating shift*, *Irregular shift* and *No shift work.*

Psychological distress symptoms were measured with a Kessler-10 scale (Kessler et al., 2002). Participants were asked 10 items about how often they felt a range of psychological symptoms in the last 4 weeks on a 5-point scale (1 = *None of the time*; 5 = *All of the time*; range 10-50).

Work-family conflict was assessed using a 4-item, 5-point scale (1 = *Strongly disagree*, 5 = *Strongly agree*) which measured both the degree to which work interfered with family; and the degree to which family interfered with work. Higher scores indicated higher work-family conflict (Marshall & Barnett, 1993).

Demographic variables measured in the study included: Gender (i.e. *Male* or *Female*); Single parent status (i.e. *Partnered parents* (including parents who are married or de facto) or *Single parents* (including those divorced, separated, widowed, or never married); Pre-tax income (i.e. the cut-off point was set at $800 per week, which is ~120% of the median weekly personal income for people aged ≥15 years in Australia (ABS, 2016)); Highest level of education (*Bachelor's or higher degree* vs *Below Bachelor's*); Number of children (*1-2 children* vs *At least 3 children*); and The age of the youngest child.

A series of *employment characteristics* were also included in the study: Occupations consisted of: *Manager/Administrator* (e.g. business owner, managing director);

Professional/Associate professional (e.g. nurse, teacher, and accountant); *Tradesperson* (e.g. electrician, plumber); *Clerical or service worker* (e.g. reception, retail or sales, office coordinator); *Labourer and related worker* (e.g. construction, road worker) and *Other*. Job quality was estimated based on 4 items reflecting job flexibility, job security, autonomy and leave access. Each of the four items required a binary response (*Yes*/*No*), and an overall count of these working conditions was summed to represent job quality. The job quality score was then categorized into a binary variable based on the median score: i.e. *High job quality* (if score≥3) or *Low job quality* (if score<3). Work hours per week (*Under 20 hours*, *20~40 hours* or *Above 40 hours*), and Permanent position (*Permanent ongoing position*; or *Fixed term contract/casual basis/some other basis/don't know*) were also measured.

4.3.4 Statistical analysis

In the current analyses, first, to describe and compare individuals working different types of schedules, univariate analyses (i.e. chi-squared tests and ANOVAs) were carried out to assess the association of each demographic and work-related variable (including work-family conflict, and so informing Hypothesis 1) with shift work. All demographic and work-related variables found to be significantly associated with shift work (as presented in Table 4.1) were controlled for in the subsequent simple mediation, simple moderation and moderated mediation analyses, except for tertiary education, which was significantly correlated with both single parents status (Spearman $\rho = .103$, $p < .001$) and income (Spearman $\rho = .112$, $p < .001$) (i.e. potential collinearity). Based on this result, variables controlled for in all the multivariate analyses were single parent status, income, number of children, job quality, work hours, occupation type and permanent position.

Second, Preacher and Hayes "test of mediation" (Hayes, 2009; Preacher & Hayes, 2004) was applied to assess the mediation effect of work-family conflict in the association between shift work and psychological distress (Hypothesis 2). This test utilizes bootstrapping to ''generate a reference distribution, which is then used for confidence interval estimation and significance testing'' (MacKinnon et al., 2007, p. 601). Bootstrapping overcomes the normality assumptions necessary in other tests of mediation, such as the Sobel test (Sobel, 1982); and other limitations of Baron's and Kenny's "causal steps approach" (1986). Third, we adopted simple moderation models to examine the moderating effect of gender on the association between shift work and work-family conflict, controlling for covariates, and the

moderating effect of gender on the association between shift work and psychological distress, controlling for covariates and work-family conflict (Hypothesis 3).

Finally, the moderated mediation model, also known as "conditional process analysis" (Hayes, 2013), was applied to assess whether or not the mediation effect of work-family conflict on the association between shift work and psychological distress is moderated by gender (Hypothesis 4). In other words this final step assessed whether the mediation effect was different for fathers and mothers.

It is important to note that in the approaches taken in these analyses, a significant association between independent variable X and dependent variable Y is not a necessary prerequisite for a mediation/moderation effect between X and Y. Similarly, the simple mediation model is not a necessary precursor for a moderated mediation model (Hayes, 2009; Parker et al., 2011; Preacher & Hayes, 2004). This is because Preacher and Hayes (Hayes, 2009; Preacher & Hayes, 2004) argue that in multivariate models, there could be more than one pathway (or mediating variable) to carry the effect from X through to Y, and multiple paths may operate in opposite directions (if this is the case an association between X and Y may not be observed).

All analyses were performed using SPSS 25.0. The simple mediation, simple moderation and the moderated mediation analyses were performed using PROCESS, which is a statistical macro for conducting mediation and moderation analyses in SPSS (Hayes, 2013; Hayes & Preacher, 2014; Preacher & Hayes, 2004).

4.4 Results

4.4.1 Sample characteristics for parents working different schedules

The results of the descriptive and univariate analyses are presented in Table 4.1. Compared to non-shift workers, shift workers were more likely to be male, single parents and have at least three children. The proportion of workers with a Bachelor's or higher degree, or with an income higher than $800/week, was lower for shift workers. Shift workers were less likely to be in a permanent position, or a high-quality job. The univariate analyses showed that shift work was significantly associated with higher work-family conflict and psychological distress (showing support for Hypothesis 1). All variables with a significant univariate association (except education level) were taken into account in subsequent analyses.

Table 4.1 Descriptive and univariate analyses for the sample

		No shift	***Regular***	***Rotating***	***Irregular***	**Total**
Total number of workers		342 (28.3%)	358 (29.7%)	209 (17.3%)	299 (24.8%)	1208 (100.0%)
Demographic variables						
Gender [a] ***	*Males*	78 (22.8%)	149 (41.6%)	119 (56.9%)	106 (35.5%)	452 (37.4%)
	Females	264 (77.2%)	209 (58.4%)	90 (43.1%)	193 (64.5%)	756 (62.6%)
Single or married parents [a] *	*Married parents*	297 (86.8%)	296 (82.7%)	184 (88.0%)	240 (80.3%)	1017 (84.2%)
	Single parents	45 (13.2%)	62 (17.3%)	25 (12.0%)	59 (19.7%)	191 (15.8%)
Income [a] ***	*≥$800/week*	290 (84.8%)	263 (73.5%)	181 (86.6%)	217 (72.6%)	951 (78.7%)
	<800/week	52 (15.2%)	95 (26.5%)	28 (13.4%)	82 (27.4%)	257 (21.3%)
Tertiary education [a] ***	*Bachelor's or higher*	253 (74.0%)	160 (44.7%)	86 (41.1%)	157 (52.5%)	656 (54.3%)
	Below Bachelor's	89 (26.0%)	198 (55.3%)	123 (58.9%)	142 (47.5%)	552 (45.7%)
Number of children [a] **	*2 children or less*	275 (80.4%)	273 (76.3%)	144 (68.9%)	211 (70.6%)	903 (74.8%)
	3 or more children	67 (19.6%)	85 (23.7%)	65 (31.1%)	88 (29.4%)	305 (25.2%)
Age of youngest child[b] NS		6.25 (5.02)	6.20 (4.77)	5.33 (4.29)	6.32 (4.74)	6.09 (4.77)
Work-related variables						
Occupational type [a]***	*Manager/Administrator*	48 (14.0%)	24 (6.7%)	17 (8.1%)	11 (3.7%)	100 (8.3%)
	Professional	214 (62.6%)	144 (40.2%)	87 (41.6%)	165 (55.2%)	610 (50.5%)
	Tradesperson	6 (1.8%)	30 (8.4%)	27 (12.9%)	10 (3.3%)	73 (6.0%)
	Clerical/service worker	44 (12.9%)	71 (19.8%)	26 (12.4%)	31 (10.4%)	172 (14.2%)
	Labourer or related worker	2 (0.6%)	23 (6.4%)	14 (6.7%)	9 (3.0%)	48 (4.0%)
	Other	28 (8.2%)	66 (18.4%)	38 (18.2%)	73 (24.4%)	205 (17.0%)
Work hours [a]***	*Work 20 hours or less per week*	37 (10.8%)	42 (11.7%)	10 (4.8%)	33 (11.0%)	122 (10.1%)
	Work 20-40 hours per week	151 (44.2%)	164 (45.8%)	67 (32.1%)	125 (41.8%)	507 (42.0%)
	Work more than 40 hours per week	154 (45.0%)	152 (42.5%)	132 (63.2%)	141 (47.2%)	579 (47.9%)
Employment type [a]***	*Permanent*	285 (83.3%)	301 (84.1%)	185 (88.5%)	196 (65.6%)	967 (80.0%)
	Not permanent	57 (16.7%)	57 (15.9%)	24 (11.5%)	103 (34.4%)	241 (20.0%)
Job quality [a] ***	*High quality*	269 (78.7%)	228 (63.7%)	102 (48.8%)	122 (40.8%)	721 (59.7%)
	Low quality	73 (21.3%)	130 (36.3%)	107 (51.2%)	177 (59.2%)	487 (40.3%)
Work-family conflict (1-5) [b] ***		3.40 (.79)	3.37 (.81)	3.52 (.70)	3.60 (.71)	3.46 (.77)
Health & wellbeing						
Distress symptoms (10-50) [b] *		18.68 (6.85)	20.10 (7.69)	20.04 (8.03)	20.37 (8.15)	19.76 (7.66)

[a] N (% within the column); Pearson Chi-Square test. [b] Mean (*SD*); One-way ANOVA. *p<0.05 level; ** p<0.01 level;***p< 0.001 level; NS not significantly association

4.4.2 The mediation effect of work-family conflict

Table 4.2 illustrates the results from the simple mediation model analysis examining the indirect (mediation) effect of work-family conflict, both before and after controlling for covariates. The indirect effect is quantified as the product of the direct effect of shift work on work-family conflict (path *a*), and the direct effect of work-family conflict on psychological distress (path *b*). It is clear that the association between irregular shift work and higher psychological distress can be explained by greater work-family conflict, both before (*Coeff*=.66, 95%CI [.27 to 1.08]) and after controlling for covariates (*Coeff*=.39, 95%CI [.00 to- .79]) (partially supporting Hypothesis 2). The coefficients from all other pathways were no longer statistically significant after taking the covariates into consideration.

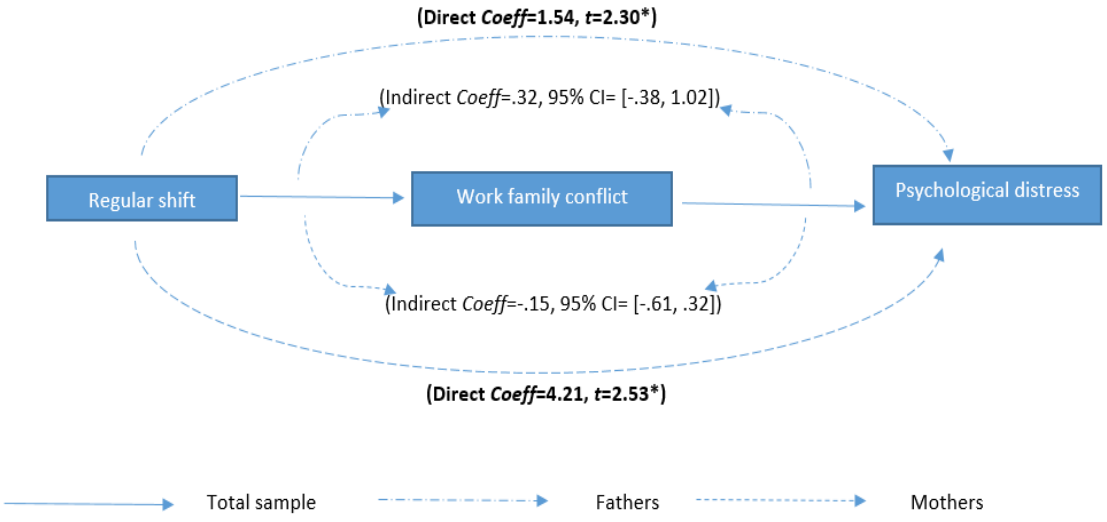
Table 4.2 Simple mediation model

	Crude model[1]								
	Total effect			Direct effect			Indirect effect		
	Effect	*SE*	*t*	*Effect*	*SE*	*t*	*Effect*	*BootSE*	*95%BootCI*
Regular	1.41	.58	2.45*	1.53	.54	2.82**	-.12	.21	-.52 – .30
Rotating	1.35	.67	2.02*	.97	.63	.13	.39	.22	-.04 – .83
Irregular	1.69	.60	2.79**	1.03	.57	1.80†	.66	.21	.27 – 1.08
	Adjusted model[2]								
	Total effect			Direct effect			Indirect effect		
	Effect	*SE*	*t*	*Effect*	*SE*	*t*	*Effect*	*BootSE*	*95%BootCI*
Regular	.76	.59	1.30	.86	.56	1.54	-.10	.20	-.48 – .29
Rotating	.34	.70	.49	.14	.67	.21	.20	.22	-.23 – .63
Irregular	.43	.63	.69	.05	.60	.08	.39	.20	.00 – .79

[1] Before adjusting for covariates [2] Adjusting for single parent status, income, number of children, job quality, work hours, occupation type and permanent position *†p<0.1 level; *p<0.05 level; ** p<0.01 level*

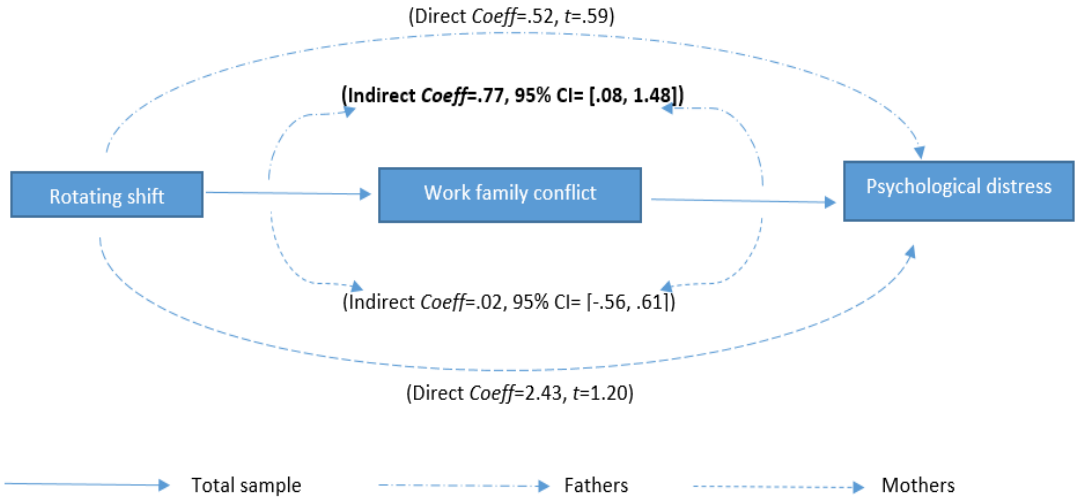
Before formally testing the moderated-mediation model (i.e. the mediation effect conditional on gender), the direct and indirect effects of shift work were first examined separately for fathers and mothers in separate stratified mediation models. The results are displayed respectively for regular, rotating and irregular shifts in Figures 4.2-4.4. For regular shift work, the indirect effect via work-family conflict was not significant for either mothers or fathers. For both genders the direct effect was significant, and it was stronger for mothers (*Coeff*=4.21, *p*<.05) than fathers (*Coeff*=1.54, *p*<.05) (reflecting the simple moderation effect found above). As in Figure 4.3, the indirect effect of rotating shift work on psychological distress via work-family conflict was significant for fathers (*Coeff*=.77, 95%CI [.08 – 1.48]), but not for mothers (*Coeff*=.02, 95%CI [-.56 – .61]). In addition, when the effect of work-family conflict was controlled for, the direct effect of rotating shift on psychological distress was not significant for fathers (*Coeff*=.52, *p*>.05) or mothers (*Coeff*=2.43, *p*>.05). Similarly, the

indirect effect of *irregular shift work* was also significant for fathers (*Coeff*=1.00, 95%CI [.29 – 1.74]) but not mothers (*Coeff*=.21, 95%CI [-.26 – .71]), as shown in Figure 4.4. The direct effect was not significant for either gender (*fathers: Coeff*=-.16, *mothers: Coeff*=.04, both *p*>.05).



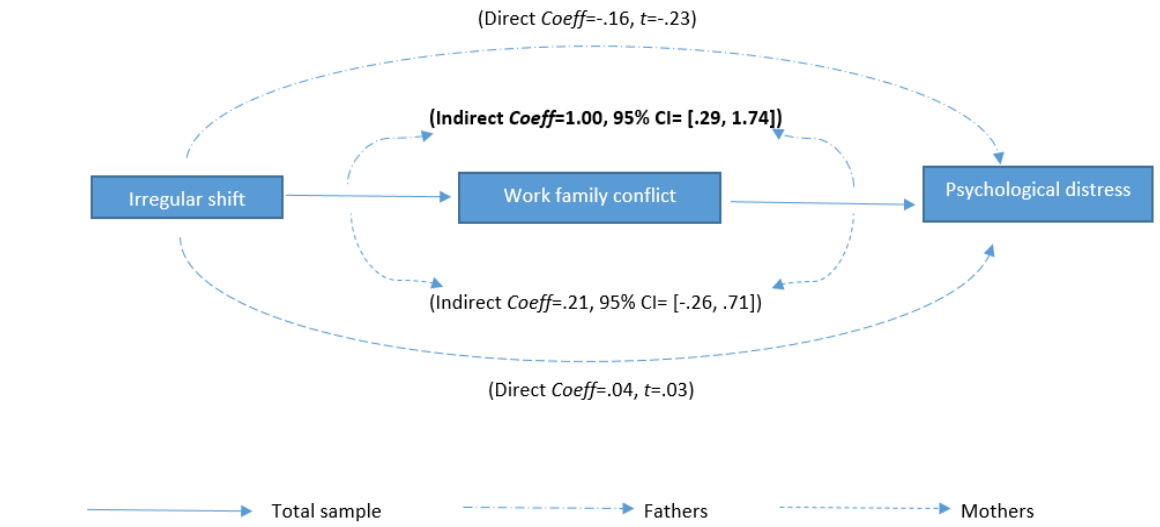
**p<0.05. CIs are bootstrapped.*

Figure 4.2 Indirect and direct effects of *regular shift work* conditional on gender for each shift work type



CIs are bootstrapped.

Figure 4.3 Indirect and direct effects of *rotating shift work* conditional on gender for each shift work type



CIs are bootstrapped.

Figure 4.4 Indirect and direct effects of *irregular shift work* conditional on gender for each shift work type

4.4.3 The moderating effect of gender

Two simple moderation models tested the moderating effect of gender on the association between shift work and work-family conflict (path *a*), and the association between shift work and psychological distress (path *c*), respectively. The coefficients from the models are displayed in Table 4.3. The association between shift work and work-family conflict was stronger for fathers, such that the interaction between irregular shift work and gender showed a trend towards a statistically significant effect (*Coeff*=-.97, $p<.1$). On the contrary, the association between shift work and psychological distress was stronger for mothers, as shown by the significant interaction between regular shift work and gender (*Coeff*=2.67, $p<.05$). The results show some support for Hypothesis 3.

Table 4.3 Regression coefficients from simple moderation models (*path a and path c*) controlling for all demographic and employment characteristics

	Work-family conflict			**Psychological distress**		
	Coeff	*SE*	*t*	*Coeff*	*SE*	*t*
Regular shift [a]	.39	.42	.93	-1.12	1.02	-1.10
Rotating shift [b]	.94	.44	2.13*	-1.38	1.07	-1.30
Irregular shift [c]	1.22	.45	2.73**	-.37	1.09	-.34
Work-family conflict	/	/	/	.82	.07	11.67***
Gender [d]	1.06	.39	2.74**	-2.60	.94	-2.78**
Regular shift × Gender	-.57	.50	-1.15	2.67	1.20	2.21*
Rotating shift × Gender	-.91	.56	-1.62	1.91	1.36	1.40
Irregular shift × Gender	-.97	.52	-1.86†	.20	1.27	.16
Single parents [e]	1.27	.24	5.39***	1.96	.57	3.41***
Number of children [f]	.63	.20	3.21**	.63	.48	1.32
Income [g]	-.42	.25	-1.64	1.13	.61	1.86†
Part-time work [h]	-1.23	.31	-3.90***	-.34	.76	-.44
Overtime work [i]	.45	.21	2.17*	.12	.50	.24
Trades person [j]	-.43	.47	-.93	-1.38	1.13	-1.22
Professional [k]	.83	.33	2.56*	-1.67	.79	-2.12*
Clerical or service worker [l]	.86	.39	2.20*	-.45	.94	-.48
Labourer [m]	-.12	.53	-.23	-.78	1.28	-.61
Other [n]	.32	.37	.87	-.96	.90	-1.07
Job quality [o]	.80	.19	4.18***	1.80	.46	3.89***
Permanent position [p]	-.28	.23	-1.18	.05	.56	.10

[a] Regular shift: 0 = *day shift or other shift work*, 1 = *regular shift work*; [b] Rotating shift: 0 = *day shift or other shift work*, 1 = *rotating shift work*; [c] Irregular shift: 0 = *day shift or other shift work*, 1 = *irregular shift work*; [d] Gender: 0 = *male*, 1 = *female*; [e] Single parents: 0 = *married parents*, 1 = *single parents*; [f] Number of children: 0 = *2 children or less*; 1 = *3 or more children*; [g] Income: 0= *more than $800/week or prefer not to say*, 1 = *less than $800/week*; [h] Part-time work: 0 = *work more than 20 hours/week*, 1 = *work less than 20 hours/week*; [i] Over-time work: 0 = *work less than 40 hours/week*, 1 = *work more than 40 hours/week*; [j] Trades person: 0 = *any other occupation*, 1 = *Trades person* [k] Professional: 0 = *any other occupation*, 1 = *Professional*; [l] Clerical or service worker: 0= *any other occupation*, 1 = *Clerical or service worker*; [m] Labourer: 0= *any other occupation*, 1 = *labourer*; [n] Other: 0 = *Managers/Administrators, Trades person, Professional, Clerical or service worker, or Labourer*; 1 = *other occupations*. [o] Job quality: 0 = *high quality*, 1 = *low quality*; [p] Permanent position: 0 = *permanent position*, 1= *not permanent position*. *† p<0.1; *p<0.05; ** p<0.01;***p< 0.001*

4.4.4 The moderated mediation effect

The results regarding the formal test of the moderated mediation effect and the indexes are shown in Table 4.4. In contrast to the results describing gendered effects in Figures 4.2-4.4, none of the three types of shift work showed a statistically significant difference for the indirect effects between genders (*Regular: Index*=-.47, 95%CI [-1.29 – .37]; *Rotating: Index*=-.75, 95%CI [-1.60 – .17]; *Irregular: Index*=-.79, 95%CI [-1.62 – .05]). However, irregular shift work showed a trend towards significance for the gender differences (*Index*=-.79, 90%CI [-1.53 – -.11]).

On the whole, the results provided mixed support for Hypothesis 4. In the simple mediation analyses stratified by gender, both rotating and irregular shift work showed significant indirect/mediation effects on psychological distress through work-family conflict for fathers, but not for mothers. Yet, the summary results for the formal moderated mediation model suggested that the differences in the indirect effect between fathers and mothers did not reach statistical significance for any of the three types of shift work. A trend was shown for irregular shift work, such that the association between irregular shift work and greater psychological distress via work-family conflict was relatively stronger for fathers than mothers.

Table 4.4 Index of moderated mediation (difference between conditional indirect effects)

	Index	***BootSE***	***95%BootCI***	***90%BootCI***
Regular shift	-.47	.42	-1.29 – .37	-1.14 – .23
Rotating shift	-.75	.45	-1.60 – .17	-1.50 – .00
Irregular shift	-.79	.43	-1.62 – .05	-1.53 – -.11

4.4.5 Supplementary data and analyses

Supplementary analyses provided additional information about sociodemographic, work-related and wellbeing-related covariates separately for mothers and fathers (see Supplementary Tables S1– S4), thus highlighting broad contextual differences by gender. As shown in Table S1 and S2, there are few gender differences in terms of the univariate association between types of work schedules and these covariates. Table S3 summarized the associations between the covariates and psychological distress, both directly and indirectly via the mediating effect of work-family conflict (without adjusting for other covariates). Being a single parent, having more children, working as a professional or as a clerical or service worker, and low job quality are all associated with higher levels of psychological distress through the indirect effect of work-family conflict. Conversely, working part-time is associated with lower levels of psychological distress via decreased work-family conflict.

However, the results of the full moderated-mediation analyses in Table S4 suggest that there are no significant gender differences regarding the indirect effect of work-family conflict on the associations between these covariates and psychological distress. In line with the moderated-mediation effect of shift work described in 4.4.4 - although in the analyses stratified by gender, number of children and part-time work only show a significant effect for mothers but not fathers, while working as a clerical or service worker only show significant effects for fathers but not mothers, the formal testing of any gender difference shows no statistical significance.

4.5 Discussion

The results of Study 1 in this chapter show some evidence of an association between undertaking shift work and higher psychological distress. This association was found to be either direct, or indirect via work-family conflict, depending on the type of shift work undertaken (i.e. regular, irregular or rotating shifts). All effects were substantially reduced after controlling for related work and family covariates, pointing towards the interplay between shift work and other job characteristics. The findings suggest different patterns for fathers and mothers; however, for the most part, these gender differences did not reach traditional cut-points for statistical significance. Working irregular shifts was associated with increased work-family conflict and subsequently a higher level of psychological distress, and fathers were shown to be at greater risk (although this finding only represented a trend towards statistical significance). Working regular shifts was associated with poorer mental health, but this was not due to increased work-family conflict, and this association was stronger for mothers. The findings are set against a backdrop of literature that typically discusses gender differences in job characteristics and work-family conflict by stratifying analyses for men and women separately rather than formally testing for interaction effects.

Interpreting the simple mediation model for the whole sample

Initially, before gender differences were explored, the simple mediation model showed that working in irregular shift work (but not regular or rotating shift work) was associated with greater work-family conflict, which in turn mediated the association between irregular shift work and higher psychological distress. These results align with a previous systematic review conducted by Zhao et al. (2019) (see Appendix 1), which found that irregular shift work has a negative impact on workers' mental health. The current results suggest that irregular/unpredictable shift work may disrupt family routines and is a barrier to forming consistent patterns in work and family roles; and that this work-family disruption is

connected to greater psychological distress over and above other stressors involved in working irregular shifts (i.e. lower income, lack of permanency, poorer job quality).

Interpreting the simple moderation and moderated-mediation models: The role of gender

Gender similarities and differences emerged in the simple moderation and moderated-mediation models. After accounting for potential confounders (demographic and work-related), regular shift work was found to be associated with greater mental health problems for both genders, but not because of higher levels of work-family conflict. Instead, other adversities related to shift work – such as sleep-related problems, fatigue, or obesity – may explain experiences of psychological distress for these workers (Saksvik et al., 2011). Importantly, the association between regular shift work and mental health was stronger for mothers. Future research should continue to isolate the mechanisms that explain this association, especially for mothers. It may be that mothers' high hours of unpaid domestic work and care (Craig & Powell, 2018; Craig & Mullan, 2011) are a mechanism for their greater psychological distress in the context of also undertaking shift work, but that mothers do not perceive their high load of family responsibilities as being in conflict with their work duties (and thus this is not captured by the work-family conflict measure). Unpaid work was not assessed in the current study to explore this further and so this is an avenue for future research.

The results showed some similarities regarding rotating and irregular shift work. The simple mediation models conducted separately for fathers and mothers showed that rotating and irregular shift working fathers' greater psychological distress could potentially be explained by greater work-family conflict, while none of the results suggested that mothers who worked in rotating or irregular shifts experienced higher work-family conflict or psychological distress. However, these gender differences are somewhat speculative as the overall test of moderated mediation showed no statistically significant differences between mothers and fathers (although there was a trend towards a significant effect for irregular shift work).

The potential gender differences highlighted in the current study demonstrate some similarities, and also some interesting contrasts, when compared with past research. Consistent with research investigating shift working fathers by Haines et al. (2008), the current results point towards an association between shift work, work-family conflict and mental health among fathers. One interpretation is that in our modern society, where gender equality is improving and the meaning of being a husband/father is moving beyond being the breadwinner, shift working fathers (particularly those in irregular and rotating shift work) remain less able to participate in family/home-based activities, resulting in higher

work-family conflict. This idea aligns with research by Craig and Powell (2011) who found that shift working fathers' participation in domestic work is very low. The opportunity (or lack of opportunity) for family-friendly work arrangements specifically for shift working fathers should be further investigated. Interestingly, the current findings for mothers contrast with several studies. Both Haines III et al. (2008) and Carlson et al. (2011) found that mothers working nonstandard hours experienced higher work-to-family conflict and poorer mental health than mothers working standard hours, However our study, in line with Jansen et al. (2003), found no association between mothers' shift work and their work-family conflict. The current results may indicate that for mothers, shift work as a deliberate strategy to balance work and family is in part successful, despite the other potential drawbacks for their mental health. However, considering that gender differences in the current study should be interpreted with caution (due to low statistical significance), more research is necessary to further probe the role played by gender.

Strengths and limitations

Study 1 investigated the association between different shift working schedules and parents' psychological distress – and the mediating role of work-family conflict – based on data provided by a large Australian sample of employed parents (both mothers and fathers) from a range of occupations, with children across diverse age groups. The broad sample provides a more comprehensive (population-based) understanding of the experience of shift working parents compared to past studies, which have often been restricted to a focus on mothers or fathers, parents of infants, or certain occupations. The current study is one of the first to investigate gender differences in relation to shift work, work-family conflict and mental health by formally testing the moderating effect of gender, and, furthermore, is the first study to formally test for gender differences using a moderated-mediation model. The results indicate that although the effect was descriptively different between genders, there were no statistically significant gender differences at the $p<.05$ level. More research is needed to further explore such potentially important gender differences. A further strength of the present study is the adjustment of the broad range of potential confounders including job-related factors such as work hours and job quality, allowing us to examine the association between the main variables of interest independent of potential confounders.

There are also limitations which need to be acknowledged. First, the online recruitment methodology used to collect the data for the Families at Work survey could lead to queries about the representativeness of the sample. Comparisons have been made between the Families at Work sample and a nationally representative sample of parents within LSAC. As

previously mentioned in 3.2.1, these analyses found that although parents in the Families at Work sample were largely comparable to those in the LSAC sample, those in the former sample were more likely to be single parents, have a tertiary education and live in less disadvantaged neighborhoods. In addition, our own supplementary analyses comparing the current analysis sample with the LSAC sample found that the current sample was more advantaged socio-economically. While the research suggests that overall, Facebook is still a feasible, low-cost means to recruit large national samples (Bennetts et al., 2019), we acknowledge that shift workers in the current sample may be more socio-economically advantaged than shift workers in the general population. On the other hand, this research could be seen as complementary to past evidence focusing on parents with low incomes (Grzywacz et al., 2016), demonstrating that the negative impact of shift work on work-family conflict and mental health is not restricted to workers with a low socioeconomic status (refer to 2.5.1 Demographic characteristics in Chapter 2 for further information regarding the association between socioeconomic status, shift work and mental health).

A further potential limitation of the study is that the relationship between shift work and parents' mental health was assessed without considering the job characteristics of partners. It may be that it is couples' joint work schedules, rather than each individual's work schedule, that most greatly influences parents' work-family conflict and mental health (Perry-Jenkins et al., 2007; Strazdins et al., 2006). Quality time with families is essential for our mental wellbeing. For each family, the time they spend together is not only dependent on each individual's work hours, but also on the couple's combined work hours. Therefore, the detrimental effect of shift work may not be exerted by shift work itself, but by the lack of synchronicity between the work schedules of the couple (Muurlink et.al., 2014). An in-depth investigation of couples' work schedules may shed more light on the reasons for gender differences between mothers and fathers. For example, mothers who work shifts may choose to do so to fit around their partners' work schedules and to balance work and family needs, whereas fathers may be more likely to undertake shift work as a non-optional job requirement. This highlights the need for further research which examines the impact of couples' work schedule combinations.

The cross-sectional design of the study also limits investigation of the links between working shifts, work-family conflict and mental health in a "causal framework" or over the longer term. There is a possibility that the impacts of shift work on parental mental health only emerge after several years' accumulation (Bara & Arber, 2009). These 'temporal' questions can only be tackled robustly using longitudinal data, tracking employed parents over time.

Thus, the following two chapters begin to more robustly address the question of a possible causal relationship between shift work and parental wellbeing by using longitudinal data. Furthermore, it is needs to be acknowledged that the sample size in Study 1 may also have limited the ability to detect statistically significant effects, and therefore this chapter provides a balanced approach to discussing both statistically significant finds and important trends that might inform future research.

4.6 Conclusion

Study 1 has begun to highlight the complex interplay between parents' work schedules and their experiences of work-family conflict and psychological distress. The study's findings provide further impetus to explore gender differences in these work- and wellbeing-related experiences. Parents, especially fathers, who work irregular shifts may be at greater risk of work-family conflict and psychological distress, whilst the poorer mental health of parents working regular shifts does not appear to be because of work-family conflict, and this effect has been found to be stronger for mothers. As the labour force becomes increasingly fractured, in terms of working schedules, work hours, and workplace locations, it is critical that the potential impacts of nonstandard work hours on families and workers' wellbeing continues to be identified. The following two chapters continue to investigate the association between shift work and wellbeing for parents, but using longitudinal data and examining not only work-family conflict and psychological distress as potential adverse outcomes, but also lower levels of couple relationship quality.

Chapter 5 Study 2 Longitudinal study of Australian shift working parents' wellbeing: Associations with psychological distress, work-family conflict and relationship quality

5.1 Summary

The study in this chapter investigates the link between shift work and three indicators of workers' wellbeing (psychological distress, work-family conflict and relationship quality) using a nationally representative sample of dual-earner parents, drawn from data from the Longitudinal Study of Australian Children (LSAC). This longitudinal data makes it possible to more deeply explore in this chapter whether there might be a causal connection (independent of other factors) between shift work and parental wellbeing. The LSAC data was collected between 2008-2018. Hybrid models were adopted to clarify within-individual changes in wellbeing in association with changes in shift work, as well as between-individual differences between shift workers and non-shift workers. The results demonstrate that shift work has different connections to wellbeing for mothers and fathers, and also across different wellbeing indicators. The main finding from this study is that for fathers, shift work is significantly, and potentially casually, associated with lower relationship quality. No associations between shift work and psychological distress were found for either mothers or fathers. With regard to work-family conflict, there were indications that shift working mothers have less work-family conflict and shift working fathers have more, but this was shown to be most likely because of the job and family characteristics that exist between shift workers and non-shift workers (rather than within-individual changes in shift work).

5.2 Introduction

The disruption in shift workers' routines and schedules (in comparison to how most of the regular working population organize their roles, responsibilities and activities) has led to a substantial body of research exploring the association between working shifts and workers' wellbeing. However, while some dimensions of wellbeing have been examined in detail, others have been rarely explored. Wellbeing is a complex and multidimensional concept. In general, it refers to "good mental states, including all of the various evaluations, positive and negative, that people make of their lives and the affective reactions of people to their experiences." (Diener, 2006; OECD, 2013 p.29). Given the multi-faceted nature of the construct, past research has highlighted the importance of adopting multiple and various measures when examining wellbeing (Liu et al., 2011; Wright & Brown, 2017). With regard to shift work and its association with workers' wellbeing, existing research has focused particularly on mental health, largely looking at depression and psychological distress. As stated earlier in this thesis, while there is a substantial body of evidence that has examined the association between shift work and mental health, the findings have been mixed (Zhao et al., 2019 in Appendix 1). Much less research has investigated the possible impacts of shift work on parents' mental health specifically, and even less has examined other dimensions of wellbeing important for parents and family functioning, such as work-family conflict and couple relationship quality. Other limitations include a lack of longitudinal research attempting to find evidence for a causal association between shift work and parental wellbeing, as well as a lack of research that has attempted to take partners' work and wellbeing into account.

For dual-earner couples (the predominant employment situation in Australian couple families with children), successful family functioning relies not only on each individual parent's time allocation, but also on how couples jointly allocate time between work and family (Jacobs & Gerson, 2001). In couple families, each person's work hours and work schedules may have implications for their partners. Relatedly, each person's family experience may result from not only their own work hours and schedules, but also their partners' (Craig & Brown, 2017; Chait Barnett et al., 2008).

When investigating the impacts of shift work on wellbeing, the intersection between partners' work schedules promotes the need to consider both partners' working conditions, yet this variable has rarely been investigated. In addition, the potential cross-over of work pressures to the family domain highlights the importance of examining the connection between one

partner's work schedule and the wellbeing of the other – although again, this has rarely been investigated, especially using longitudinal research. *The current study* makes important contributions to these gaps in evidence by including data from both partners to explore the association between shift work and wellbeing for parents. Given the previously stated importance of distinguishing different dimensions of wellbeing (Liu et al., 2011), wellbeing is explored using three correlated, but distinct, aspects – psychological distress, work-family conflict and relationship quality. The existing evidence regarding the wellbeing of shift working parents in each of these domains is outlined below. While some of this content has already been touched on in previous chapters, it is expanded upon here as each of these three aspects are potentially important indicators of overall family functioning in the context of the work-family interface (Dinh et al., 2017a). The evidence for the three wellbeing indicators is outlined separately for convenience, although existing research suggests that they are highly inter-related (Allen et al., 2000; Wang et al., 2012; Hawkins & Booth, 2005).

5.2.1 Parents' shift work and psychological distress

As discussed earlier in this thesis, very few studies have examined the association between shift work and mental health problems specifically among working parents. Additionally, past research about shift working parents' mental health has largely focused on parents of infants, and overall, the findings have been mixed. For example, while Grzywacz et al. (2016) found that working an irregular schedule during the child's first year of life was associated with maternal depressive symptoms, research by Shepherd-Banigan et al. (2016), also focusing on mothers of infants, found no such association. Other research conducted among fathers of infants found that while night shifts were not directly correlated with psychological distress, they did indirectly impact on fathers' mental health via increases in work-family conflict (Cooklin et al., 2015). Only three studies, two cross-sectional (Rosenbaum & Morett, 2009; Strazdins et al., 2006) and one longitudinal (Perry-Jenkins et al., 2007), additionally took partners' work schedules into consideration, and the results of these studies were all different (see Chapter 2 for further details).

5.2.2 Parents' shift work and work-family conflict

A number of studies (Davis et al., 2008; Fenwick & Tausig, 2004; Staines & Pleck, 1984) have demonstrated that working a nonstandard schedule is associated with higher levels of work-family conflict. The potential causes include frequently missing out on family events, such as shared mealtimes and family vacations, and fatigue related to sleep deprivation

(Gassman-Pines, 2011; Shen et al., 2006). These disruptions may compromise individuals' capability to fulfil family responsibilities and may lead to both time-based and strain-based work-family conflict (see 2.4.1 for further details).

It is noteworthy, as also stated in Chapter 2, that shift work has a higher prevalence among parents of young children – suggesting there may be particular implications for work-family conflict in these cases. These parents, especially mothers, may utilize working nonstandard schedules as a strategy to provide care to their children while maintaining their employment (Presser, 2003; Hattery, 2001). If this is the case, shift work may in fact be protective against work-family conflict. But alternatively, the extra issues enabled by working shifts may lead to more conflict between work and family roles. The scarcity of studies, and the inconsistency of results regarding shift working parents' work-family conflict leaves these questions unanswered (Cooklin et al., 2015; Davis et al., 2008; Liu et al., 2011). Liu et al. (2011) argued that a positive effect of shift work was more likely when parents received more support from partners, in other words, when couples could share/negotiate childcare responsibilities. When this was not possible, shift work was associated with higher work-family conflict. Aligning with this idea of possible negative effects, Davis et al. (2008) found that weekend workers whose partners worked nights experienced less positive spillover between work and family, compared to weekend workers whose partners did not work nights. Although the sample used by Davis et al. (2008) was not focused on parents, the results still highlight the importance of taking partners' work schedules and work conditions into consideration.

The association between shift work and work-family conflict may also differ between fathers and mothers (as shown in Chapter 4, also Zhao et al., 2020). In addition, a study by Davis et al. (2008) showed no significant interaction between shift work and gender for negative work-family/family-work spillover. However, compared to females, night-working males experienced less positive work-family spillover. Moreover, fathers with a child under the age of 6 experienced more negative spillover from family to work when they worked night shifts, while no such effect was found for their female counterparts. Together, these studies show some support for the hypotheses that shift work has a stronger relationship with work-family conflict for males, and that work schedule clashes between partners might impact on work family balance, but further research is needed, particularly longitudinal research considering the effect of both partners work schedules.

5.2.3 Parents' shift work and relationship quality

As raised earlier, the quality of family life is potentially compromised when one or both partners is working shifts, due to added restrictions on the time the family is able to spend together. This includes not only time with the whole family and children, but also time with partners. Thus, it is a reasonable possibility that shift work could have a negative impact on couples' relationship quality. Chapter 2 provides theoretical explanations as to why shift work could be associated with relationship quality (see 2.4.2). However, there has been very little quantitative research investigating the link between shift work and marital/relationship quality (Kalil et al., 2010). The central research on this matter is Presser (2000), who found that couples were significantly more likely to divorce or separate when fathers or mothers were working night or rotating shifts. Presser (2000) concluded that this finding was not because people in troubled marriages were more likely to move into shift work. The study was replicated and extended ten years later by Kalil et al. (2010). The new study also found an association between mothers' night shift and marriage instability. However, a study conducted by Mills & Täht (2010) showed different results: only schedules with varying (i.e. more unpredictable) hours (but not evening, night or weekend shifts) had a clear impact on partnership quality. Interestingly, the impact was negative for women and positive for men. The differences in findings may be attributed to the different cultural context – both Presser (2000) and Kalil et al. (2010) conducted their research in the U.S., whereas the study by Mills & Täht (2010) was conducted in Europe, where the working conditions and labour market regulations were more favourable and opening hours were more stringent, as Mills & Täht (2010) stated.

Importantly, given relationship quality can be conceptualized as a "couple-level" variable, experienced by both partners, further research is needed to explore this issue using couple-level data (Gareis et al., 2003). Presser (2003) found that for dual-earner couples with children under age 19, when one person (either father or mother) worked rotating shifts while the other worked day shifts, the couple had more low-quality time; and when both of them worked non-day shifts, they had more low-quality time and experienced more general marital unhappiness. Additionally, Davis et al. (2008) found that working night shifts, and having a spouse who worked night shifts, had a significant impact on marital instability. The time a couple spends together is not only dependent on individuals' work hours, but also on the couples' combined work hours. Therefore, the detrimental effect of shift work on marital quality may not be exerted by shift work itself, but rather, by the lack of synchronicity

between the work schedule of one partner and the work schedule of the other (Muurlink et al., 2014).

5.2.4 Study 2: Aims and study design

The analyses undertaken in the current chapter aim to extend and add clarity to the existing research literature, by further exploring the link between working shifts and workers' wellbeing using longitudinal data. More specifically, five time-points of data are used from a nationally representative sample of dual-earner *parents* to examine the link between shift work and workers' psychological distress, work-family conflict and relationship quality. The analyses are distinct from existing research in several ways:

First, existing studies primarily compare wellbeing between shift workers and non-shift workers (Dockery et al., 2009; Bildt & Michelsen, 2002), or between individuals who have worked shifts for longer versus shorter periods of time (Bara & Arber, 2009; Grzywacz et al., 2016). This approach of comparing wellbeing between individuals is an important starting point, but is limited in terms of providing evidence for a causal link between shift work and workers' wellbeing. It is possible that the associations found in these studies originate from unmeasured differences between individuals who *do* or *do not* work shifts (or who undertake shift work for different periods of time), rather than from the shift work itself (Allison, 2009; Hiilamo et al., 2019). Fixed effects regression models (adopted by Llena-Nozal, 2009 to investigate shift work and mental health) go some way towards overcoming this problem by using longitudinal data to track changes in shift work within the same individuals over time (*i.e. within-person changes*). However, one drawback of the fixed-effect model is that differences between individuals, which may also be of interest to researchers, are not included. The current chapter adopted a hybrid model introduced by Schunck (2013) and Schunck & Perales (2017) to allow exploration of both within- and between-person estimates to identify both changes in wellbeing in association with changes in shift work (*i.e. time-varying characteristics within-individuals*), as well as between-individual differences (*i.e. time-invariant differences between those who do or do not work shifts*).

Second, the couple-level design and the wide range of variables included in the present study allowed us to control for a greater variety of family-related and work-related factors as covariates than is commonly available. As previously mentioned in Chapter 2, a variety of contextual factors are likely to impact on the association between shift work and parental wellbeing. Past research has shown that factors such as financial hardship (Han, 2008;

Kuruvilla & Jacob, 2007) and having a young child (Presser, 2003; Mann et al., 2010; Paulson & Bazemore, 2010) may simultaneously contribute to (or co-occur with) mental health problems and working shifts. Thus, the connection between shift work and poorer wellbeing could potentially be explained by health selection – i.e. individuals who undertake shift work may be more vulnerable to mental health problems due to their pre-existing socio-economic and/or family circumstances (Han, 2008; Kuruvilla & Jacob, 2007). Moreover, shift work is often intertwined with other unfavourable working conditions (e.g. insecure work, high job demands, low flexibility), and as these job characteristics are related to mental health problems, they may also affect the link between shift work and poorer mental health (Vogel et al., 2012; Wittmer & Martin, 2010). Additionally, as shift work has the potential to impact on how individuals allocate their time between paid work and domestic responsibilities, it is quite possible that shift work will not only affect the wellbeing of workers themselves, but also have a crossover effect on their partners' wellbeing, which suggests that it is important to account for this influence (Craig & Powell, 2011). The current study takes all these factors into consideration to more accurately ascertain the nature of the relationship between shift work and workers' wellbeing.

Finally, the analyses in the current chapter also adopt three indicators of wellbeing that are all crucial for healthy family functioning – work-family conflict, psychological distress and relationship quality. Chapter 2 explained the reasoning for each of these indicators to be associated with shift work from a theoretical perspective. Moreover, Hobfoll's Conservation of Resources (COR) theory (1989) offers a theoretical guide for understanding the interrelationship of the three concepts. According to COR theory, individuals seek to acquire and maintain resources, such as objects, conditions, personal characteristics and energies. Both perceived and actual loss, as well as lack of gain, of resources could all lead to psychological stress (Hobfoll, 1989; Grandey & Cropanzano, 1999). Environmental circumstances often threaten or cause a depletion of people's resources and juggling work and family is a good example of these contextual circumstances. For example, people invest more resources when managing role conflicts between work and family, which creates more stress and results in an increase in psychological distress (Shimazu et al., 2013; Hobfoll, 1989; Grandey & Cropanzano, 1999). Meanwhile, in an effort to retain more resources in such circumstances, people may also withdraw from others (including their partners) by being less supportive and reducing interactions (Shimazu et al., 2013; Shimazu et al., 2009), and this

may lead to reduced relationship quality. This conceptualization demonstrates the links between high work-family conflict, high psychological distress and low relationship quality.

In summary, this chapter aims to more deeply investigate the association between shift work and parents' psychological distress, work-family conflict and couple relationship quality using a nationally representative sample of dual-earner parents. The study includes multiple (i.e. five) waves of data and measures both within-individual changes during the study period and time-invariant between-individual differences (by adopting within and between-effects models). The analyses control for a series of personal/family-related and work-related characteristics potentially associated with shift work to ascertain the link between shift work and wellbeing irrespective of other potential confounding factors.

5.3 Method

5.3.1 Data source

The data for this chapter is drawn from parents of young children (aged 4-5 to 12-13 years) who participated in at least two waves of Waves 3-7 of Baby cohort (B) of the Longitudinal Study of Australian Children (LSAC). We took Wave 3 as our starting point because it was the first wave when the specific information on parents' work schedules was collected. LSAC is a nationally representative longitudinal study which aims to examine the interplay of factors facilitating or impeding children's development (Sanson & Johnstone, 2004; Gray & Sanson, 2005). LSAC has been approved by Australian Institute of Family Studies Ethics Committee (Gray & Sanson, 2005; Soloff et al., 2005). Chapter 3 provides more details regarding the LSAC study design, methods and sample characteristics (also see Soloff et al., 2005). The sample in LSAC is broadly representative of all Australian families and, because LSAC includes a wide range of information about parents' labour force participation, family functioning, and parents' and children's health and wellbeing, it is a strong data source for investigating the effect of work characteristics and experiences at the family level (Sanson & Johnstone, 2004). Data has been collected biennially since 2004 (Wave 1), via face-to-face interviews (where one primary parent reported data for themselves and their partner) and self-report questionnaires. Therefore, the data used in current study was collected roughly between 2008 (Wave 3) and 2018 (Wave 7). The Wave 1 sample of the LSAC B cohort consisted of 5107 children and their families. The attrition rate, as a percentage of the Wave 1

response, was 14.1% for Wave 3, 16.9% for Wave 4, 20.0% for Wave 5, 26.3% for Wave 6, and 33.8% for Wave 7 (Usback, 2018).

5.3.2 The Study 2 sample

To address the aims of Study 2, the sample was restricted to families where the children had two resident parents and both parents were employed at the time of the data collection. The parents were required to be opposite sex couples, either married or de facto. Biological parents, step-parents, adopted parents, and foster parents were all included in the sample, but families were excluded where one of the parents reported he/she was an "unrelated person", "unrelated adult" or "boarder/housemate" in reference to their relationship with the child. Parents could be working full-time, part-time, or currently on maternity/paternity leave. However, multiple job holders were excluded to avoid confusion about their primary status as shift or non-shift workers.

To be included in the current study, parents had to have provided responses in at least two, and up to five, waves in LSAC (3.23 on average). Some families had undergone changes during the follow-up period, such as separating from a spouse or single parents re-partnering. For convenience and accuracy the couples before and after remarriage were treated as two totally different couples. Consequently, two mothers who married twice during the survey were analysed twice. Both participated in Waves 3 and 4 with the child's biological father, and also in Waves 6 and 7 with the child's stepfather. All other couples were analysed only once. In total, the analytic sample included 6190 couple observations from 1915 couples.

5.3.3 Variables and measures

Shift work: In all Waves (3-7), the parent responding in the face-to-face interview (mothers or fathers, but most often mothers) was required to report the work schedule types they and their partners worked in the main job/business. All work schedules were then categorized into two groups: *Shift work* and *Non-shift work*. A regular daytime schedule was categorized as *Non-shift work*, while all other work schedules, including a regular evening shift, a regular night shift, a rotating shift that changed from days to evenings to nights, a split shift with two distinct periods each day, on call, an irregular schedule and others, were all categorized as *Shift work*. In the analyses, we took one parent's own shift work status as the independent variable, but also controlled for the other parent's shift work status.

Psychological distress was measured across all waves using the Kessler-6 psychological distress scale, a well-validated scale for assessing and screening for mental health problems in the general population (Kessler et al., 2002). Both parents were asked in the self-report questionnaire six items about how often they had felt a range of psychological symptoms, such as nervousness and hopelessness, in the preceding four weeks. Each of these items was responded to using a 5-point scale (1 = *All of the time*; 5 = *None of the time*). In all waves the scores for each item were reverse coded and summed, such that higher scores indicated greater psychological distress and poorer mental health (range 6-30).

Work-family conflict was assessed across all waves using a 4-item, 5-point scale (1 = *Strongly disagree*, 5 = *Strongly agree*) (range 1-5) adapted from Marshall & Barnett (1993). Two items measured the degree to which work interfered with family; the other two items measured the degree to which family interfered with work. Higher scores on the scale indicated higher work-family conflict. This combined scale has been used in prior research assessing parents' work-family conflict based on data from the LSAC (Dinh et al., 2017b; Cooklin et al., 2016, 2015).

Relationship quality was consistently assessed across all waves using six items adapted from the Hendrick relationship quality scale (Hendrick, 1988). Each item has 5 points, ranging from 1=*Poorly* to 5=*Extremely well*. Higher scores represent a higher level of relationship satisfaction after two of the items were reverse coded.

Number of children, which was computed from parents' responses to the survey question that asked them to state the "number of siblings of the study child in the household".

Infant at home (i.e. child aged ≤2 years) was measured by responses to the question of "whether there was a new sibling of study child born since last wave". If the parent answered *yes*, this was coded as indicating there was an infant (≤2 years old) in the household. All other answers were coded as *No infant*.

Socioeconomic status was represented by a Z-score for the socioeconomic position of the family, relative to all families in the survey. This variable representing socioeconomic position was calculated based on occupational prestige, income and education (Baker et al., 2017). In the current study, the socioeconomic status of each family was grouped into two categories: *Higher than average* (Z>0), or *Lower than average* (Z≤0).

Age. Both parents were asked about their age at their last birthday. Parents were then classified into two groups: 40 years and under, or above 40 years old.

Share of domestic work. Both parents were asked whether or not they thought they did their fair share of the domestic tasks (housework, home maintenance, shopping and cooking). Their answers were grouped into three categories: *I do my fair share*, *I do less than my fair share* and *I do more than my fair share*.

Work hours and partners' work hours. Both parents were asked about the average hours they worked per week. Their answers were classified into three groups: *Part-time* – working under 20 hours/week, *Full-time* – working 20~40 hours/week, and *Overtime* – working over 40 hours/week.

Job quality was a count of four indicators - job flexibility, job security, job autonomy and leave access. Each of the four indicators was measured on a multiple-response scale consisting of a single question or a series of questions. Scale scores for each indicator were then categorized into binary variables based on the median score (as a cut-off point), such that a higher than median score for each variable was coded as 1=*Yes*, representing jobs that were flexible, secure, with higher autonomy and leave access. On the contrary, a lower than median score for each variable was coded as 0=*No* representing jobs that were inflexible, insecure, and had lower autonomy and leave access. Overall job quality was then calculated as the sum of the four binary *Yes*/*No* items (range 0-4).

Occupation was coded according to the Australian and New Zealand Standard Classification of Occupations (ANZSCO). All occupations were classified into eight categories: *Managers*, *Professionals*, *Technicians*, *Service workers*, *Clericals*, *Sales*, *Operators*, and *Labourers*.

5.3.4 Statistical analyses

As all parents in this study were selected to ensure they had participated in at least two waves of the LSAC, analytic approaches suitable for panel data analyses were required in order to account for the non-independence between responses by the same individual in different waves. All data was stored and analysed using STATA version 15 (StataCorp, 2017). Due to the likely gender differences in shift work, all models were fitted separately for mothers and fathers. This aligns with most studies in this area, which either analysed data from mothers and fathers separately (Dockery et al., 2009; Kalil et al., 2010), or controlled for gender in their analyses (Liu et al., 2011; Kleiner & Pavalko, 2010). For the current study, all models were fitted separately for mothers and fathers in order to capture more information on the similarities and differences between mothers and fathers.

The analyses consisted of three stages. In the first stage, to describe and compare overall differences (pooled across Waves 3-7) between shift workers and non-shift workers, population-average models were fitted to assess the association between shift work and each individual sociodemographic and work-related variable. The coefficient estimates of population-average models report the differences in the population mean of these variables between shift workers and non-shift workers, whilst treating the dependency between different responses (in different waves) from the same individuals as noise/a nuisance (Gardiner et al., 2009; Hsiao, 2003). The population-average model is based on a linear regression model, and is therefore suitable for continuous outcomes. When the outcomes were binary variables, population-average logit models, based on logistic regression models, were fitted. Outcomes that were multi-categorical variables were recoded into dummy variables (each with two levels) and then assessed through population-average logit models. As there was no explicit pattern for the within-person correlations across different waves, the working correlation structure of the models was specified as unstructured (Jang, 2011).

In the second stage, population-average models were fitted to assess the associations between shift work and each outcome variable (psychological distress, work-family conflict and relationship quality), controlling for a number of sociodemographic and work-related variables. In this way, the analyses reported the population-level association between shift work and workers' wellbeing, after taking a series of potential confounders into consideration. However, given these models cannot determine whether associations with wellbeing result from changes in work schedule, or from unmeasured differences between shift workers and non-shift workers, a final, third stage of analyses were conducted.

In this third stage, hybrid models were conducted to obtain both within-individual estimates and between-individual estimates. The within-individual estimates illustrated the within-individual association between changes in undertaking shift work and corresponding changes in wellbeing, when all time-invariant differences between workers were accounted for. The between-individual estimates illustrated how the observable and unobservable differences between individuals were associated with the differences in their wellbeing (Schunck & Perales, 2017).

5.4 Results

5.4.1 The characteristics of shift working parents

Table 5.1 shows the differences between shift working mothers and non-shift working mothers in terms of demographic and work-related characteristics (with data pooled across all waves). Compared to mothers who were not in shift work, shift working mothers were relatively younger, had more children, and were more likely to have an infant in their household. The proportion of mothers who were in a relatively lower socioeconomic position was also higher for shift workers than non-shift workers. Working shifts was not associated with mothers' share in domestic work, although it was associated with both their own work hours and their partners' work hours. Shift working mothers were significantly less likely to work long/overtime hours - in fact, 59% were working part-time as opposed to only 34% of non-shift working mothers. In most of the cases (52%) where mothers were working shifts, their partners were working over 40 hours per week. The occupational areas and job characteristics of shift working mothers were somewhat different from the non-shift working mothers. Notably, jobs requiring shift work were usually of lower quality and more often included labourers.

As shown in Table 5.2, there were also a number of differences between shift working fathers and non-shift working fathers. These patterns were somewhat distinct from the status of shift working/non-shift working mothers. Among fathers, there were no clear differences between shift workers and non-shift workers in terms of age, the number of children they had, whether or not there was an infant at home, and socioeconomic status. However, shift working fathers were more likely to report doing more than their fair share of domestic work. At the same time, compared to their non-shift working counterparts, they were also more likely to work part-time/short hours. There were no differences in their partners' work hours. Shift working fathers were more likely to be in jobs of lower quality, and were less likely to be managers, professionals and clerical persons, and more likely to be service workers and operators.

5.4.2 Population-average models for the association between shift work and wellbeing indicators

Table 5.3 illustrates the population-level estimates for the association between shift work and workers' psychological distress, work-family conflict and relationship quality for mothers and fathers. Model 1 included the workers' shift work status; Model 2 added partners' shift work; Model 3 included sociodemographic covariates; and Model 4 added work characteristics. In general, there were no significant differences between the reported wellbeing outcomes of shift workers and non-shift workers, except for fathers' work-family

conflict. Shift working fathers experienced higher work-family conflict in all models, even after accounting for all the covariates (Model 4: *Coeff*=0.05, $p<.05$). Shift work also appeared to be tenuously associated with poorer relationship quality for fathers, but the effect failed to reach significance (Model 4: *Coeff*=-0.04, $p<.10$).

5.4.3 Hybrid model (within- and between-individual effects) for shift work and wellbeing indicators

Table 5.4 shows the estimates of the between- and within-individual effects of shift work in association with the wellbeing indicators obtained from the hybrid models. As all variables in the models were time-varying, each variable had both a time-invariant between-individual effect and time-varying within-individual effect. The results of the hybrid models thus provided more information than the results of the population-average models (in addition to results for both mothers and fathers, for each indicator of wellbeing, and for each model depending on the covariates controlled for). Table 5.4 only shows the effects for the main shift work variable – see Supplementary Tables 5-10 in Appendix 6 to see the effects for the covariates included in the model. Overall, there was no effect of shift work in association with *psychological distress* – neither when individuals changed their shift work status (i.e. within-person effects), nor between shift workers and non-shift workers (i.e. between-person effects). However, shift work did appear to have some associations with mothers' and fathers' work-family conflict and relationship quality.

In terms of *work-family conflict for mothers*, the within-individual effect was not significant, suggesting that when mothers worked shifts, their work-family conflict was no different to when they did not work shifts. The between-individual effect was significant in the initial models – i.e. shift working mothers' work-family conflict score was 0.10 ~ 0.13 lower than that of non-shift working mothers across Models 1-3 (in Model 3: Between-subjects effect: *Coeff*=-0.1, $p<.05$) – until work-related variables were added into the model. This suggests the lower work-family conflict of shift working mothers, compared to non-shift working mothers, may be due to work-related factors co-occurring with shift work (e.g. more frequent part-time work). In terms of *work-family conflict for fathers*, while the results of the population-average model indicated that their work-family conflict was associated with shift work (Table 5.3), the results of the hybrid model in Table 5.4 show that this was not due to within-person differences (i.e. changes resulting from moving in and out of shift work). The between-person effect shows that similar to mothers, there was a difference in work-family

conflict between shift working and non-shift working fathers, but in contrast to the patterns of mothers, shift working fathers experienced higher levels of work-family conflict. This between-individual effect was reduced after controlling for work-related variables, from *Coeff*=0.14, $p<.001$ to *Coeff*=0.08, $p<.1$. The difference appears in part to be due to the lower quality of shift working fathers' jobs (as shown in Table 5.2), as poor job quality was also shown to have an association with fathers' work-family conflict in the hybrid model as shown in Table S8 in Appendix 6 (Between-subjects effect: *Coeff*=-0.15, $p<.001$).

The within-individual associations for *relationship quality* showed some significance for both mothers and fathers (Table 5.4). *For mothers*, the within-person effect shows that changes in shift work status were associated with changes in relationship quality, such that mothers experienced better relationship quality when they were in shift work (Models 1 and 2). However, the effect was no longer significant when sociodemographic and work-related covariates were included (Models 3 and 4), suggesting that corresponding changes in other related factors such as having an infant in the home and part-time work are driving the effect (i.e. Within-person effect of infant in the home: *Coeff*=0.07, $p<.05$; Within-person effect of part-time work: *Coeff*=0.05, $p<.05$, see Table S9 in Appendix 6). In terms of *relationship quality for fathers,* shift work showed a negative within-person association with fathers' relationship quality, and the strength of this association increased as more covariates were added to the model. It appears that the effects of the covariates mask the negative effect of shift work, and this is exposed when they are adjusted for. When all covariates were controlled for, the within-person effect showed that when fathers enter shift work, on average their relationship quality score dropped by 0.05 (Within: *Coeff*=-0.05, $p<.05$). This suggests that shift working fathers' lower relationship quality can in part be attributed to shift work itself, rather than to the individual differences between shift working and non-shift working fathers (i.e. the between-person effect was not significant through any of the models).

Table 5.1 Characteristics of shift workers and non-shift workers among mothers

		Mothers		
		Non-shift work	***Shift work***	**Total**
Total number of observations		4983 (80.50%)	1207 (19.50%)	6190 (100%)
Age[#]**	*⩽40 years of age*	2438 (48.93%)	677 (56.09%)	3115 (50.32%)
	>40 years of age	2545 (51.07%)	530 (43.91%)	3075 (49.68%)
Number of children[‡]***		2.41(±.80)	2.58 (±.93)	2.45(±.83)
Infant at home[#]***	*No*	4672 (93.76%)	1084 (89.81%)	5756 (92.99%)
	Yes	311 (6.24%)	123 (10.19%)	434 (7.01%)
Social economic status[#]*	*Lower than average*	1739 (34.90%)	506 (41.92%)	2245 (36.27%)
	Higher than average	3244 (65.10%)	701 (58.08%)	3945 (63.73%)
Share of domestic work[#]	*I do my fair share*	2249 (45.18%)	528 (43.78%)	2777 (44.91%)
	I do less than my fair share	126 (2.53%)	35 (2.90%)	161 (2.60%)
	I do more than my fair share	2603 (52.29%)	643 (53.32%)	3246 (52.49%)
Work hours[#]	*Part-time****	1688 (33.88%)	708 (58.66%)	2396 (38.71%)
	Full-time	2748 (55.15%)	413 (34.22%)	3161 (51.07%)
	*Overtime***	547 (10.98%)	86 (7.13%)	633 (10.23%)
Partner's work hours[#]	*Part-time*	136 (2.73%)	35 (2.90%)	171 (2.76%)
	Full-time	2441 (48.99%)	543 (44.99%)	2984 (48.21%)
	*Overtime***	2406 (48.28%)	629 (52.11%)	3035 (49.03%)
Job quality[‡]***		3.10 (±.91)	2.73 (±.95)	3.03 (±.93)
Occupation[#]	*Managers†*	676 (13.58%)	134 (11.13%)	810 (13.10%)
	Professionals	1908 (38.32%)	447 (37.13%)	2355 (38.09%)
	Technicians	150 (3.01%)	47 (3.90%)	197 (3.19%)
	Service Workers	519 (10.42%)	187 (15.53%)	706 (11.42%)
	Clericals†	1296 (26.03%)	234 (19.44%)	1530 (24.75%)
	Sales Workers	264 (5.30%)	77 (6.40%)	341 (5.52%)
	Operators [^]	31 (0.62%)	18 (1.50%)	49 (0.79%)
	*Labourers***	135 (2.71%)	60 (4.98%)	195 (3.15%)

[#] Number of observations (% within the column) [‡] Mean (±*SD*) of all observations † $p<0.1$; *$p<0.05$; ** $p<0.01$;***$p< 0.001$. [^] No results as too few cases

Table 5.2 Characteristics of shift workers and non-shift workers among fathers

		Fathers		
		Non-shift work	***Shift work***	**Total**
Total number of observations		5075 (81.99%)	1115 (18.01%)	6190 (100.0%)
Age[#]	*⩽40 years of age*	1844 (36.36%)	431 (38.65%)	2275 (36.77%)
	>40 years of age	3228 (63.64%)	684 (61.35%)	3912 (63.23%)
Number of children[‡]		2.44 (±81)	2.47 (±89)	2.45(±83)
Infant at home[#]	*No*	4728 (93.16%)	1028 (92.20%)	5756 (92.99%)
	Yes	347 (6.84%)	87 (7.80%)	434 (7.01%)
Social economic status [#]†	*Lower than average*	1734 (34.17%)	511 (45.83%)	2245 (36.27%)
	Higher than average	3341 (65.83%)	604 (54.17%)	3945 (63.73%)
Share of domestic work[#]	*I do my fair share*	3133 (62.35%)	683 (61.75%)	3816 (62.24%)
	I do less than my fair share	1399 (27.84%)	294 (26.58%)	1693 (27.61%)
	*I do more than my fair share**	493 (9.81%)	129 (11.66%)	622 (10.15%)
Work hours[#]	*Part-time****	94 (1.85%)	77 (6.91%)	171 (2.76%)
	Full-time	2501 (49.28%)	483 (43.32%)	2984 (48.21%)
	Over time	2480 (48.87%)	555 (49.78%)	3035 (49.03%)
Partner's work hours[#]	*Part-time*	1975 (38.92%)	421 (37.76%)	2396 (38.71%)
	Full-time	2584 (50.92%)	577 (51.75%)	3161 (51.07%)
	Over time	516 (10.17%)	117 (10.49%)	633 (10.23%)
Job quality[‡]***		3.19 (±83)	2.78 (±93)	3.12 (±86)
Occupation[#]	*Managers***	1429 (28.20%)	197(17.68%)	1626 (26.30%)
	*Professionals***	1477 (29.14%)	197 (17.68%)	1674 (27.08%)
	Technicians†	1014 (20.01%)	196 (17.59%)	1210 (19.57%)
	*Service Workers****	94 (1.85%)	233 (20.92%)	327 (5.29%)
	*Clericals****	369 (7.28%)	20 (1.80%)	389 (6.29%)
	Sales Workers	214 (4.22%)	39 (3.50%)	253 (4.09%)
	*Operators****	239 (4.72%)	162 (14.54%)	401 (6.49%)
	Labourers	232 (4.58%)	70 (6.28%)	302 (4.89%)

[#] Number of observations (% within the column) [‡] Mean (±*SD*) of all observations † $p<0.1$; *$p<0.05$; ** $p<0.01$;***$p< 0.001$

Table 5.3 Population-level responses on the association between shift work and wellbeing

Mothers								
Psychological distress (*6-30*)	*Model 1* (n[#]=6146)		*Model 2* (n=6146)		*Model 3* (n=6141)		*Model 4* (n=5995)	
	Coeff	*z*	*Coeff*	*z*	*Coeff*	*z*	*Coeff*	*z*
	0.00	0.05	0.01	0.12	0.01	0.11	-0.08	-0.85
Work-family conflict (*1-5*)	*Model 1* (n=6054)		*Model 2* (n=6054)		*Model 3* (n=6048)		*Model 4* (n=5967)	
	Coeff	*z*	*Coeff*	*z*	*Coeff*	*z*	*Coeff*	*z*
	-0.02	-1.02	-0.02	-0.90	-0.01	-0.52	0.01	0.24
Relationship quality (*1-5*)	*Model 1* (n=6135)		*Model 2* (n=6135)		*Model 3* (n=6129)		*Model 4* (n=5982)	
	Coeff	*z*	*Coeff*	*z*	*Coeff*	*z*	*Coeff*	*z*
	0.02	1.00	0.02	1.05	0.01	0.58	0.00	0.23
Fathers								
Psychological distress (*6-30*)	*Model 1* (n=6120)		*Model 2* (n=6120)		*Model 3* (n=6069)		*Model 4* (n=5878)	
	Coeff	*z*	*Coeff*	*z*	*Coeff*	*z*	*Coeff*	*z*
	0.10	1.08	0.11	1.11	0.12	1.28	0.08	0.82
Work-family conflict (*1-5*)	*Model 1* (n=6104)		*Model 2* (n=6104)		*Model 3* (n=6051)		*Model 4* (n=5925)	
	Coeff	*z*	*Coeff*	*z*	*Coeff*	*z*	*Coeff*	*z*
	0.06	2.80**	0.06	2.77**	0.07	2.88**	0.05	1.97*
Relationship quality (*1-5*)	*Model 1* (n=6153)		*Model 2* (n=6153)		*Model 3* (n=6098)		*Model 4* (n=5907)	
	Coeff	*z*	*Coeff*	*z*	*Coeff*	*z*	*Coeff*	*z*
	-0.03	-1.65†	-0.03	-1.63	-0.03	-1.72†	-0.04	-1.86†

[#]In this table, n represents number of observations

† sig at 0.1 level, * sig at 0.05 level, **sig at 0.01 level

Model 1: own shift work. Model 2: including variables in Model 1 + partner's shift work. Model 3: including variables in Model 2 + number of children, infant at home, socioeconomic status, age, share of domestic work. Model 4: including variables in Model 3 + work hours, partner's work hours, job quality and occupation

Table 5.4 Between- and within-individual associations between shift work and wellbeing

		Model 1 (n[#]=6146)		*Model 2* (n=6146)		*Model 3* (n=6141)		*Model 4* (n=5995)	
Mothers		*Coeff*	*t*	*Coeff*	*t*	*Coeff*	*t*	*Coeff*	*t*
Psychological distress (*6-30*)	Within-person shift work	-0.05	-0.49	-0.04	-0.40	-0.04	-0.40	-0.11	-1.00
	Between-person shift work	0.21	1.24	0.20	1.21	0.18	1.06	-0.01	-0.06
		Model 1 (n[#]=6054)		*Model 2* (n=6054)		*Model 3* (n=6048)		*Model 4* (n=5967)	
		Coeff	*t*	*Coeff*	*t*	*Coeff*	*t*	*Coeff*	*t*
Work-family conflict (*1-5*)	Within-person shift work	0.01	0.38	0.01	0.45	0.02	0.59	0.03	0.95
	Between-person shift work	-0.13	-2.73**	-0.12	-2.63**	-0.10	-2.11*	-0.04	-0.87
		Model 1 (n[#]=6135)		*Model 2* (n=6135)		*Model 3* (n=6129)		*Model 4* (n=5982)	
		Coeff	*t*	*Coeff*	*t*	*Coeff*	*t*	*Coeff*	*t*
Relationship quality (*1-5*)	Within-person shift work	0.04	2.07*	0.04	2.11*	0.04	1.78†	0.03	1.26
	Between-person shift work	-0.06	-1.39	-0.06	-1.36	-0.07	-1.59	-0.08	-1.84†
Fathers									
		Model 1 (n[#]=6120)		*Model 2* (n=6120)		*Model 3* (n=6069)		*Model 4* (n=5878)	
		Coeff	*t*	*Coeff*	*t*	*Coeff*	*t*	*Coeff*	*t*
Psychological distress (*6-30*)	Within-person shift work	0.14	1.23	0.15	1.31	0.16	1.42	0.16	1.40
	Between-person shift work	0.10	0.58	0.08	0.47	0.14	0.81	-0.09	-0.47
		Model 1 (n[#]=6104)		*Model 2* (n=6104)		*Model 3* (n=6051)		*Model 4* (n=5925)	
		Coeff	*t*	*Coeff*	*t*	*Coeff*	*t*	*Coeff*	*t*
Work-family conflict (*1-5*)	Within-person shift work	0.04	1.28	0.03	1.17	0.03	1.17	0.03	0.93
	Between-person shift work	0.13	3.22**	0.13	3.37***	0.14	3.60***	0.08	1.71†
		Model 1 (n[#]=6153)		*Model 2* (n=6153)		*Model 3* (n=6098)		*Model 4* (n=5907)	
		Coeff	*t*	*Coeff*	*t*	*Coeff*	*t*	*Coeff*	*t*
Relationship quality (*1-5*)	Within-person shift work	-0.04	-1.72†	-0.04	-1.72†	-0.04	-1.75†	-0.05	-2.20*
	Between-person shift work	-0.01	-0.34	-0.01	-0.25	-0.02	-0.50	0.02	0.51

[#]In this table, n represents number of observations

‡ For occupation, Managers are reference group

† sig at 0.1 level, * sig at 0.05 level, **sig at 0.01 level, ***sig at 0.001 level

Model 1: own shift work. Model 2: including variables in Model 1 + partner's shift work. Model 3: including variables in Model 2 + number of children, infant at home, socioeconomic status, age, share of domestic work. Model 4: including variables in Model 3 + work hours, partner's work hours, job quality and occupation. See supplementary tables (5-10) in Appendix 6 for the effects for covariates included in the sequential models.

5.5 Discussion

The current chapter used five waves of data from a nationally representative cohort of employed Australian mothers and fathers to examine the relationship between parents' shift work and their wellbeing over time. The results show that the relationship between shift work and wellbeing differs for Australian parents, depending on their gender, the indicator of wellbeing measured, and whether the focus is on between-person differences (i.e. shift worker vs non-shift worker) or within-person differences (i.e. changes when people move in and out of shift work).

The results showed no association between shift work and psychological distress, for either fathers or mothers. This was the case when focusing on both between-person differences and within-person change. This finding differs somewhat from prior research, including the meta-analysis results displayed in Appendix 1, which found that shift workers were 32% more likely to have mental health problems than non-shift workers (Zhao et al., 2019). However, very few studies (including the meta-analysis) have focused specifically on parents; nor have they used broadly representative samples controlling for a range of family and work-related confounders. In support of the current findings, Llena-Nozal (2009) used fixed effect regression modelling with nationally representative Australian household panel data, and similarly found no evidence that within-person changes in shift work were associated with changes in psychological distress. While the study 2 showed no association between shift work and mental health problems for parents, there was some evidence of a relationship with work-family conflict and relationship quality (aspects of wellbeing that are related to mental health).

Although the results suggest that shift work is related to work-family conflict, this association seems to be driven by between-person differences in shift and non-shift workers and their job characteristics, albeit in different ways for mothers and fathers. For mothers, the between-person effects showed that shift workers had lower work-family conflict, partly due to work-related variables such as working part-time – i.e. shift working mothers were more likely to work part-time (Table 5.1), and working part-time showed a significant between-person effect on work-family conflict in the hybrid model (Table S7 in Appendix 6, Between: *Coeff*=-0.46, $p<.001$). Interestingly, as also shown in Table 5.1, partners of shift working mothers often work overtime. Therefore, it is possible that shift working mothers in this sample were actually under-employed. They may have cut back their work hours, either voluntarily or involuntarily, and spent more time on domestic work to fulfil family needs and

allow their partners to work more hours (Landivar, 2015). As previously pointed out, these mothers may have chosen to work shifts as a strategy to balance work and family, and therefore shift work did not lead to work-family conflict for them (Hattery, 2001; Presser, 2003). In fact, the results indicate that these mothers did not feel they were doing "more than their fair share" of domestic work (as shown in Table 5.1). For fathers, consistent with prior research (e.g. Jansen et al., 2003; Davis et al., 2008; and also Study 1 in this thesis), the population average (PA) model in the current study showed that shift work was associated with higher work-family conflict after controlling for all covariates. However, the hybrid model showed that this was largely due to heterogeneity between shift working and non-shift working fathers and, primarily, the poorer job quality experienced by shift workers. This finding highlights the importance of studies investigating the impact of shift work to consider job quality and other work-related variables to minimize potential confounding. Notably, some between-individual effects remained after controlling for all covariates, suggesting that shift work is likely to be correlated with other unobserved variables associated with work-family conflict (Schunck, 2013), a finding that would be important for future research to explore.

There are some interesting possible interpretations regarding the findings for couple relationship quality. For mothers, the PA model showed no associations between shift work and relationship quality. However, careful exploration of the results suggests that this could potentially be explained by the within- and between-individual effects operating in different directions and cancelling each other out. The within-person effect initially showed that moving into shift work had a positive impact on mothers' relationship quality, although this was not significant when covariates were added. Interestingly, on the contrary, the between-person effect indicated that mothers in shift work may have a lower relationship quality compared to their non-shift working counterparts (a non-significant trend, *Coeff*=-0.08, $p<.1$ after including all the covariates). In other words, shift working mothers experienced a relatively poorer relationship quality compared to non-shift working mothers, but mothers' relationship quality improved when they moved into shift work. Moreover, it is noteworthy that this improvement had less to do with shift work itself, and more to do with other factors co-occurring with changes when moving into shift work, such as having an infant and working part-time. Given that the between-individual effect was trending toward significance, in contrast to those of Presser (2000), our results point to the possibility that engaging in shift work may be part of a deliberate strategy for some mothers to reduce couple

conflicts and improve their relationship with their partners, and that it may to some degree be effective.

Turning to fathers' couple relationship quality, the PA model showed that at a population-level, shift working fathers experienced a relatively poorer relationship quality compared to non-shift working fathers, a finding aligned with Presser's research (2000). The significant within-person results from the hybrid model suggested that this negative association is more related to being in shift work than other between-person differences. Fathers experienced a worse relationship quality when in shift work compared to the times when not in shift work, and no other individual characteristics in the model explained this association. The result potentially provides support for a causal link between shift work and relationship quality for fathers.

Overall, the findings regarding shift work and relationship quality were different for mothers and fathers, potentially because they undertake shift work for different reasons. Compared to mothers, fathers' shift work showed a stronger association with work-related variables (such as occupation), and fewer associations with demographic and family-related variables (such as the number of children, having an infant in the family, and partners' work hours). In other words, fathers' shift work is a requirement of their jobs, whereas mothers' shift work is more related to the requirements of their families. As a consequence, fathers may be less able to adjust their schedules when their relationship quality is threatened (Presser, 2000). To clarify the robustness of these interpretations, further studies examining wellbeing and job quality in association with shift work transitions are needed.

A further overall consideration is the need to understand why the current study found evidence of associations with shift work for work-family conflict and relationship quality, but not for psychological distress. This is somewhat contradictory to expectations, given all three factors are correlated and indicate broader wellbeing. One possibility is that impacts on work-family conflict and relationship quality in particular are more immediate and/or proximal, with an effect being more quickly observable than an effect on one's mental health. Alternatively, as outlined earlier, some prior research shows that the interactions between shift work and wellbeing are complex and not necessarily consistent across all wellbeing domains (Presser 2003). The current study supports the idea that there are complex trade-offs involving job quality/career, family and wellbeing, and that these are different for shift working mothers and fathers.

Strengths and Limitations

The research reported in this chapter appears to be the first study to have examined the association between shift work and wellbeing (psychological distress, work-family conflict and relationship quality) specifically for parents, using a nationally representative, longitudinal sample. By adopting hybrid modelling, the analyses carried out in Study 2 were able to use all the data available to consider the contribution made by both between-person differences in shift workers' characteristics and within-person change. Despite the strengths of the study, there are some important limitations to acknowledge. First, combining all shift work schedule types together may mask important differences between shift work types, since existing studies have shown that different schedules have different impacts on people's wellbeing. Unfortunately, the small numbers within each shift work type in the LSAC data did not allow for a robust investigation of differences between schedule types (i.e. regular vs irregular vs night shifts). Second, although the analyses included partners' work hours, schedules and basic information on their share of domestic work, these variables were broad. More specific data (e.g. from a time use survey) would shed further light on how these covariates are operating to impact shift workers. Thirdly, although the analyses made it possible to control for unmeasured time-invariant covariates, unmeasured time-varying variables may have played a role in the association between shift work and wellbeing. (Allison, 2009). Finally, while connecting (or not connecting) changes in shift work with wellbeing brings us closer to understanding the causal relationship between these factors than do cross-sectional or population-averaged studies, causality, and in particular the direction of causality, cannot be concluded from the findings of Study 2. For example, the results may be influenced by the healthy worker effect, meaning that healthy people are able to select into better quality work (i.e. non-shift working jobs) (Kröger et al., 2015). A further study focused on teasing out the bi-directional associations between shift work and parents' wellbeing is needed to move still closer, to identifying causal directions.

5.6 Conclusion

This chapter has reported on one of the first studies in the literature to use longitudinal data to consider multiple indicators of individual and family wellbeing for shift working parents. The results of the study demonstrate that shift work has different connections to wellbeing for mothers and fathers. While there were no associations with psychological distress, there were indications that shift working mothers have less work-family conflict and shift working

fathers have more, most likely because of the job and family characteristics that exist between shift workers and non-shift workers. There were also indications that for mothers, moving into shift work is associated with changes (potentially improvements) in relationship quality, while it is associated with a concurrent deterioration in relationship quality for fathers. As families continue to negotiate their working time within a global context of increasingly fractured work routines (in terms of schedules, work hours, and workplace locations), it is critical to acknowledge the complexities involved and continue to explore the potential impacts of nonstandard work hours on families and workers' wellbeing.

Chapter 6 Study 3 Poor wellbeing as a predictor of shift work transitions

6.1 Summary

The study documented in this chapter aims to gain insight into whether prior poor wellbeing (i.e. psychological distress, work-family conflict and relationship quality) might predict working parents' shift work transitions. More specifically, using longitudinal data from the Baby (B) cohort of the Longitudinal Study of Australian Children (LSAC), Study 3 examines whether high psychological distress, high work-family conflict and low relationship quality at one time point will result in working parents in Australia moving from non-shift work to shift work, or moving from shift work to non-shift work at a subsequent time point. Population-average models and population-average logit models were adopted in the analyses conducted in the study. Mothers and fathers were analysed separately. The findings suggest that mothers with high psychological distress were more likely to transition from non-shift work to shift work, while no such effect was found for fathers. However, work-family conflict and relationship quality were not found to impact on either fathers' or mothers' transitions into shift work. In terms of transitions out of shift work, none of the parental wellbeing indicators included in this study (i.e. psychological distress, work-family conflict or relationship quality) was found to predict parents' subsequent transitions out of shift work.

6.2 Introduction

People do shift work for different reasons. Some reflect choices, for instance, people may select themselves into shift work so they can work around their roles and responsibilities regarding childcare and/or care for other family members; while others work shifts out of necessity, bound by the nature of the job and the related regulations, as well as by their skill set and education level, which may restrict the jobs they are able to obtain (Presser, 2003). Regardless of the reasons people undertake shift work, as discussed throughout this thesis, there is a growing concern that shift work is associated with compromises in workers' physical and mental wellbeing. A diverse range of physical and mental health problems, such as cardiovascular diseases and depression, have been found to be linked to shift work (Moreno et al., 2019; Zhao et al., 2019). To date, rigorous research has been conducted and more convincing evidence has been provided for the negative effects of shift work on physical health (Moreno et al., 2019). In contrast, the association between shift work and mental health and wellbeing has received far less attention with many questions still unaddressed. In particular, the current chapter explores the under-investigated possibility that wellbeing might drive workers, and select them into (or out of) jobs that include shift work hours. While the opening section of the chapter introduces selection into shift work (based on mental wellbeing) as a possibility for all workers, the discussion and research analyses narrow down to focus in particular on parents, and decisions that they might make when influenced by their mental health, relationship quality and/or work-family conflict.

So far, the majority of studies investigating the relationship between shift work and wellbeing are still based on cross-sectional designs and data. The systematic review described in Chapter 2 of this thesis (Zhao et al., 2019) focused on large-scale, quantitative studies examining the association between multiple types of shift work and mental health problems, and found that around two third of the studies reviewed were cross-sectional. Although these cross-sectional studies provide important evidence regarding whether or not shift work and mental wellbeing are related,

limited information can be drawn from these studies in terms of possible casual interactions. To address this, a number of longitudinal studies have also been conducted. Some of these longitudinal studies have investigated whether shift work at a certain time point is related to mental health problems several months or years later (Bildt & Michelsen, 2002; Shields, 2002), while others have compared the mental health status of people working shifts for longer as opposed to shorter periods of time (Bara & Arber, 2009; Grzywacz et al., 2016). There are also studies measuring changes in mental health along with transitions in work schedules (De Raeve et al., 2007; Llena-Nozal, 2009). What is evident is that these cross-sectional and longitudinal studies have largely been one-directional in terms of causal hypotheses, adopting a social causation framework where the assumption is that shift work leads to changes in mental wellbeing. In contrast, far less research has investigated the possible reverse causal relationship, usually termed a "health selection effect", where pre-existing deficits in mental wellbeing are hypothesised to have a subsequent effect on people's decisions (or forced choices) regarding working shifts (De Raeve et al., 2009).

The health selection effect, or healthy worker effect, may impact on people's shift work decisions in two directions: first, as healthy people are more likely to be selected into better quality work, people with health problems may be more likely to find themselves "selected" into lower quality work, including shift work jobs. For example, having mental health problems may limit people's capacity to cope with high work demands and this may compromise their opportunities in the job market (Thielen et al., 2014), resulting in them having to put up with unfavourable job conditions, including shift work. Furthermore, people with health and wellbeing difficulties may need to take time off more frequently to visit their doctors and/or receive treatment, which may affect the hours they are able to work, such that they may not be able to work a standard daytime schedule. Although no direct evidence has been found regarding whether poorer mental wellbeing predicts (or precedes) moving into shift work, past research had supported a link between mental health problems and negative

employment consequences. A Danish study (Thielen et al., 2014) found that workers with depressive symptoms had a higher risk of increased sick leave, unemployment and work disability. Another study found that mental health problems increased the risk of becoming unemployed, as well as the duration of unemployment – suggesting that poor mental health may be a barrier to returning to the workforce (Butterworth et al., 2012).

A second possibility is that people who suffer from mental health and wellbeing problems may leave shift work as their mental health condition deteriorates. Consequently, only those who can cope better with the adverse effects of shift work will stay in these jobs, and those who become ill will drop out of shift work, leading to an underestimate of shift work's negative impact on workers' mental health in cross-sectional studies, as well as some longitudinal studies. Two studies have measured the association between having mental health difficulties and leaving shift work, and both of their samples were drawn from the Maastricht Cohort Study. One was a study by De Raeve et al. (2009), which explored the association between deterioration in mental health and subsequent changes in working time arrangements. The study showed that employees who experienced prolonged fatigue were more likely to reduce their work hours and leave a shift work job, while no effect on shift work decisions was found for employees who experienced psychological distress. However, a different study by van Amelsvoort et al. (2004), found that high levels of fatigue, the need for recovery, poor sleep quality, poor general health, insufficient leisure time and work-family conflict all predicted an increased risk of leaving shift work.

The scarcity of research in this area that explores how mental wellbeing might impact on shift work, and the dissimilarity of results in existing studies, all suggest a need for more studies to be conducted, potentially in different cultural contexts, with different definitions of shift work, and different indicators of mental wellbeing. It is critically important to examine the potential impacts of mental wellbeing on shift work decisions, as the ambiguous nature of the temporal relationship between shift work

and mental health has been a major challenge for shift work research. If people with poor mental health are indeed more likely to quit shift work, or avoid shift work in the first place, the effects of shift work may be underestimated (as studies may only include current shift workers who have a greater tolerance of shift work) (Moreno et al., 2019). On the other hand, if people with poor mental health are more likely to be in shift work, the association between shift work and mental health could be misunderstood, especially in cross-sectional studies where the time sequence is unclear, meaning that it was possibly not shift work that impacted on mental health, but rather, poor mental health that drove people into working shifts.

A possible gender difference is also an important factor to be considered. Past research on the association between shift work and mental health has often received different results for males and females (Zhao et al., 2019). For example, Bara & Arber (2009) found that shift work was related to poor mental health for both females and males; however, night shifts were shown to have a greater impact on males, while varied shifts were shown to have a greater impact on females. Gender differences regarding the impact of shift work may be attributed to the possibility that males and females undertake shift work for different reasons (Presser, 2000). As the responsibility of domestic work and childcare still more often rests on women, they may be more likely to self-select themselves into shift work to fulfil family needs. Therefore, shift work could be particularly disadvantageous for women when it clashes with family routines – as may happen to women working varied/unpredictable shifts (Moreno et al., 2019). Additionally, in terms of shift work transitions, women's tendency to put family first (and men's tendency to retain the role of breadwinner) means that it is common for them to arrange their jobs and work schedules based on family needs (Cha, 2010; Dinh et al., under review). Consequently, if they feel their family life is under threat, they may be more likely to change their schedule to reduce the pressure. Men, on the other hand, usually do shift work based on the requirements of the job, and therefore may be less likely to change their work schedules even when their family life is threatened (Presser, 2000). The results of analyses reported in the

previous chapter align with this idea. They showed that for mothers, shift work was associated with not only their own work hours, but also their partners' work hours – in other words, shift working mothers tended to work fewer hours and had a partner working overtime. Potentially these mothers reduced their work hours and worked around their partners' schedules, by working a nonstandard schedule to compensate for their partners' "absence" in family life and to fulfil family needs (Cha, 2010; Dinh et al., under review). In contrast, for fathers, there was no association shown between shift work and their partners' work hours.

Study 3: Aims, study design and analysis

Taking the above considerations into account, the study documented in this chapter aims to gain insight into a possible healthy worker effect related to shift working parents. To be specific, the chapter investigates whether or not workers' mental wellbeing (i.e. psychological distress, work-family conflict and relationship quality) at one time-point will predict their decisions moving in and out of shift work at a later time-point, using multiple time-points of data from a nationally representative sample of dual-earner *parents*. As has been argued throughout this thesis, working parents are a population who require specific attention in investigating the impacts of shift work, as fulfilling childcare needs is one of the main reasons for which parents, especially mothers, report undertaking shift work (Presser, 2003). In addition, the fact that working parents need to negotiate work-related and family-related responsibilities at the same time means they may be under increased pressure if shift work is not successful, impacting their ability to manage work and family roles, the quality of family relationships and mental health.

Study 3 investigates the possibility that for parents in regular, daytime jobs (i.e. non-shift work jobs), those who experience higher levels of psychological distress and work-family conflict or a poorer relationship quality (i.e. poorer parental wellbeing) are more likely to move into shift work rather than stay in non-shift work schedules. Conversely, the study also investigates the possibility that among shift workers, parents who experience higher levels of psychological distress and work-family

conflict or a poorer relationship quality are more likely to move out of shift work to a regular, daytime job, rather than staying in shift work schedules. Study 3 also speculates (and investigates) whether mothers, compared to fathers, are more likely to change their schedules, either moving in or moving out of shift work, based on the notion that it is more often mothers' work that changes to fit around family responsibilities and dynamics (including relationship quality and wellbeing) than fathers' work (Cha, 2010; Dinh et al., under review).

Additionally, to more accurately ascertain the nature of the relationship between parents' wellbeing and their transitions into/out of shift work, the study controlled for a series of family-related and work-related factors that potentially impact on people's work time arrangements in a subsequent wave. These factors – which include whether there is an infant at home and the share of domestic work undertaken by each parent (Presser, 2003), socioeconomic status (Han, 2008), and occupation type (ABS, 2012a) – may affect the association between parents' wellbeing and their decisions concerning shift work. It is also important to study the association between wellbeing and shift work in the family context and to take partners' wellbeing into consideration, since couples' family experiences and wellbeing are usually interrelated (Gerstorf et al., 2013), and it is not uncommon for shift work to be a decision made jointly by the couple in the best interests of the whole family (Pagnan et al., 2011). Therefore, the study only included partnered parents where both parents were working and adjusts for partners' wellbeing within analyses.

6.3 Method

6.3.1 Data source

Data for the current study is drawn from parents of young children (aged 4-5 to 12-13 years) participating in at least two consecutive waves (of Waves 3-7) of the Longitudinal Study of Australian Children (LSAC), Baby (B) cohort. The analyses took Wave 3 as the starting point because this was the first wave when specific

information on parents' work schedules was collected. As has been described in the methods chapter (Chapter 3) LSAC is a nationally representative longitudinal study which aims to examine the interplay of factors facilitating or impeding children's development (Gray & Sanson, 2005). The study has been approved by the Australian Institute of Family Studies Ethics Committee (Gray & Sanson, 2005; Soloff et al., 2005). Study design and methods are described in further detail in Chapter 3 and in technical papers about the study (e.g. Soloff et al., 2005). The LSAC sample was broadly representative of all Australian families and the study includes a wide range of information about parents' labour force participation, family functioning, and parents' and children's health and wellbeing. It is a strong data source for investigating the effect of work characteristics and experiences at the family level (Sanson & Johnstone, 2004). Data has been collected via face-to-face interviews (where one primary parent reported data for themselves and their partner) and self-report questionnaires biennially since 2004 (Wave 1). Therefore, the data used in current study was collected between 2008 (Wave 3) and 2018 (Wave 7). The Wave 1 sample of the LSAC B cohort consisted of 5107 children and their families. The attrition rate, as a percentage of the Wave 1 response, was 14.1% for Wave 3, 16.9% for Wave 4, 20.0% for Wave 5, 26.3% for Wave 6, and 33.8% for Wave 7 (Usback, 2018).

6.3.2 The Study 3 sample

The sample was restricted to families where the children had two resident opposite-sex parents, who were married or in a de facto relationship. These parents could be the study child's biological parents, step-parents, adopted or foster parents. Both parents were required to be working, either full-time, part-time, or currently on maternity/paternity leave, at the time of the data collection. The sample was then split into a father sample and a mother sample. In the father sample, those fathers who currently worked less than 20 hours per week were excluded, regardless of the mothers' work hours; and same was done for mother sample: those mothers who currently worked less than 20 hours/week were also excluded, regardless of the

fathers' work hours. These restrictions ensured that the analyses only included samples with parents who were working a high number of part-time to full-time hours in the analyses (regardless of their partners' working hours). This was done to minimise confusion between shift work and part-time work. As was found in Study 2 (Chapter 5), part-time work is more common in shift workers, particularly shift working mothers, and it is possible that parents with poor mental health might transition into a shift work job with the aim of reducing work hours. Given that the intention of the analyses was to examine the influence of parents' mental wellbeing specifically on shift work transitions, it was important to separate the influence on shift work transitions from the influence on work hours. Thus, narrowing the sample was one way of reducing the potential influence of part-time work. Multiple job holders were also excluded to avoid confusion about their primary status as shift or non-shift workers.

6.3.3 Variables and measures

Psychological distress was measured in all waves using the Kessler-6 psychological distress scale, a well-validated scale for assessing and screening for mental health problems in the general population (Kessler et al., 2002). Both parents were asked six items in the self-report questionnaire about how often they had felt a range of psychological symptoms, such as nervousness and hopelessness in the previous four weeks. Each of these items was responded to using a 5-point scale (1 = *All of the time*; 5 = *None of the time*). In all waves the scores for each item were reverse coded and summed, such that higher scores indicated greater psychological distress and poorer mental health (range 6-30). In the relevant analyses, one parent's own assessment of their psychological distress was included as the main predictor of interest (i.e. the independent variable), but in addition, the analyses also controlled for the other parent's (i.e. partner's) psychological distress assessment.

Work-family conflict was assessed across all waves using a 4-item, 5-point scale (1 = *Strongly disagree*, 5 = *Strongly agree*) (range 1-5) adapted from Marshall & Barnett

(1993). Two items measured the degree to which work interfered with family; the other two items measured the degree to which family interfered with work. Higher scores on the scale indicated higher work-family conflict. This combined scale has been used in prior research to assess parents' work-family conflict based on data from the LSAC (Dinh et al., 2017a; Cooklin et al., 2016, 2015). Both parents' reported separately on the measure of work-family conflict. In the relevant analyses, one parent's own assessment of their work-family conflict was included as the main predictor/independent variable of interest and the other parent's work-family conflict assessment was included as a covariate.

Couple relationship quality was consistently assessed across all waves using six items adapted from the Hendrick relationship quality scale (Hendrick, 1988). Each item on the scale is measured on 5 points, from 1=*Poorly* to 5=*Extremely well*. Higher scores represent higher levels of relationship satisfaction (a total scale score was calculated by summing all items after two of the negatively-worded items were reverse coded). Both parents were asked to report on these items. In the relevant analyses, one parent's own assessment of their relationship quality was taken as the main predictor/independent variable, and the other parent's relationship quality assessment was included as a covariate.

Shift work transitions. In all Waves (3-7), the parent responding in the face-to-face interview (mothers or fathers, but most often mothers) was required to report the work schedule type they and their partner worked in their main job/business. In the current study, all work schedules were then categorized into two groups: *Shift work* and *Non-shift work.* A regular daytime schedule was classified as *Non-shift work*, while all other work schedules, including a regular evening shift, a regular night shift, a rotating shift (that changes from days to evenings to nights), a split shift with two distinct periods each day, being on call, an irregular schedule and others, were all categorized as *Shift work.*

Table 6.1 shows how shift work transitions were coded in the current analyses. Given only families who participated in at least two consecutive waves were included in the

analyses, the information from two adjacent waves was combined and coded to capture transitions into and out of shift work. Parents who were in the *Shift work* group in both the current wave and previous wave were categorized into a *SW to SW* group, representing those who stayed in shift work across the two waves. Parents who were in the *Shift work* group in the current wave but had previously been in the *Non-shift work* group in the previous wave were categorized into a *Non-SW to SW* group, representing those who moved into shift work during the interval. Then, parents who were in the *Non-shift work* group in the current wave but in the *Shift work* group in the previous wave were categorized into a *SW to Non-SW* group, representing who moved out of shift work during the 2-year interval. Finally, parents who were in the *Non-shift work* group at both the current and previous waves were categorized into *Non-SW to Non-SW* group, representing those who stayed out of shift work consistently. In sum, these coding decisions created four categories representing shift work transitions across two consecutive waves (i.e. time-points spaced 2 years apart): *SW to SW, Non-SW to SW, SW to Non-SW,* and *Non-SW to Non-SW*.

Table 6.1 Measures of shift work transitions

Transition types	**Transition categories**	**Shift work status in previous wave → Shift work status in current wave**
Moving out	Moving out of shift work	*Shift work* → *Non-shift work* (coded =1)
	Staying in shift work	*Shift work* → *Shift work* (coded =0)
Moving in	Moving into shift work	*Non-shift work* → *Shift work* (coded =1)
	Staying out of shift work	*Non-shift work* → *Non-shift work* (coded =0)

In the analyses, the shift work transitions were coded as two dependent/outcome variables. To be specific, two separate analyses were conducted: 1) the first analyses explored the impact of wellbeing on whether or not parents' moved out of shift work, by comparing those who stayed in shift work (*SW to SW* = coded as 0) to those who moved out of shift work (*SW to Non-SW* = coded as 1); 2) the second analyses explored the impact of wellbeing on whether parents moved into shift work, by comparing those who stayed out of shift work (*Non-SW to Non-SW* = coded as 0) to those who moved into shift work (*Non-SW to SW* = coded as 1).

Table 6.2 provides an example of these shift work transitions, namely, how a parent's shift work status could change across the waves. As can be seen from Table 6.2, this "example" parent stayed out of shift work (i.e. *Non-SW to Non-SW*) from Wave 3 to Wave 4, moved into shift work (i.e. *Non-SW to SW*) from Wave 4 to Wave 5, then stayed in shift work (i.e. *SW to SW*) from Wave 5 to Wave 6, and moved out of shift work (i.e. *SW to Non-SW*) by Wave 7. It is worth mentioning that this is only an example and this particular transition pattern may or may not describe an actual transition pattern in the sample. Many parents in the current sample did not participate in all five waves, and as a result, only the transition patterns across the waves they participated in were captured.

Table 6.2 An example of shift work transitions across different waves

	Wave 3	**Wave 4**	**Wave 5**	**Wave 6**	**Wave 7**
Shift work status	*Non-shift work*	*Non-shift work*	*Shift work*	*Shift work*	*Non-shift work*
Shift work transitions	/	Staying out of shift work	Moving into shift work	Staying in shift work	Moving out of shift work

Infant at home (i.e. child aged ≤2 years) was measured by responses to the question of "whether there was a new sibling of study child born since last wave". If the parent answered *yes*, this was coded as indicating there was an infant (≤2 years old) in the household, while all other answers were coded as *No infant*.

Socioeconomic status was represented by a Z-score for the family's socioeconomic position, relative to that of all families in the survey. This variable representing socioeconomic position was calculated based on occupational prestige, income and education (Baker et al., 2017). In the current study, the socioeconomic status of each family was grouped into two categories: *Higher than average* (Z>0), or *Lower than average* (Z≤0).

Age. Both parents were asked about their age at their last birthday. Parents were then classified into two groups: *40 years and under*, or *Above 40 years old*.

Share of domestic work. Both parents were asked whether or not they thought they did their fair share of the domestic tasks (housework, home maintenance, shopping and cooking). Their answers were grouped into three categories: *I do my fair share*, *I do less than my fair share* and *I do more than my fair share*.

Work hours. Both parents were asked about the average hours they worked per week. Their answers were classified into three groups: *Part-time* – working under 20 hours/week, *Full-time* – working 20~40 hours/week, and *Overtime* – working over 40 hours/week. Because the analyses were limited to the main parent working over 20 hours per week (as described earlier), in each analysis the father sample consisted of fathers working full-time or overtime, while mothers worked part-time, full-time or overtime. Similarly, the mother sample consisted of mothers working full-time or overtime, while fathers worked part-time, full-time or overtime. Both parents' work hours were controlled for as covariates in the analyses.

Employment type. All working parents in the sample were asked whether they worked for an employer or for their own business. Those who reported working for an employer were then asked about their job tenure. The potential responses were: *in a permanent ongoing position, on a fixed term contract, on a casual basis*, and *on some other basis*. To simplify the model, the current chapter merged the two questions and classified these working parents' employment type into three categories: *Permanent position, Own business* and *Fixed/casual/other contracts*.

Partner's shift work status (i.e. *Shift work* or *Non-shift work*) was also taken into consideration.

Job quality was a count of four indicators - job flexibility, job security, job autonomy and leave access (i.e. the sum of four binary *Yes*/*No* items) (range 0-4).

Occupation was coded according to the Australian and New Zealand Standard Classification of Occupations (ANZSCO). All occupations were classified into eight categories: *Managers, Professionals, Technicians, Service workers, Clericals, Sales, Operators*, and *Labourers*.

6.3.4 Statistical analyses

The aim of Study 3 was to examine the association between parents' wellbeing and their decisions/outcomes concerning shift work transitions in the subsequent 2-year period. All individuals in the selected sample had participated in at least two (and up to five) consecutive waves of the LSAC database. Therefore, analytic approaches suitable for panel data analyses were required in order to account for the non-independence between responses by the same individuals in different waves. All data was stored and analysed using STATA version 15 (StataCorp, 2017). Due to the likely gender differences in shift work and wellbeing (as described in previous chapters), all models were fitted separately for mothers and fathers to provide information regarding the similarities and differences between mothers and fathers.

The analyses were conducted in two steps. First, to describe and compare overall differences (pooled across Waves 3-7) between individuals in different shift work transition groups, descriptive statistics were summarized for each covariate (sociodemographic and work-related) for mothers and fathers in each of the shift work transition groups. Population-average logit models were then fitted to assess: a) the association between each covariates (in univariate or simple models) and parents' outcomes regarding moving *out of shift work*; and b) the association between each covariate (again in univariate models) and parents' outcomes regarding moving *into shift work*. The population-average logit model is based on logistic regression models, and is appropriate when the outcome is a binary variable. The coefficient estimates of population-average logit models report the population-level differences in the predictors (or independent variables) between parents in different shift work transition groups whilst treating the dependency between different responses (in different waves) from the same individuals as noise/a nuisance (Gardiner et al., 2009; Hsiao, 2003). As there was no explicit pattern for the within-person correlations across different waves, the working correlation structure of the models was specified as unstructured (Jang, 2011).

Second, population-average logit models were fitted to assess the associations between each wellbeing indicator (psychological distress, work-family conflict and relationship quality) and parents' decisions/outcomes regarding moving out of shift work in the subsequent 2-year period, as well as the associations between these wellbeing indicators and parents' decisions/outcomes regarding moving into shift work. All sociodemographic and work-related variables included in the first step were controlled for in the second main analyses. These second analyses also controlled for the corresponding wellbeing indicators of partners. These approaches were designed to determine, at a population level, whether working parents' level of wellbeing predicted their outcomes regarding shift work transitions.

6.4 Results

6.4.1 The characteristics of parents in each shift work transition group

Table 6.3 shows the differences between mothers and fathers who stayed in shift work (across both time-points) and those who moved out of shift work, in terms of demographic and work-related characteristics in the previous wave (data was pooled across all waves). For mothers, the only significant difference between the two groups was age. Mothers who were relatively younger were more likely to stay in shift work. For fathers, no differences were found for sociodemographic characteristics between those who stayed in shift work and those who moved out of shift work, but a few work-related variables were shown to have a significant effect. Fathers in their own business (i.e. self-employed) were more likely to move out of shift work than those who were employed either in permanent or non-permanent positions. Fathers' occupation types also appeared to be different between the two groups, but as there were few cases in these occupation types, no reliable results can be drawn.

Table 6.3 Characteristics of mothers and fathers in the wave before moving out of shift work

		Mothers			Fathers		
		SW [a] *to SW*	*SW to Non-SW* [b]	Total	*SW to SW*	*SW to Non-SW*	Total
Total number of observations		140 (61.14%)	89 (38.86%)	229 (100.0%)	387 (66.38%)	196 (33.62%)	583 (100.0%)
Age[#]	*≤40 years of age*	79 (56.43%)	50 (56.18%)	129 (56.33%)	182 (47.03%)	85 (43.37%)	267 (45.80%)
	>40 years of age	61 (43.57%)	39 (43.82%)	100 (43.67%)	205 (52.97%)	111 (56.63%)	316 (54.20%)
Infant at home[#]	*No*	132 (94.29%)	79 (88.76%)	211 (92.14%)	353 (91.21%)	171 (87.24%)	524 (89.88%)
	Yes	8 (5.71%)	10 (11.24%)	18 (7.86%)	34 (8.79%)	25 (12.76%)	59 (10.12%)
Social economic status[#]	*Lower than average*	51 (36.43%)	35 (39.33%)	86 (37.55%)	181 (46.77%)	92 (46.94%)	273 (46.83%)
	Higher than average	89 (63.57%)	54 (60.67%)	143 (62.45%)	206 (53.23%)	104 (53.06%)	310 (53.17%)
Share of domestic	*I do my fair share*	58 (41.43%)	38 (42.70%)	96 (41.92%)	239 (62.24%)	119 (61.66%)	358 (62.05%)
work[#]	*I do less than my fair share*	10 (7.14%)	4 (4.49%)	14 (6.11%)	109 (28.39%)	52 (26.94%)	161 (27.90%)
	I do more than my fair share	72 (51.43%)	47 (52.81%)	119 (51.97%)	36 (9.38%)	22 (11.40%)	58 (10.05%)
Work hours[#]	*Full-time*	113 (80.71%)	73 (82.02%)	186 (81.22%)	197 (50.90%)	79 (40.31%)	276 (47.34%)
	Overtime	27 (19.29%)	16 (17.98%)	43 (18.78%)	190 (49.10%)	117 (59.69%)	307 (52.66%)
Partner's work hours	*Part-time*	5 (3.57%)	3 (3.37%)	8 (3.49%)	153 (39.53%)	82 (41.84%)	235 (40.31%)
	Full-time	81 (57.86%)	49 (55.06%)	130 (56.77%)	199 (51.42%)	92 (46.94%)	291 (49.91%)
	Overtime	54 (38.57%)	37 (41.57%)	91 (39.74%)	35 (9.04%)	22 (11.22%)	57 (9.78%)
Partner's shift work	*Non-shift work*	105 (75.00%)	64 (71.91%)	169 (73.80%)	286 (73.90%)	131 (66.84%)	417 (71.53%)
status	*Shift work*	35 (25.00%)	25 (28.09%)	60 (26.20%)	101 (26.10%)	65 (33.16%)	166 (28.47%)
Employment type[#]	*Permanent position*	106 (75.71%)	52 (58.43%)	158 (69.00%)	319 (82.43%)	112 (57.14%)	431 (73.93%)
	Own business	24 (17.14%)	29 (32.58%)	53 (23.14%)	53 (13.70%)	73 (37.24%)	126 (21.16%)
	Fixed/casual/other	10 (7.14%)	8 (8.99%)	18 (7.86%)	15 (3.88%)	11 (5.61%)	26 (4.46%)
Job quality[‡]		2.93 (±.86)	2.93 (±.89)	2.93 (±.87)	2.94 (±.86)	2.94 (±.90)	2.94 (±. 87)

Occupation[#]	*Managers*	12 (8.57%)	18 (20.22%)	30 (13.10%)	45 (11.63%)	43 (21.94%)	88 (15.09%)
	Professionals	71 (50.71%)	33 (37.08%)	104 (45.41%)	56 (14.47%)	38 (19.39%)	94 (16.12%)
	Technicians	3 (2.14%)	5 (5.62%)	8 (3.49%)	63 (16.28%)	40 (20.41%)	103 (17.67%)
	Service Workers	28 (20.00%)	15 (16.85%)	43 (18.78%)	119 (30.75%)	11 (5.61%)	130 (22.30%)[Λ]
	Clericals	9 (6.43%)	10 (11.24%)	19 (8.30%)	3 (0.78%)	4 (2.04%)	7 (1.20%)
	Sales Workers	9 (6.43%)	4 (4.49%)	13 (5.68%)	10 (2.58%)	18 (9.18%)	28 (4.80%)[Λ]
	Operators	6 (4.29%)	1 (1.12%)	7 (3.06%)	73 (18.86%)	28 (14.29%)	101 (17.32%)
	Labourers	2 (1.43%)	3 (3.37%)	5 (2.18%)	18 (4.65%)	14 (7.14%)	32 (5.49%)

[#] Number of observations (% within the column) [‡] Mean (±*SD*) of all observations **Bold for significance** [Λ] sig but convergence not achieved [a] SW: Shift work [b] Non-SW: Non-shift work

Table 6.4 shows the differences in characteristics between mothers and fathers who stayed out of shift work (across both time-points), and those who moved into shift work. No significant differences regarding demographic characteristics between the two groups were found for either mothers or fathers. With regard to work-related variables, both mothers and fathers in their own business had more chance of moving into shift work, compared to their employed counterparts working under a permanent or fixed contract. Occupation type also seemed to be relevant for both genders, but for mothers, managers were more likely to move into shift work, while for fathers, operators were more likely to move into shift work, but service workers were less likely to move into shift work. There were also some other differences between fathers and mothers. Mothers who were working overtime (more than 40 hours per week) were more likely to move into shift work within the following two years, while no such effect was found for fathers. Additionally, fathers (but not mothers) who were in relatively lower-quality jobs were more likely to move into shift work. Partners' work characteristics showed no effect on either fathers' or mothers' shift work transitions.

6.4.2 Population-average models for the associations between wellbeing indicators and subsequent shift work transition outcomes.

Tables 6.5 to 6.7 show the population-level estimates for the association between each wellbeing indicator (i.e. psychological distress in Table 6.5, work-family conflict in Table 6.6 and relationship quality in Table 6.7, respectively) and their outcomes regarding parents moving out of shift work. The same tables also display the association between these wellbeing indicators, and outcomes regarding parents moving into shift work across the subsequent two years. Model 1 included the workers' own wellbeing variable; and partners' corresponding wellbeing indicator variable was added to Model 2. Model 3 included sociodemographic covariates; and work characteristics were added to Model 4. In general, there was very little indication that different levels of wellbeing predicted subsequent shift work transitions. For fathers, none of the wellbeing indicators at Time 1 were significantly

associated with a transition either into or out of shift work at Time 2. This was the case from the initial univariate level, which only included the indicator of wellbeing (Model 1), through to the final model, which included all covariates. For mothers, there were no significant associations between work-family conflict and relationship quality and subsequent shift work transitions. However, there was a statistically significant finding for psychological distress. Mothers who had higher psychological distress were more likely to move into shift work in the following 2 years than they were to consistently remain working a non-shift work schedule (Model 4: *Coeff*=0.15, $p<.001$).

Table 6.4 Characteristics of mothers and fathers in the wave before moving into shift work

		Mothers			Fathers		
		Non-SW [b] *to Non-SW*	*Non-SW to SW* [a]	Total	*Non-SW to Non-SW*	*Non-SW to SW*	Total
Total number of observations		1650 (96.55%)	59 (3.45%)	1709 (100.0%)	2697 (93.61%)	184 (6.39%)	2881 (100.0%)
Age[#]	*≤40 years of age*	874 (52.97%)	34 (57.63%)	908 (53.13%)	1126 (41.78%)	84 (45.65%)	1210 (42.03%)
	>40 years of age	776 (47.03%)	25 (42.37%)	801 (46.87%)	1569 (58.22%)	100 (54.35%)	1669 (57.97%)
Infant at home[#]	*No*	1545 (93.75%)	56 (94.92%)	1601 (93.79%)	2460 (91.28%)	170 (92.39%)	2630 (91.35%)
	Yes	103 (6.25%)	3 (5.08%)	106 (6.21%)	235 (8.72%)	14 (7.61%)	249 (8.65%)
Social economic status[#]	*Lower than average*	479 (29.03%)	22 (37.29%)	501 (29.32%)	868 (32.18%)	85 (46.20%)	953 (33.08%)
	Higher than average	1171 (70.97%)	37 (62.71%)	1208 (70.68%)	1829 (67.82%)	99 (53.80%)	1928 (66.92%)
Share of domestic work	*I do my fair share*	787 (47.73%)	27 (45.76%)	814 (47.66%)	1679 (62.88%)	108 (59.02%)	1787 (62.64%)
	I do less than my fair share	52 (3.15%)	2 (3.39%)	54 (3.16%)	751 (28.13%)	56 (30.60%)	807 (28.29%)
	I do more than my fair share	810 (49.12%)	30 (50.85%)	840 (49.18%)	240 (8.99%0	19 (10.38%)	259 (9.08%)
Work hours[#]	*Full-time*	1389 (84.18%)	42 (71.19%)	1431 (83.73%)	1378 (51.09%)	80 (43.48%)	1458 (50.61%)
	Overtime	261 (15.82%)	17 (28.81%)	278 (16.27%)	1319 (48.91%)	104 (56.52%)	1423 (49.39%)
Partner's work hours	*Part-time*	50 (3.03%)	2 (3.39%)	52 (3.04%)	1080 (40.04%)	92 (50.00%)†	1172 (40.68%)
	Full-time	888 (53.82%)	33 (55.93%)	921 (53.89%)	1376 (51.02%)	79 (42.93%)	1455 (50.50%)
	Overtime	712 (43.15%)	24 (40.68%)	736 (43.07%)	241 (8.94%)	13 (7.07%)	254 (8.82%)
Partner's shift	*Non-shift work*	1369 (82.97%)	50 (84.75%)	1419 (83.03%)	2227 (82.57%)	145 (78.80%)	2372 (82.33%)

work status	*Shift work*	281 (17.03%)	9 (15.25%)	290 (16.97%)	470 (17.43%)	39 (21.20%)	509 (17.67%)
Employment type[#]	*Permanent position*	1319 (79.94%)	34 (57.63%)	1353 (79.17%)	2037 (75.53%)	120 (65.22%)	2157 (74.87%)
	Own business	167 (10.12%)	18 (30.51%)	185 (10.83%)	586 (21.73%)	56 (30.43%)	642 (22.28%)
	Fixed/casual/other	164 (9.94%)	7 (11.86%)	171 (10.01%)	74 (2.74%)	8 (4.35%)	82 (2.85%)
Job quality[‡]		3.31 (±.83)	3.16 (±.81)	3.30 (±.83)	3.39 (±.76)	3.1 (±.83)	3.37 (±.77)
Occupation[#]	*Managers*	249 (15.10%)	17 (28.81%)	266 (15.57%)	706 (26.22%)	43 (23.50%)	749 (26.04%)
	Professionals	724 (43.91%)	21 (35.59%)	745 (43.62%)	857 (31.82%)	41 (22.40%)	898 (31.22%)
	Technicians	44 (2.67%)	0 (0.0%)	44 (2.58%)	554 (20.57%)	35 (19.13%)	589 (20.48%)
	Service Workers	117 (7.10%)	8 (13.56%)	125 (7.32%)	35 (1.30%)	13 (7.10%)	48 (1.67%)
	Clericals	426 (25.83%)	7 (11.86%)	433 (25.35%)	213 (7.91%)	6 (3.28%)	219 (7.61%)
	Sales Workers	61 (3.70%)	2 (3.39%)	63 (3.69%)	120 (4.46%)	12 (6.56%)	132 (4.59%)
	Operators	7 (0.42%)	0 (0.0%)	7 (0.41%)	99 (3.68%)	23 (12.57%)	122 (4.24%)
	Labourers	21 (1.27%)	4 (6.78%)	25 (1.46%)	109 (4.05%)	10 (5.46%)	119 (4.14%)

[#] Number of observations (% within the column) [‡] Mean (±*SD*) of all observations. **Bold for significance** [a] SW: Shift work [b] Non-SW: Non-shift work

Table 6.5 The effect of psychological distress (6-30) on shift work transitions next wave

Mothers												
	Model 1 (n[#]=227)			*Model 2* (n=227)			*Model 3* (n=227)			*Model 4* (n=225)		
	Coeff	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*
SW→ non-SW [a]	.07	1.42	-.03 – .17	.07	1.36	-.03 – .17	.07	1.32	-.03 – .18	.07	1.33	-.04 – .19
	Model 1 (n=1695)			*Model 2* (n=1684)			*Model 3* (n=1682)			*Model 4* (n=1606)		
	Coeff	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*
Non-SW→ SW [b]	.12	3.42	.05 – .19**	.12	3.18	.04 – .19**	.12	3.28	.05 – .19**	.15	3.81	.07 – .22***
Fathers												
	Model 1 (n=578)			*Model 2* (n=574)			*Model 3* (n=568)			*Model 4* (n=556)		
	Coeff	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*
SW→ non-SW	.01	0.43	-.04 – .07	.01	0.47	-.04 – .07	.02	0.69	-.04 – .08	-.01	-0.35	-.08 – .05
	Model 1 (n=2850)			*Model 2* (n=2839)			*Model 3* (n=2813)			*Model 4* (n=2763)		
	Coeff	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*
Non-SW→ *SW*	.02	0.82	-.03 – .08	.02	0.69	-.04 – .08	.02	0.66	-.04 – .07	.01	0.20	-.05 – .07

[#]In this table, n represents number of observations

† sig at 0.1 level, * sig at 0.05 level, **sig at 0.01 level, ***sig at 0.001 level

[a] Workers who continue doing shift work as reference

[b] Workers who continue doing non-shift work as reference

Model 1: own psychological distress. Model 2: including variables in Model 1 + partner's psychological distress. Model 3: including variables in Model 2 + whether infant at home, socioeconomic status, age, share of domestic work. Model 4: including variables in Model 3 + work hours, partners' work hours, partners' shift work status, employment type, occupation and job quality.

Table 6.6 The effect of work-family conflict (1-5) on shift work transitions next wave

Mothers												
	Model 1 (n=227)			*Model 2* (n=225)			*Model 3* (n=225)			*Model 4* (n=224)		
	Coeff	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*
SW→ non-SW [a]	.05	0.26	-.32 – .42	-.06	-0.33	-.44 – .31	-.09	-0.45	-.48 – .30	.08	0.37	-.36 – .53
	Model 1 (n=1698)			*Model 2* (n=1684)			*Model 3* (n=1681)			*Model 4* (n=1613)		
	Coeff	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*
Non-SW→ SW [b]	.19	1.05	-.16 – .53	.19	1.09	-.16 – .55	.27	1.46	-.09 – .64	.26	1.35	-.12 – .64
Fathers												
	Model 1 (n=577)			*Model 2* (n=566)			*Model 3* (n=560)			*Model 4* (n=553)		
	Coeff	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*
SW→ non-SW	-.06	-0.44	-.33 – .21	-.05	-0.36	-.32 – .22	-.04	-0.29	-.32 – .24	.05	0.30	-.28 – .38
	Model 1 (n=2862)			*Model 2* (n=2820)			*Model 3* (n=2791)			*Model 4* (n=2758)		
	Coeff	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*
Non-SW→ SW	.07	0.62	-.15 – .29	.10	0.88	-.13 – .33	.10	0.87	-.13 – .34	.03	0.24	-.22 – .28

† sig at 0.1 level, * sig at 0.05 level, **sig at 0.01 level, ***sig at 0.001 level

[a] Workers who continue doing shift work as reference

[b] Workers who continue doing non-shift work as reference

Model 1: own work-family conflict. Model 2: including variables in Model 1 + partner's work-family conflict. Model 3: including variables in Model 2 + whether infant at home, socioeconomic status, age, share of domestic work. Model 4: including variables in Model 3 + work hours, employment type, occupation and job quality, partner's work hours, partners' shift work status.

Table 6.7 The effect of relationship quality (1-5) on shift work transitions next wave

Mothers												
	Model 1 (n[#]=226)			*Model 2* (n=226)			*Model 3* (n=226)			*Model 4* (n=224)		
	Coeff	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*
SW→ non-SW [a]	.38	1.75	-.04 – .81†	.41	1.59	-.10 – .93	.43	1.55	-.11 – .97	.33	1.17	-.23 – .90
	Model 1 (n=1694)			*Model 2* (n=1684)			*Model 3* (n=1681)			*Model 4* (n=1606)		
	Coeff	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*
Non-SW→ SW [b]	-.14	-0.77	-.51 – .22	.17	0.70	-.30 – .63	.16	0.69	-.30 – .63	.21	0.87	-.27 – .70
Fathers												
	Model 1 (n=581)			*Model 2* (n=576)			*Model 3* (n=570)			*Model 4* (n=558)		
	Coeff	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*
SW→ non-SW	.02	0.17	-.26 – .31	.13	0.75	-.21 – .47	.16	0.93	-.18 –.50	.10	0.52	-.29 – .50
	Model 1 (n=2862)			*Model 2 (*n=2834)			*Model 3* (n=2805)			*Model 4* (n=2762)		
	Coeff	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*	*Coeff*	*z*	*95%CI*
Non-SW→ SW	-.11	-0.88	-.34 – .13	-.01	-0.10	-.30 – .27	-.02	-0.13	-.31 – .27	-.02	-0.12	-.32 –.29

† sig at 0.1 level, * sig at 0.05 level, **sig at 0.01 level, ***sig at 0.001 level

[a] Workers who continue doing shift work as reference

[b] Workers who continue doing non-shift work as reference

Model 1: own relationship quality. Model 2: including variables in Model 1 + partner's relationship quality. Model 3: including variables in Model 2 + whether infant at home, socioeconomic status, age, share of domestic work. Model 4: including variables in Model 3 + work hours, employment type, occupation and job quality, partner's work hours and partner's shift work status.

6.5 Discussion

The study reported in this chapter investigated two possibilities regarding how a health selection effect might impact on parents' decisions/outcomes around shift work. The first possibility investigated was whether among parents working a regular, daytime schedule, those who with poorer parental/family wellbeing would be more likely to move into shift work (i.e. any type of nonstandard work schedules). This was posed both in the context of shift work being a potential escape or solution to work-family conflict and relationship problems (in particular for women), and also in terms of the restricted employment opportunities that may be available when mental health problems develop. The second possibility investigated was whether among parents working nonstandard schedules, those with poorer mental wellbeing would be more likely to move out of shift work. This was framed in terms of the possibility that only those who can cope better with the adverse effects of shift work will be able to stay in these jobs. The analyses undertaken in this chapter only found evidence for the first possibility, that is, the results supported a longitudinal relationship between poorer mental health and a subsequent transition from a non-shift work job to a shift work job, although this was only found to be the case among mothers.

When interpreting the results for the first transition that was explored, namely, transitions into shift work, it is important to remember that shift work is usually correlated with unfavourable working conditions such as low job quality and nonstandard employment. The current study controlled for a series of work characteristics including work hours, contract types and job quality, and also excluded workers who were underemployed (i.e. working less than 20 hours per week), to specifically examine whether parental wellbeing is related to shift work transitions above and beyond its association with other negative employment conditions. Therefore, the association between psychological distress and transition into shift work found here cannot be attributed to the impact of poor mental health on negative employment consequences. This potentially means that working mothers' transition into shift work subsequent to experiencing higher psychological distress was not necessarily because their job opportunities became limited. It is more likely that these working mothers made an attempt to adapt to their poorer mental health by changing their work time arrangements, although more extensive research is needed to confirm this finding. On a different note, the finding that mothers with poorer mental health were more likely to move into shift work indicates that care is needed when interpreting the significant associations between shift work and mental health in available research, especially in cross-sectional studies – such as that

conducted in Study 1 (Chapter 4) – as failing to take this into account may mean that estimates of the reverse possibility (that doing shift work causes psychological distress) may be overestimated (Park, 2016).

In contrast with previous findings (De Raeve et al., 2009; van Amelsvoort et al., 2004), this research found no evidence that poor wellbeing predicted leaving shift work. There are numerous factors, such as differences in cultural contexts, differences in wellbeing indicators adopted, specific covariates accounted for, as well as differences in follow-up periods that might explain the different findings between the current study and previous studies. In particular, Study 3 adopted a broader definition of shift work that includes all types of nonstandard work schedules, while the measures of shift work in De Raeve et al. (2009) and van Amelsvoort et al. (2004) both emphasized frequent night work. It is possible that poor mental health predicts workers leaving a night work job, but is not related to workers leaving a broad range of shift working jobs. In addition, it is noteworthy that current research focused on working parents while previous studies were conducted among more general populations. Being a parent is related to caregiving responsibilities that interplay with individuals' career decisions. There is a possibility that shift working parents with poor mental wellbeing were reluctant to leave shift work because they were concerned about the potential impact of these decisions on the financial security of their family. Further research is needed to more confidently draw conclusions on this matter.

The current study included three wellbeing indicators – psychological distress, work-family conflict and relationship quality – but only psychological distress was found to be linked to shift work transitions. While we might expect that all three of these wellbeing indicators would have the same results, the association between wellbeing and shift work transitions was in part different across the different wellbeing indicators. One potential reason for only finding evidence for psychological distress in association with a transition into shift work might be that psychological distress is more central to people's health and ability to function at work, and it therefore has a greater influence on people's decisions, compared to other slightly more distal factors, such as work-family conflict and relationship quality. The results regarding relationship quality in the current research are in line with those of Presser (2000), who examined whether people in troubled marriages were more likely to move into shift work and found this was not the case.

The results of Study 3 also partially support the idea that mothers were more likely than fathers to make work schedule transitions when experiencing poor mental wellbeing. As

stated in Chapter 2, despite the prevalence of dual-earner families in current society, fathers are still largely contained within the breadwinner role while mothers are still largely attributed the homemaker role. Fathers may think it is their primary responsibility to provide financial support to the family and ensure the family's financial security. Therefore, compared to mothers, fathers may be less willing to risk any disruptions on their employment, even when their mental health is not good. Importantly, parents' poor mental health may also have negative impacts on the family, since parental wellbeing and family functioning is interrelated (as previously stated in Chapter 2). However, fathers may have less capacity to address this negative impact than mothers, partly because they have less responsibility to maintain family functioning, and partly because it is their financial and social responsibility to maintain their current jobs. On the contrary, mothers, tend to fit their work around their family's needs. Therefore, they may be more likely to make changes in their jobs when experiencing poor wellbeing, potentially due to concerns about the impact of their wellbeing on family life.

The results of this study also suggest that the significantly higher work-family conflict and poorer relationship quality among shift working fathers found in Study 2 (Chapter 5) is not because of a health selection effect. This finding takes us one step closer to detangling the possible causal links between shift work and parental wellbeing for fathers. Study 2 (Chapter 5) also found that on a population level, shift working fathers had relatively higher work-family conflict compared to non-shift working fathers and that within-person changes in fathers shift work status was not associated with changes in work-family conflict. Both those prior results and the findings, of Study 3 together suggest that any higher levels of work-family conflict in fathers are not due either to health selection (meaning that fathers with high work-family conflict are more likely to move into shift work) or social causation (meaning that shift work leads to greater work-family conflict for fathers). These findings instead suggest that other more stable variables (i.e. between person differences) might draw together an association between fathers' shift work and work-family conflict. The current study equally found that fathers' relationship quality was not associated with their transitions either into or out of shift work. Combining this result with the findings from longitudinal analyses in reported in Chapter 5 (i.e. that fathers' within-person changes in shift work are associated with changes in relationship quality) supports the possibility that shift work may have a harmful effect on fathers' relationship quality.

Strengths and limitations

The growing trend of maternal labour force participation means that the phenomenon of "parents in dual-earner families" is becoming more and more prevalent. How these working parents combine their work and care responsibilities, and how they cooperate with their partner to keep the family functioning, are all interesting and important issues. The current study focused on the particular population of working parents in dual-earner families and conducted research in the under-investigated area of a possible health selection effect driving shift work transitions. Although it is widely acknowledged that health selection effects have a major impact on employment transitions and may thus potentially cause bias in occupational health research, few studies have measured the effect of health on employment transitions – far less than have examined the reverse causal direction. The current study is one of the very few that has investigated the association between mental wellbeing and subsequent shift work transitions among working parents. The study used a nationally representative sample to measure the association at a population level, and also took a series of potentially relevant demographic and work-related factors into consideration.

Admittedly, the study also has some important limitations: first, the dataset used in Study 3 (i.e. LSAC) only captured participants' shift work status every two years, resulting in relatively long intervals. This study defined reports of working shifts in two adjacent waves as "staying in shift work" during this period and defined reports of not working shifts in two adjacent waves as "staying out of shift work" during this period. However, it is possible that participants made additional transitions sometime between these periods. In future research, investigators should consider measuring shift work transitions using data with shorter intervals of time to capture information about shift work transitions more thoroughly and accurately.

The current research focused on population level information, so the results were relatively broad and lack more specific, detailed information. For example, this study found that at a population level, poor parental wellbeing does not predict working parents' transition out of shift work, but the study did not explore whether this finding differs across different sub-groups people and different families. Each person has his or her own reasons when making changes in their work schedules, and the current chapter did not explore these reasons in detail – either at the individual or the population level. Studies in the future should "dig deeper" into the reasoning and contexts within families (including undertaking both

qualitative research and focused quantitative research), to provide a more thorough picture of parents' wellbeing and their shift work decisions.

A further important consideration is that this study was conducted only among dual-earner parents. Although, as previously highlighted, dual-earner parents now make up a major proportion of families in contemporary society and it is particularly important to target this population, the results of this study may not be applied to other family types (e.g. couples without children, single parents), which are also increasing in prevalence. Therefore, further research is required to investigate whether or not the associations (or lack of associations) found in current study could be extended to explain parents' experience in different family types.

6.6 Conclusion

The current chapter reported on a study that examined the role that health selection (i.e. prior parental wellbeing) might play in predicting mothers' and fathers' shift work transitions. The findings showed that mothers with high psychological distress were more likely to transition from non-shift work to shift work, while no such effect was found for fathers. However, work-family conflict and relationship quality were not found to impact on either fathers' or mothers' transitions into shift work. In terms of transitions out of shift work, none of the parental wellbeing indicators included in this study (i.e. psychological distress, work-family conflict or relationship quality) was found to predict parents' subsequent transitions out of shift work.

Chapter 7 General discussion

7.1 Summary

The three studies undertaken in this thesis are all set within the broader labour force context of increasing demand for services within a 24/7 economy, which has brought about requirements for businesses and services to be available at all hours of the day (Presser, 2003). Consequently, shift work is a common reality for many workers within Australia and also around the world. Given that shift work has the potential to disrupt workers' daily routines, social interactions and circadian rhythms, it has long been a concern that shift work may compromise workers' health and wellbeing. The three studies reported in the current thesis set out to explore the association between shift work and mental wellbeing, focusing on the challenges shift work might bring to successfully negotiating both work and family responsibilities. Taking the focus of the thesis into consideration, the studies constrained the samples investigated to a specific population in the work force, namely, working parents with children under 18 (and mostly under 12), as this is the life stage where work and family responsibilities often both peak and can cause pressure. Three wellbeing indicators relevant to family functioning were examined – psychological distress, work-family conflict and couples' relationship quality. Gender differences were also explored, given the gendered division of care responsibilities in the family, and the gendered expectations that exist in the workplace (such as working long hours).

The findings of this research thesis highlight the complex interplay between shift work and the wellbeing indicators examined, and potential differences between genders. In general, the thesis provides evidence to suggest that shift work has a detrimental effect on parental wellbeing, but the effect varies across types of work schedules, different wellbeing indicators, and between mothers and fathers. There is no evidence in the findings to suggest that shift work improves family functioning or parents' wellbeing – which is also an important finding given previous hypotheses that working shifts may help parents tag-team to negotiate work and care roles better. In the following subsections, the associations (and lack of associations) between shift work and the wellbeing indicators are discussed in more detail. The strengths and limitations of this thesis are also discussed, as well as some of the implications of its findings for future research.

7.2 General findings

7.2.1 The variety across different types of work schedules

The association between shift work and parental wellbeing may be dependent to some extent on the type of shift work schedule being worked – and this was explored in the cross-sectional analyses undertaken in Study 1. The results of Study 1 showed some evidence that all types of nonstandard work schedules, including regular, rotating, and irregular shifts, are associated with compromises in parental wellbeing. However, the pathways linking these schedules to parents' mental health (as indicated by level of psychological distress) were different. Working rotating and irregular shifts were more likely to be indirectly associated with mental health (i.e. psychological distress) through increased levels of work-family conflict, although this indirect association was only found for fathers, but not mothers. Working regular shifts showed a more direct association with psychological distress, particularly for mothers, and was not related to work-family conflict.

This variety across different work schedules is understandable, considering rotating and irregular shifts have more potential to disrupt a family's daily or weekly routine, compared to more predictable regular shifts. Rotating and irregular shift workers are constantly changing the hours they work. As a result, their daily routines are constantly disrupted and it is particularly difficult for them, as well as their families, to establish family routines that promote enjoyable family time together (Fenwick & Tausig, 2004). This disruption and lack of family time may lead to work-family conflict, aligning with the finding mentioned above that increased work-family conflict is one of the pathways linking rotating and irregular shift work to poorer mental health. Several past studies have provided strong evidence regarding an association between working irregular shifts and poor mental health (Zhao et al., 2019), particularly for males (Niedhammer et al., 2015), but the association between irregular shift work and work-family conflict has rarely been measured. The findings of Study 1 in this thesis, not only support past studies in demonstrating that irregular shift work was associated with mental health, but also provide new insights into the mechanism of this association, by showing that it is potentially through increased work-family conflict that irregular shift work and mental health problems are related to each other.

In terms of whether irregular and rotating shifts differ in their potential impacts, past studies have not reached a consensus as to whether rotating shifts are similar to or distinct from irregular shifts. In some studies, researchers have conceptualized and categorized rotating

shifts as a type of "irregular schedule" (e.g. Kleiner & Pavalko, 2010; Llena-Nozal, 2009), while other scholars disagree and have argued that there are important distinctions between these types of shift work – such as the argument that rotating shift workers are usually able to predict their schedules, whereas irregular shift workers are not (Niedhammer et al., 2015). The current research thesis provided relatively similar findings for rotating and irregular shift work, suggesting that, despite potential differences in their definitions, the two types of nonstandard schedules shared similarities in terms of their association with workers' mental health. The current research supports grouping the two schedules together, as past studies have done when exploring the association between shift work and workers' wellbeing. However, given the limited research available to date, future analyses should continue to be designed to explore possible differences whenever sufficient sample sizes in each shift working category are available.

The findings of Study 1 also showed that there was no association between regular shift work and work-family conflict, possibly because the regularity of these schedules made it easier for workers and their families to adapt and maintain homeostasis in family life. Yet, regular shift work was still associated with poorer mental health, and the association was significant for both fathers and mothers, although stronger for mothers. As discussed in Chapter 4, this raises questions about adversities related to regular shift work other than work-family conflict – such as sleep-related problems, fatigue, unhealthy behaviours or obesity/being overweight/ – that may explain experiences of psychological distress for these workers (Saksvik et al., 2011).

The current thesis only explored differences in shift work schedules in the cross-sectional analyses undertaken in Study 1, where the sample size was sufficient to underpin this investigation. Examining differences in shift work schedules in longitudinal research is more complex. In longitudinal studies, there are numerous possibilities regarding the range of work schedule transitions participants might make over the study periods. For example, workers may move from not being in any type of shift work to being in any one of multiple types of shift work. Conversely, they may also move from any type of shift work to a non-shift work schedule. It is also likely that people move across different types of shift work, for example, from night shifts to weekend shifts, or from irregular shifts to rotating shifts. Additionally, there are also a number of workers who stay in the same schedule, shift work or non-shift work, throughout the whole period. This variety in the transition patterns of participants' work schedules, together with the limited number of cases in each transition type, can make it

very difficult to summarize the similarities and dissimilarities across different types of shift work in longitudinal studies. Such was the case in this thesis, where insufficient numbers changing between each of the schedule types meant that the longitudinal studies undertaken in Study 2 and Study 3, only investigated differences between non-shift workers and all shift workers (i.e. a measure that combined all workers who undertook any types of shift work), while differences across different types of shift work were not examined.

7.2.2 Variations across different wellbeing indicators

Three wellbeing indicators were included in the current thesis – psychological distress, work-family conflict and relationship quality. In the cross-sectional research (Study 1) which included both married and single parents, the focus was on work-family conflict and psychological distress. In the longitudinal research (Study 2 and Study 3), couple relationship quality was also investigated, as the studies were restricted to couples and included data from both partners. As mentioned previously in Chapter 2, existing research has established that psychological distress, work-family conflict and relationship quality are highly interrelated with each other (Cooklin et al., 2016; Borgmann et al., 2019; Yucel & Fan 2019; McTernan et al., 2016; Nigatu & Wang, 2018; Proulx et al., 2007; Goldfarb & Trudel, 2019), and all three domains can therefore be viewed as indicators, or reflections of parental wellbeing. Keeping this in mind, this thesis focused predominantly on the association between shift work and each parental wellbeing indicator separately, rather than on the interrelationship between the three wellbeing indicators. The interrelationship between work-family conflict and psychological distress was only considered in the cross-sectional research (Study 1), where the mediating effect of work-family conflict on the association between shift work and psychological distress was examined. The two longitudinal studies (Study 2 and 3) did not consider the mediating (or moderating) role of one wellbeing indicator on the association between shift work and the other wellbeing indicators, as it was reasonably hypothesised that shift work is likely to interact with all indicators in a consistent fashion (due to the established correlations across these different measures of parental wellbeing).

Despite the established interrelationships across these wellbeing indicators, there were some interesting differences in their associations with shift work. In general, relatively more evidence was found for the effect of shift work on work-family conflict and couple relationship quality, compared to the effect on the wellbeing indicator most central to people's mental health – *psychological distress*. To be specific, only in the cross-sectional

Study 1, was there some evidence that shift work was significantly associated with psychological distress. The longitudinal Study 2 found no evidence that changes in shift work status are linked to changes in psychological distress (i.e. no significant within-person differences were found). The findings of Study 1 might be explained by the longitudinal transitions investigated in Study 3, where, at least for mothers, high psychological distress predicted moving into shift work. Thus, while there is some evidence from the thesis that shift work and psychological distress are linked, there is minimal support that exposure to shift work is causally associated with subsequent distress, prompting the need for more research to examine health selection or other third variables as possible explanations.

The cross-sectional research (in Study 1) found that *work-family conflict* was significantly related to shift work, and could also mediate the association between shift work and psychological distress. But in the longitudinal analyses in Study 2, this association largely dropped to a non-significant level. Although the population-average model found that, at a population level, shift working fathers experienced higher levels of work-family conflict compared to non-shift working fathers, the results of the more rigorous hybrid model suggested that this was likely due to some of the unobservable differences between shift working and non-shift working fathers, rather than shift work itself. Lastly, the association with shift work of the third wellbeing indicator, *relationship quality*, was only examined in the longitudinal studies. Changes in shift work were found to be linked to within-individual changes in fathers' relationship quality (in Study 2). Additionally, in Study 3, neither work-family conflict nor relationship quality predicted parents' transitions into or out of shift work, suggesting that health selection does not explain any associations found earlier in Studies 1 or 2.

One interpretation of the differences in the findings across different wellbeing indicators is that, compared to psychological distress, the impacts of shift work on work-family conflict and relationship quality are more proximal or immediate, such that the effect on these indicators can be observed even when parents are in shift work for a relatively short period of time. In contrast, it may be that people typically need to be in shift work for a longer duration of time before impacts on psychological distress are observed. Similarly, it is also possible that psychological distress is affected by a greater number of intersecting factors than work-family conflict and relationship quality. Therefore, the impact of shift work alone may not be strong enough to result in significant changes. This could also explain why it was psychological distress, and not work-family conflict or relationship quality that drove

mothers' shift work decisions in study 3: if psychological distress represents a more detrimental impact on wellbeing compared to work-family conflict or relationship quality, it may be more likely to prompt people to take action (and change their working conditions).

Each individual Study chapter provides more detailed comparisons between the current findings and previous research. However in general, this thesis has provided more nuanced evidence regarding the association between shift work and parental wellbeing than is available in existing studies, having explored three indicators of parental wellbeing in both cross-sectional and longitudinal studies (including both a causation and health selection perspective). One of the most noteworthy results is the significant and potentially casual effect of shift work on fathers' relationship quality. In the past, very limited attention has been given to the possible effect of shift work on workers' couple relationships, suggesting more research in this area is warranted.

7.2.3 Variations between fathers and mothers

While there is variation in the findings, on balance, the results of the current thesis showed that shift work had a more significant effect on fathers' wellbeing compared to that of mothers. In the cross-sectional research (Study 1), shift work was found to have a direct effect (i.e. an effect independent of work-family conflict) on both fathers' and mothers' psychological distress. While the effect was significantly stronger for mothers, the longitudinal research conducted in Study 3 indicates this may have been driven by a health selection effect – such that mothers with higher levels of psychological distress are more likely to transition into shift work. In addition, the mediating effect of work-family conflict was only indicated for fathers and not mothers (although the moderating effect of gender was not quite statistically significant). For mothers, neither work-family conflict nor relationship quality was found to be related to shift work, concurrently or over time, in any direction, while for fathers, both of these wellbeing indicators showed some associations with shift work. Meanwhile, it is also noteworthy that parental wellbeing (in particular psychological distress) had the potential to promote mothers to move into shift work, but had no effect for fathers. Taken together, the findings illustrate a series of possibilities where fathers' shift work impacts their wellbeing, while mothers' wellbeing impacts decisions/opportunities around their shift work.

The data used in the current thesis did not extend to exploring the reasons why parents undertake shift work, and this is an area that requires further research before a thorough

explanation of the gender differences related to both the causes and consequences of shift work can be given. One possibility for the findings in this thesis is that, as raised in Chapter 2, fathers tend to endure the negative impacts caused by work, and are thus more reluctant to change their jobs when their mental health suffers, because they may see it as a compromise to their masculinity (Cha, 2010; Presser, 2000). This leaves fathers potentially caught in shift work even when their wellbeing suffers and mothers freer to undertake shift work when it aligns with their own and their family's needs. However, this is in part speculation, and further research is needed to understand the reasons why mothers and fathers undertake shift work and why they are able, or not able to change their work decisions based on their own and their family's wellbeing.

7.3 Strengths and limitations

This thesis has taken a holistic approach to examine the impact of shift work on parents' wellbeing using quantitative data at a population level. The three studies included in the thesis were all based on data from large-scale community samples of Australian parents that adopted validated and consistent measures of parental wellbeing, with clear definitions of shift work. The results of the thesis provide findings that are more comprehensive and likely to be more generalizable compared to past research, which has predominantly been conducted among smaller samples of parents, often within a particular demographic (e.g. new parents in the postpartum period), or within selective occupations or selective types of nonstandard work schedules. However, there are a number of important limitations that need to be acknowledged. While the limitations related to each study were listed respectively in each chapter, some more general limitations of the thesis are acknowledged below.

First, the samples included in the thesis were relatively high in terms of socioeconomic status. The Families at Work survey was conducted online, and recruitment was predominantly via social media, meaning that parents required access to the internet to participate in the survey. As a consequence, those parents with no internet access (typically those with a lower socioeconomic status), were not able to be surveyed. Additionally, although the LSAC survey is nationally representative, the research undertaken in this thesis only included dual-earner families in the analyses. These families are typically more advantaged and well-resourced compared to single-parent families and families with only one earner. This is certainly a limitation of the current thesis and limits the extent to which its findings can be generalized to

families with a lower socioeconomic status. However, from another perspective, this research can be seen as complementary to past evidence that has related shift work to experiencing financial hardship (Grzywacz et al., 2016), as the findings presented in this thesis suggest that the negative impacts of shift work on parental wellbeing are not restricted to workers with low socioeconomic status.

A second limitation, as previously mentioned, is that the sample sizes in each shift work group were not sufficient to explore differences in shift work types in the longitudinal research conducted in Study 2 and Study 3. Preliminary analyses revealed that there were neither enough changes or transitions between the individual shift work categories (i.e. regular, rotating, irregular) in the LSAC study to support conducting hybrid models to explore within- and between-person differences, nor to code the transitions to examine health selection. Differences between the shift work types, especially between shift work hours that are predictable and those that are not, remains an important area for future research.

A third limitation relates to the decision to take a holistic, yet somewhat siloed, approach to the parental wellbeing indicators examined within this thesis. An alternative approach could have been to simultaneously model all of the wellbeing indicators at one time (for example using a structural equation modelling approach). This approach would have strengthened the thesis investigation into which wellbeing indicators had the strongest association with shift work. However, given the exploratory nature of some of the analyses (i.e. virtually no research has previously examined shift work in relation to couple relationship quality for mothers and fathers) the approach taken was to examine each indicator separately to build the evidence incrementally. Also, the relatively small associations that have been found in this thesis suggests that including multiple wellbeing indicators may cause "over-adjustment" and increase the likelihood of missing potentially important nuances or clues within the data.

Finally, as stated in the previous subsection, the current thesis was not able to specifically measure or report on the reasons behind parents' decisions to undertake (or not undertake) shift work. Whether or not parents undertook shift work on a voluntary or involuntary basis would be expected to lead to different impacts on wellbeing, and this difference was not captured in the current thesis. Study 3 investigated the hypothesis that parents' wellbeing levels may predict their transitions into and out of shift work, by examining whether parents' wellbeing was related to their shift work transitions 2 years later. But as this is a significant period of time, there are limitations in linking individuals' shift work decisions to their wellbeing 2 years earlier. It is likely that other events (that were not controlled for in the

analyses) happened within the 2-year period, and that these events also impacted upon parents' decisions about moving in or out of shift work. In view of the fact that parents were not asked about the reasons, the nature, or the consequences of their shift work transitions in more detail, there is a level of uncertainty that remains in the interpretation of the findings.

7.4 Implications

7.4.1 Implications for future research

As discussed in previous chapters, in spite of the increasing prevalence of different types and ways of working (including shift work) in society today, efforts to understand the impacts on mental health and wellbeing remain limited. This thesis focused on shift working parents and examined the association between shift work and these parents' psychological distress, work-family conflict and couple relationship quality. In the future, these research questions can be expanded to include other wellbeing indicators potentially related to shift work and to explore the pathways and mechanisms through which shift work impacts on wellbeing. For example, shift work may also impact on the parent-child relationship in various ways – negatively, and perhaps also positively – given there is some evidence regarding shift working parents' and their children's wellbeing levels (Li et al., 2014; Strazdins et al., 2006). There are also potentially unexplored differences between shift workers and non-shift workers in terms of the ways they socialise and interact with both individual and family-friends. Past research has shown that shift workers can become particularly close to their colleagues (Regehr, 2005), and there are interesting questions about the impact of this close-knit workplace culture on the family – for example, whilst it may be protective for shift workers' wellbeing, does this transfer to benefits for partners' wellbeing?

The current thesis found (in the between-person differences described in the hybrid models in Study 2) that there were some differences between shift working and non-shift working fathers that were not measured or explained by the variables included in the analyses, leading to shift working fathers experiencing greater work-family conflict. Further research is required to determine what these differences are and why they are related to work-family conflict. Such information is needed to understand exactly what explains shift working fathers' higher work-family conflict, and will be important in improving shift working fathers' work-family balance and subsequently, their mental health.

As already highlighted throughout this discussion chapter, more research is needed to understand the reasons why people decide (or are pushed) to do, or not do, shift work. This thesis reported interesting findings concerning mothers' shift work and their psychological distress. Shift working mothers appeared to experience significantly greater psychological distress compared to non-shift working mothers, and mothers with higher levels of psychological distress were also more likely to move into shift work subsequently. More rigorous research should be conducted to unravel the nature of this association. As the data adopted in the present research had a 2-year gap between interview dates, future research could consider more frequent follow-ups. This would make it possible to observe more clearly how mothers' psychological distress increased and decreased corresponding with their transitions into or out of shift work, and so deepen our understanding of the direction of the causal link.

The research analyses in this thesis involved only shift working parents and only families with dual-earning parents in longitudinal research. Considering the functioning of the family is potentially different across different family types, it would be interesting to examine how shift work interplays with family functioning in other types of families, such as couples without children, and single-earner families. In addition, the same mechanisms that cause shift workers to have problems in their couple relationships might drive them to have similar problems finding a partner and/or starting a family. Difficulties with entering and maintaining a partner relationship could be explored in future research as another impact of shift work. In order to thoroughly understand the association between shift work and family life, it will be important to also study the impact of shift work on various family types and on the formation and duration of couple relationships.

7.4.2 Implications for practice

The results of current thesis provide valuable information and implications for employers, policymakers and workers themselves, as summarized below.

1) On balance, the findings indicate that shift workers are more likely to experience mental health problems. Although for mothers, this is unlikely to be due to work-family conflict, and is potentially because mothers with poorer mental health are more likely to move into shift work. For fathers, there is evidence that shift work is associated with greater work-family conflict. However, regardless of what the reasons and the causal directions are, the likelihood is that shift workers experience poorer wellbeing compared to other workers in the labour

force. Therefore, it is even more important, relative to other workers, to be aware of and have responses that address shift workers' mental health and wellbeing. Targeted resources and support needs to be provided to shift workers to both prevent and tackle mental health problems and to reduce work-family conflict. This requires joint efforts from a range of sectors at various levels, including employers, policymakers, and co-workers, with the aim of building workplaces that have the procedures to prevent poor mental health and work-family conflict, and to support workers who are experiencing poor wellbeing.

2) More attention should be given to the detrimental effect of shift work on fathers' family life and particularly on their couple relationships (as was shown to be important in the research reported here). These results highlight the importance of involving shift workers' families in attempts to protect and improve shift workers' wellbeing. Policies and programs aimed at improving shift workers' wellbeing should consider the whole family, rather than just the workers alone. Programs related to improving relationship quality may have a particular benefit for shift working fathers.

3) The final implication to be raised regarding the findings is that the wellbeing of working fathers, or potentially, workers who are the main financial contributors in the family, requires further exploration and special attention. The thesis shows some support for the notion that these family members may be more reluctant to take action to change their job conditions to protect their mental health and wellbeing, possibly because they are concerned about the impact on their family's financial wellbeing. More generally, one interpretation is that the thesis findings reflect gender differences with respect to who provides care and who works in Australia more broadly: it would seem that men or fathers are more "stuck" in the jobs they have (regardless of the quality or the impacts on their wellbeing), whereas mothers are more likely to fit their work around their family and their partners' employment. While these findings are only implied in the thesis, these gender differences (and trade-offs) continue to be a major problem in a society that locks fathers into work (and out of caregiving) and the reverse for mothers.

7.5 Conclusion

The findings of the current research thesis show that the interplay between parents' shift work, their wellbeing and their gender roles is complex. Overall, at a population level, there is evidence that shift working parents have poorer wellbeing than those who do not work shifts.

However, it is also important to recognise that the findings of this thesis are far from conclusive and that many questions remain unanswered. Overall, the results of the thesis show support for the following propositions:

1) Shift work is concurrent with greater psychological distress, and this association may in part be explained by higher work-family conflict for fathers, but not for mothers.
2) Over time, shift work is likely to have a detrimental effect on fathers' couple relationship.
3) Mothers experiencing psychological distress, compared to mothers who do not report experiencing psychological distress, are more likely to move from a non-shift work job to a shift work job after two years,.
4) Overall, fathers appeared to be more vulnerable to the negative impacts of shift work on indicators of parental wellbeing than mothers.

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Appendices

Appendix 1: The systematic review examining the association between shift work and mental health published in the *International Archives of Occupational and Environmental Health*

Appendix 2: The paper (Study 1) published in the *Journal of Family Issues*

Appendix 3: Ethical Approval for Families at Work Survey

Appendix 4: Ethical Approval for LSAC

Appendix 5: Supplementary tables of Study 1

Appendix 6: Supplementary tables of Study 2

Appendix 1

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REVIEW

Shift work and mental health: a systematic review and meta-analysis

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Abstract

Background Shift work is common. However, research findings are mixed regarding the impact of shift work on mental health. This systematic review sought to provide a comprehensive summary of existing research examining the association between different types of shift work and mental health. The review included large-scale, non-occupation-specific research.

Methods Four electronic databases PubMed, PsycINFO, Web of Science and SCOPUS were searched to identify studies that reported on the statistical association between shift work and mental health and that used population-based samples. Two reviewers extracted information about study characteristics and data on the association between shift work and mental health. A meta-analysis was performed for longitudinal studies adopting a 'broad binary' measure of shift work.

Results Thirty-three studies were included in the final review—10 cross-sectional studies, 22 longitudinal studies, and 1 study that included both. Findings were grouped based on whether the measure of shift work focussed on: (1) night/evening work, (2) weekend work, (3) irregular/unpredictable work schedule, or (4) a broad binary measure. There was a reasonable level of evidence that overall, when a broad binary measure was adopted, shift work was associated with poorer mental health—this finding was supported by the meta-analysis results. There was also some evidence that irregular/unpredictable work was associated with poorer mental health. There was less evidence for night/evening and minimal evidence for weekend work. Inconsistencies in study methodology, limited contrasting and combining the results.

Conclusions The association between shift work and mental health is different across types of shift work. The evidence is strongest for a broad binary, general measure of shift work and for irregular or unpredictable shift work. There is a need for continued research that adopts consistent and clear measures of shift work.

Keywords Shift work · Non-standard schedules · Mental health · Psychological distress · Systematic review · Meta-analysis

Introduction

The movement towards a '24/7' economy has brought about a growing demand for shift work (Presser 2003). Shift work, also known as non-standard work schedules, points to a range of working time arrangements. To date, there appears to be no single, agreed upon, definition of the specific employment conditions that constitute as 'shift work'. As a consequence, survey items used to record respondents' work schedules vary across research studies. Generally, the term 'shift work' implies that a considerable proportion of work hours fall outside the typical 8/9 am to 4/5 pm, Monday to Friday schedule (Li et al. 2014; Presser 2003). Examples of types of shift work include regular morning, afternoon, evening or night shifts, rotating shifts and irregular shifts, and split shifts. Often people who work during weekends are considered to be shift workers as well (Australian Bureau of Statistics, ABS 2012). Importantly shift work is not the same as 'overtime' or 'extended hours' (Fenwick and Tausig 2004; Presser 2003). Shift workers work at night or weekends because it is part of their prescribed work schedule, while overtime is often undertaken by choice (i.e., to catch up on job tasks).

Shift work is now very common in most countries. In Australia, data from the Working Time Arrangements

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Survey shows that in 2012, 16% of employees regularly undertook shift work in their main job (ABS 2012). The proportion is similar to UK data reporting an average of 15% across 1999–2009 (Office for National Statistics 2011). In 2010, data from the US National Health Interview Survey showed that 29% of employees did not work a regular day shift (Alterman et al. 2013). The high prevalence of shift work has led to concerns about its potential impacts on large-scale population health.

To date, a considerable body of research has investigated the effects of shift work on physical health, and the link between the two is now well established (Kecklund and Axelsson 2016). In contrast, shift work and mental health have been studied less comprehensively (Vogel et al. 2012). Mental health problems have been acknowledged as a major public health issue. The 2007 National Survey of Mental Health and Wellbeing showed that in Australia, the prevalence of any mental disorder in a 12-month period was 20%, with anxiety and affective disorders being the most common (14.4%; 6.2%) (Slade et al. 2009). Similarly, results from the 2002 National Comorbidity Survey Replication (NCS-R) in the US showed that in a 12-month period an affective/mood disorder was experienced by 9.5% of the population and an anxiety disorder was experienced by 18.1% (Kessler et al. 2005). The significant prevalence of mental health problems and associated social and economic burden (Whiteford et al. 2013) makes it vital to explore and identify the potential drivers, including non-standard work schedules.

A number of studies provide evidence of an association between shift work and poor mental health. Whilst many of these studies are small, qualitative studies focused on specific occupations, there are a growing number of population-based studies that investigate the association across employment types. For example, Niedhammer et al. (2015) ($n = 26{,}883$ men and 20,079 women) found that having an unpredictable work schedule was significantly related to higher levels of anxiety and depression. Another longitudinal research conducted by Bara and Arber (2009) using data from the British Household Panel Survey ($n = 4549$ men and 5216 women) found that shift work had a negative long-term impact on mental health, which varied according to the duration of exposure, type of shift work and gender. These brief examples demonstrate that individual study results may vary depending on the measure of shift work used, and that a systematic review would assist with summarising this complex research literature. In addition, while several reviews have been conducted on this topic, they have either been about general health more broadly [with only had limited information about mental health (i.e., Costa 1996; Vogel et al. 2012)], or have focused on specific occupations, specific shift work types and/or specific mental health symptoms (Angerer et al. 2017; Tahghighi et al. 2017).

The aim of this systematic review was to provide a comprehensive summary (i.e., reference document) of the population-based research that has examined the association between shift work and mental health. While shift work is often measured as a broad binary variable, i.e., 'Do you undertake shift work?' with an either 'yes' or 'no' response, given there are different types of shift work schedules (i.e., night work, weekend work, rotating rosters, irregular/unpredictable work, etc.), the review sought to draw attention to the research findings in each of these schedule types. The review also aimed to provide an indication of study quality for each shift work schedule investigated, and where comparable data were available, summarise the findings available using a meta-analysis. The review focused on minimising sample and occupation-specific bias, including only large-scale studies ($n > 100$) that were not occupation or organization specific.

Method

Search strategy

The review was guided by the PRISMA reporting process (Moher et al. 2009). In December 2016 (with an updated search in December 2017), four databases (PubMed, PsycINFO, Web of Science and SCOPUS) were searched to source relevant articles reporting on the statistical association between shift work and mental health. Generally, the search used the "title and abstract" field and was limited to articles in English. Terms were entered to represent shift work and mental health: (post-traumatic stress OR PTSD OR mental health OR mental ill* OR mental dis* OR psychological health OR psychological dis* OR psychiatric OR distress OR mood dis* OR depress* OR anxiety OR panic OR phobi* OR obsessive–compulsive OR OCD OR GAD) AND (shift work OR night work OR evening work OR night shift OR evening shift OR weekend work OR work schedule OR work schedules OR (nonstandard OR non-standard AND (schedule OR schedules OR work OR employment OR job)) OR (irregular AND (schedule OR schedules OR work OR employment OR job)) OR (non-traditional AND (schedule OR schedules OR work OR employment OR job))). These terms were chosen after reviewing the language used in several key articles on this topic (Li et al. 2014; Llena-Nozal 2009). Initially, there were 3547 results. 1408 of the results were identified as duplicates or correspondences, and so were excluded. Therefore, 2139 unique articles were identified.

Study selection

The study selection process is described in the flow chart in Fig. 1. First, titles and abstracts of articles were screened for eligibility. Articles were excluded if they were clearly irrelevant or ineligible based on the following criteria: not human research, not about shift work or mental health, not empirical studies, small samples ($n < 100$), or did not have comparison groups. 1869 articles were deleted at this stage, leaving 270 potentially relevant articles. Second, the full texts of these 270 articles were obtained. Articles were again excluded if no full-text version was available, or they were found to be irrelevant or ineligible (as described above), had no validated measurements for mental health, or did not report the statistical association between shift work and mental health. Occupational-specific or organizational-specific studies, and studies based on convenience samples, were also excluded at this stage. The final number of studies eligible for inclusion based on this first search was 31.

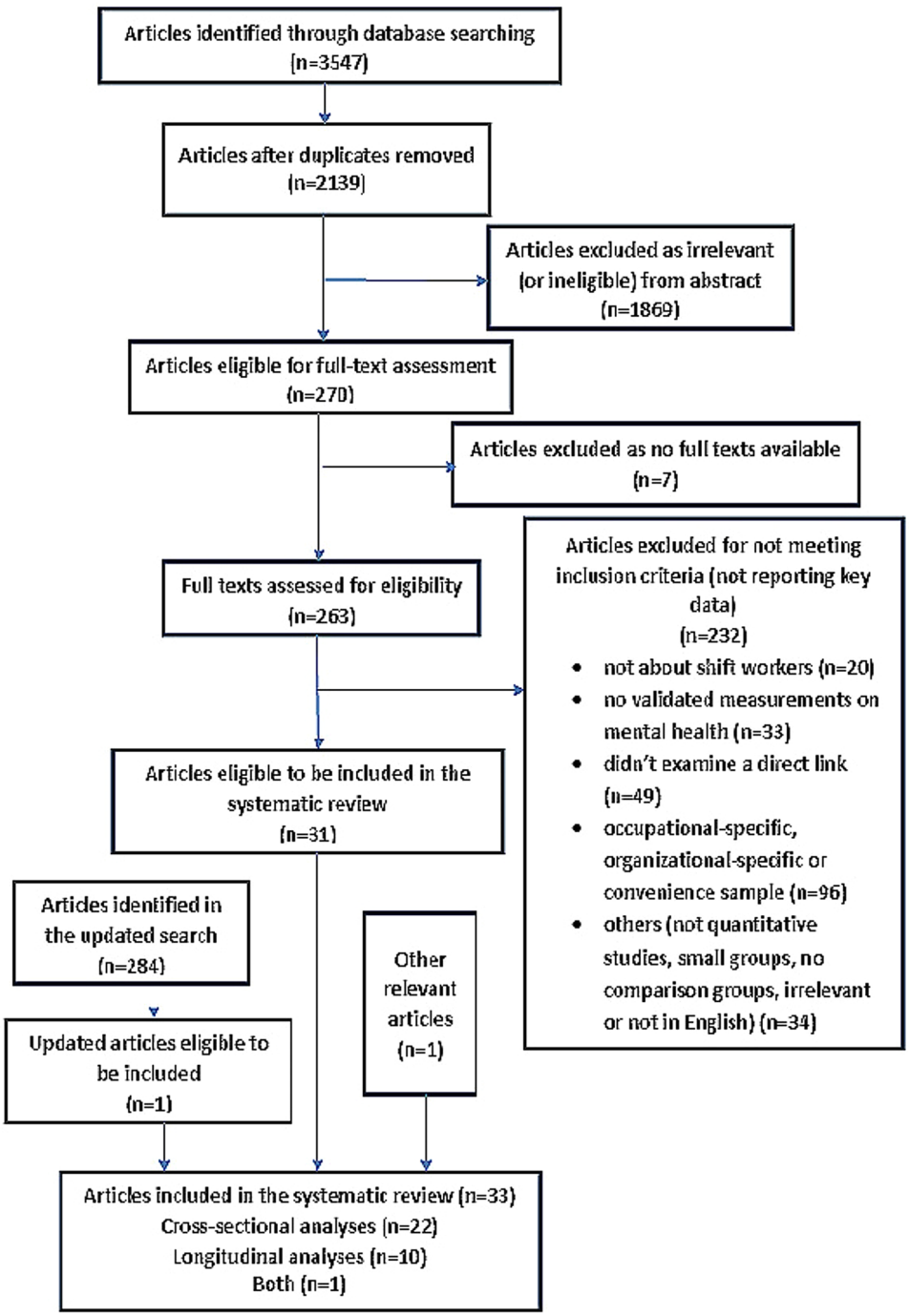

Fig. 1 Study selection and exclusion process

An updated search, which replicated the first, was conducted in December 2017 to source any relevant articles published since the first search. After deleting duplicates, 284 unique articles were identified as potentially relevant. After reviewing these articles, one additional study was included. One other relevant article was also found as part of an unrelated search. Therefore, the final number of studies included in the review was 33 (22 cross-sectional analyses, 10 longitudinal analyses and 1 study that had both cross-sectional and longitudinal analyses).

Data extraction

A standardised coding sheet was used to extract relevant data from the articles. The data to be extracted included the data source, author names, publication year, sample characteristics, study design, shift work measures, mental health measures, the variables/covariates adjusted for, and statistical estimates of the association between shift work and mental health. Data extraction was undertaken independently by two of the authors (YZ and CP). Any discrepancies were resolved through discussion to obtain a consensus.

Study quality was rated based on the Newcastle–Ottawa quality assessment scale (Wells et al. 2009). Each study was awarded one star ★ (or in some instances a half star ☆) for each criterion it fulfilled. To be specific: (1) representativeness of sample: one star for a representative sample of the general population; half star if the sample was reported to be random or somewhat representative of a specific population; no star if the representativeness was not reported. (2) Outcome measure: one star if it was based on a clinical interview or diagnosis from a medical professional or psychologists; no star for all other assessment types (all measures were validated self-assessment tools at minimum). (3) Covariate adjustment: one star if the study adjusted for both demographic and work-related covariates; half star if it adjusted for demographic covariates; no star when no covariates were included. (4) Study design: all longitudinal studies were given one extra star. (5) Outcome at baseline: one extra star was given to those longitudinal studies that considered participants' mental health problems at baseline, or examined the changes in mental health during the study period. Overall, cross-sectional studies could be awarded a total of 0–3 stars and longitudinal studies could be awarded a total of 1–5 stars. The quality of the shift work measure adopted was not rated, because all studies relied on participants' self-report of their work schedules. In addition, attrition rates were not considered as all longitudinal studies reported high follow-up rates.

Study findings were grouped into tables based on the type/measure of shift work adopted to provide an overview of the literature for each shift work type, as well as the associations between each type of shift work and mental health.

Meta-analysis

A meta-analysis was considered for each type/category of shift work, to pool the findings from the longitudinal studies included. However, often, studies did not include essential or comparable information (such as sample size, *p* value, and effect size) and therefore a meta-analysis was not possible. There was, however, sufficient information to confidently meta-analyse the findings from four of the five longitudinal studies with a broad binary measure of shift work. In these studies, the necessary information was extracted and the results for each study was converted into log odds ratios and then finally odds ratios. One longitudinal study (Llena-Nozal 2009) was omitted as it reported multiple regression coefficients, which we were not able to transform to comparable effect sizes (Aloe and Becker 2012). Meta-analyses were conducted in 'R' and a random effects model was used to account for variation between studies. 'RevMan 5' was also used to create the final forest plot displaying the results.

Results

Study characteristics

Study populations

Table 1 presents information about each study's population, sample sizes and compositions, as well as measurements of shift work and mental health. Llena-Nozal (2009) was the only study using data from multiple countries. This study analysed datasets from four nationally representative samples: The British Household Panel Survey (BHPS); The Household, Income, Labour Dynamics in Australia (HILDA) Survey; The National Population Health Survey (NPHS)—Canada; and The Swiss Household Panel (SHP). Thirteen other studies were also based on nationally representative samples, including the Longitudinal Study of Australian Children (LSAC) (Cooklin et al. 2015); the HILDA Survey (Dockery et al. 2009); the Hungarostudy 2002 in Hungary (Kopp et al. 2008); the third Korean Working Conditions Survey (KWCS) (Lee et al. 2015; Park et al. 2016); the Canadian component of an international study—GENACIS (Haines III et al. 2008); the Canadian National Longitudinal Survey of Children and Youth (Strazdins et al. 2006); NPHS in Canada (Marchand et al. 2015; Shields 2002); the Early Childhood Longitudinal Survey (ECLS) in US (Rosenbaum and Morett 2009); the US National Health and Nutrition Examination Survey (NHANES) (Wirth et al. 2017); the

Table 1 Descriptive characteristics for each study included in the systematic review

First author (year)	Study populations	Sample sizes and compositions	Shift work measure	Mental health measure	Study quality
Cross-sectional data/associations reported					
Cooklin et al. (2015)	Country/region: Australia Dataset: the Longitudinal Study of Australian Children (LSAC) Sample selection: nationally representative	$N=3243$ Gender: all male Age range: NR[†] Other criteria: fathers of infants in paid employment	(1) Works night shifts[a]: yes OR no (2) Works weekends[b]: yes OR no	Psychological distress: Kessler-6 (K-6) Cutoff point: no Timeframe: last month	★
Dockery et al. (2009)	Country/region: Australia Dataset: the Household, Income and Labour Dynamics in Australia (HILDA) Survey Sample selection: nationally representative	$N=$NR (1197 households) Gender: NR Age range: ≥15 years old Other criteria: parents of adolescents (multiple job holders excluded)	(1) Work schedules[f]: standard (regular day time) OR non-standard (regular weekend work, evening/night shift, rotating shift, split shift, other)	Mental health: subscale Short-Form General Health Survey (SF-36) Cutoff point: no Timeframe: NR (typically the past 4 weeks)	★
Haines et al. (2008)	Country/region: Canada Dataset: the Canadian component of GENACIS Sample selection: nationally representative	$N=2931$ Gender: 52.7% men and 47.3% women Age range: 43.63 ± 8.34 Other criteria: employed and working ≥20 h a week; married (or cohabiting) and having at least one child	(1) Shiftwork[f]: regular daytime schedule OR any of the other schedules (regular evening shift, regular night or graveyard shift, rotating shifts, split shifts, irregular schedule, on-call schedule)	Depression (diagnostic): the Composite International Diagnostic Interview Short-form (CIDI-SF) Cutoff point: report five symptoms (one is depressed mood or loss of interest) Timeframe: past 12 months	★★★
Joyce et al. (2013)	Country/region: West Australia Dataset: the WA Health and Wellbeing Surveillance System (HWSS) Sample selection: random sample of the population	$N=11,526$ Gender: shift workers: 65.6% male vs. 34.4% female, other employment types: 54.2% male vs. 45.8% female Age range: ≥16 years old Other criteria: not FIFO	(1) Shift worker[f]: shift workers OR workers of other employment type	Current mental health problem: self-reported as ever diagnosed by a doctor Cutoff point: yes or no Timeframe: ever	★☆
Kawabe et al. (2015)	Country/region: Japan Dataset: high-risk and population strategy for occupational health promotion (HIPOP-OHP) study (12 large companies in Japan) Sample selection: NR	$N=4427$ Gender: 3605 men and 822 women Age range: 19–69 years Other criteria: full-time workers with no physical disabilities	(1) Work type[a,d]: fixed night work OR shiftwork OR day-to-night work OR daytime work	Mental health: subscale Short-Form General Health Survey (SF-36) Cutoff point: no Timeframe: NR (typically the past 4 weeks)	☆
Kopp et al. (2008)	Country/region: Hungary Dataset: the Hungaro study 2002 Sample selection: nationally representative	$N=5863$ Gender: 3153 men and 2710 women Age range: 18–65 years Other criteria: economically active people	(1) The number of (paid and unpaid) working hours on weekend days[b]	Depression symptoms: (1) Beck Depression Score Cutoff point: no Timeframe: NR (typically past week) (2) WHO Well-Being Index (WBI-5) Cutoff point: no Timeframe: NR (typically the past 2 weeks)	★★

Table 1 (continued)

First author (year)	Study populations	Sample sizes and compositions	Shift work measure	Mental health measure	Study quality
Lee et al. (2015)	Country/region: Korea Dataset: the third Korean Working Conditions Survey (KWCS) in 2011 Sample selection: nationally representative	$N=29,711$ Gender: 59% males, 41% females Age range: NR Other criteria: self-employed workers excluded	(1) Weekend work[b]: no days of weekend work in the past month OR 1–4 days of weekend work in the past month OR > 4 days of weekend work in the past month	Depressive symptoms: WHO Well-Being Index (WBI-5) Cutoff point: < 7 defined as depressive symptoms Timeframe: past 2 weeks	★★
Marchand et al. (2003a)	Country/region: Quebec Dataset: 1998 Quebec Health and Social Survey (QHSS) Sample selection: representative of general population	$N=10,387$ Gender: 55.5% male Age range: ≥ 15 years old Other criteria: no	(1) Type of work schedule[c]: regular work schedule OR irregular work schedule	Psychological distress: ILfeld psychiatric symptoms index Cutoff point: 26.19 (last 20% of the distribution) Timeframe: past week	★★
Marchand et al. (2003b)	Country/region: Quebec, Canada Dataset: 1987 Quebec Health and Social Survey (QHSS) Sample selection: representative of general population	$N=8812$ Gender: 60.3% male Age range: ≥ 15 years old Other criteria: not alcohol abstainers or clergy	(1) Regular work schedule[c]: regular work schedules OR otherwise (alternate, irregular, on call, other)	Psychological distress: ILfeld psychiatric symptoms index Cutoff point: no Timeframe: past week	★★
Marchand et al. (2005)	Country/region: Quebec, Canada Dataset: 1998 Quebec Health and Social Survey (QHSS) Sample selection: representative of general population	$N=9501$ Gender: 43.5% female Age range: ≥ 15 years old Other criteria: employed persons	(1) Work schedule irregularity[c]: 4-point scale (never to all the time) measuring the frequency of exposure to irregular or unpredictable schedules	Psychological distress: ILfeld psychiatric symptoms index Cutoff point: no Timeframe: past week	★★
Marchand et al. (2015)	Country/region: Canada Dataset: the National Population Health Survey (NPHS) Sample selection: nationally representative	$N=5925$ Gender: 2901 women and 3024 men Age range: women, $37.3 \pm 12.2^{\#}$, men $36.7 \pm 11.8^{\#}$ Other criteria: non-obese and employed past 12 months	(1) Irregular work schedules[c]: regular OR irregular	Psychological distress: Kessler-6 Cutoff point: no Timeframe: in the last month	★
Marchand et al. (2016)	Country/region: Quebec, Canada Dataset: Salveo Study Sample selection: a random sample of 63 workplaces of the Quebec private sector	$N=1935$ Gender: 989 men and 946 women Age range: 17–70 years Other criteria: no	(1) Work schedule irregularity[c]: 4-point scale (never to all the time) measuring the frequency of exposure to irregular or unpredictable schedules	Depression symptoms: Beck Depression Inventory (BDI) Cutoff point: no Timeframe: past 2 weeks	★☆

Table 1 (continued)

First author (year)	Study populations	Sample sizes and compositions	Shift work measure	Mental health measure	Study quality
Niedhammer et al. (2015)	Country/region: France Dataset: SUMER survey Sample selection: a random sample of French employees	*N* = 46,962 Gender: 26,883 men and 20,079 women Age range: NR Other criteria: no	(1) Night work (12–5am ≥ 1 night/week)[a]: yes OR no (2) Shift work (permanent or alternating/rotating shifts, one item)[d]: yes OR no (3) Unsociable work (Sunday or Saturday ≥ 1 day/week)[b]: yes OR no (4) Predictability (time schedules for the next day, week, month and 3 months)[c]: high OR low	Depression and anxiety symptoms: the Hospital Anxiety and Depression (HAD) scale Cutoff point: no Timeframe: NR (typically the past week)	★☆
Park et al. (2016)	Country/region: Korea Dataset: the third Korean Working Conditions Survey (KWCS) in 2011 Sample selection: nationally representative	*N* = 50,032 Gender: 58.2% male, 41.8% female Age range: ≥ 15 years old Other criteria: native employees	(1) Shift work[f]: yes OR no	Depressive symptoms: WHO Well-Being Index (WBI-5) Cutoff point: ≤ 12 high-risk status for depression Timeframe: past 2 weeks	★★
Rosenbaum and Morett (2009)	Country/region: US Dataset: the Early Childhood Longitudinal Survey, Birth Cohort (ECLS-B) Sample selection: nationally representative	*N* = NR Gender: 50% male, 50% female Age range: mothers ≥ 15 years old Other criteria: mothers and resident fathers of infants in dual-earner families	(1) Joint work schedules[e]: both parents work standard day shifts OR one or both parents work a non-standard shift (i.e., evening, night, rotating, split, or other shift)	Paternal and maternal depression: the Center for Epidemiologic Studies Depression Scale (CES-D) Cutoff point: no Timeframe: NR (typically past 7 days)	★
Strazdins et al. (2006)	Country/region: Canada Dataset: Canadian National Longitudinal Survey of Children and Youth, Cycle 2 Sample selection: nationally representative	*N* = 4306 households Gender: for work schedules, 50% male, 50% female; but for mental health, 90.2% mother, 7.5% father Age range: ≥ 15 years old Other criteria: parents in dual-earner households	(1) Joint work schedule[e]: both standard OR father non-standard OR mother non-standard OR both non-standard	Parent depressive symptoms: the Center for Epidemiologic Studies Depression Scale (CES-D) Cutoff point: no Timeframe: past week	★★
Takada et al. (2009)	Country/region: Japan Dataset: 116 business establishments Sample selection: 1509 business establishments in 11 cities and districts across Japan were invited to participate	*N* = 4118 Gender: 2834 men, 1284 women Age range: men 42.3 ± 11.11[#], women 41.9 ± 11.52 Other criteria: excluded if being treated by psychiatrist	(1) Working on holidays per month[b] (as an additional index of overtime work): none OR 1–2 days OR 3–4 days OR > 4 days	Depression: the Center for Epidemiologic Studies Depression Scale (CES-D) Cutoff point: ≥ 16 high depressive symptoms Timeframe: past week	★

Table 1 (continued)

First author (year)	Study populations	Sample sizes and compositions	Shift work measure	Mental health measure	Study quality
Takahashi et al. (2011)	Country/region: Japan Dataset: NR Sample selection: random sample from a market research panel	*N* = 4280 Gender: 2513 men and 1767 women Age range: 20–59 years Other criteria: no	(1) Work schedules[f]: permanent daytime workers OR shift workers (shift work involving night shifts, shift work without night shifts, and permanent night shifts)	Depressive symptoms: the Center for Epidemiologic Studies Depression Scale (CES-D) Cutoff point: no Timeframe: past week	★☆
Takusari et al. (2011)	Country/region: Northern Japan Dataset: 17 business establishments Sample selection: NR	*N* = 3233 Gender: 2442 males, 791 females Age range: men 40.47 ± 11.42[#], women 38.71 ± 10.53 Other criteria: medium-sized business establishments	(1) Working hour distribution[a]: day dominant OR day/night mixed shift pattern OR night dominant (2) Working schedule irregularity[c]: regular OR Irregular (3) Shift work[f]: yes OR no	Common mental disorder (CMD): the Japanese 12-item version of the General Health Questionnaire (GHQ-12) Cutoff point: ≥ 3 defined as CMD Timeframe: NR (typically 'current' symptoms)	★
Vallieres et al. (2014)	Country/region: Canada Dataset: NR Sample selection: (1) 209 shift workers from a random sample of general population of Canada (51 night workers and 158 rotating shift workers) (2) 209 matched paired day workers representative of the overall day worker participants	*N* = 418 Gender: 49% male, 51% female Age range: 19–68 years Other criteria: no	(1) Work schedules[a,d]: night work OR rotating work OR day work	(1) Mental health: Subscale SF-12 Health Survey Cutoff point: no Timeframe: NR (typically past 4 weeks) (2) Depressive symptoms: Beck Depression Inventory Cutoff point: no Timeframe: past week (3) State and trait anxiety: State-Trait Anxiety Inventory Cutoff point: no Timeframe: NR (typically current OR stable)	☆☆
van de Ven et al. (2016)	Country/region: The Netherlands Dataset: "Shift Your Work" study Sample selection: NR	*N* = 441 Gender: 93.2% male Age range: 44.81 ± 8.67[#] Other criteria: shift workers of nine different industrial companies with semi- (excluding weekends) and full continuous (including weekends)	Shift schedule characteristics:[b,d] (1) consecutive shifts: ≤ 2 OR 3–4 OR ≥ 5 (2) Early starts: ≥ 7:00 h OR < 7:00 (3) Consecutive days: ≤ 5 OR ≥ 6 (4) Direction of rotation: forward OR backward (5) Weekends off: > 10.4 OR ≤ 10.4 (6) Recovery days: ≤ 2 OR 3 OR ≥ 4 (7) Rest days: ≥ 1 OR < 1. Hours worked per week ≤ 35 OR > 35	Mental health: Subscale SF-12 Health Survey Cutoff point: no Timeframe: NR (typically past 4 weeks)	☆

Table 1 (continued)

First author (year)	Study populations	Sample sizes and compositions	Shift work measure	Mental health measure	Study quality
Wirth et al. (2017)	Country/region: US Dataset: US National Health and Nutrition Examination Survey (NHANES) Sample selection: nationally representative	$N=7434$ Gender: 49% male, 51% female Age range: 46.9 ± 0.7 Other criteria: employed in regular day, evening, night, rotating shifts	(1) Shift Work[a,d,f]: regular daytime OR night or evening shifts OR rotating (night/evening and rotating shift are also combined in the analyses)	Depressive symptomatology: Patient Health Questionnaire (PHQ-9) Cutoff point: ≥ 10 (≥ 5 and ≥ 15) Timeframe: NR (typically during the last 2 weeks)	★☆
Longitudinal data/associations reported					
Bara and Arber (2009)	Country/region: Britain Dataset: British Household Panel Survey (BHPS) Sample selection: nationally representative	$N=9765$ Gender: 4549 men and 5216 women Age range: 21–73 years in 2005 Other criteria: employed ≥ 1 year between 1995–2005	(1) Night shifts (number of years)[a]: 0 OR 1 OR 2–3 OR 4–10 (2) Varied shifts (number of years)[c]: 0 OR 1 OR 2–3 OR 4–10	Mental ill health (measured at 1995 and 2005): General Health Questionnaire (GHQ-12) Cutoff point: ≥ 4 Timeframe: NR (typically 'current' symptoms)	★★★★
Bildt and Michelsen (2002)	Country/region: Stockholm, Sweden Dataset: REBUS study Sample selection: randomly selected at 1969	$N=420$ Gender: 222 women and 198 men Age range: 46–63 years old in 1997 Other criteria: people who participated in the 1997 follow-up	(1) Shift work (measured at 1993)[f]: daytime OR all other working times	(1) Sub-clinical depression (measured at 1997): Swedish Nottingham life-quality questionnaire Cutoff point: 75th percentile Timeframe: NR (typically present state) (2) Psychological well-being: General Health Questionnaire (GHQ-12) Cutoff point: 75th percentile Timeframe: NR (typically current symptoms)	★★★☆
Carlson et al. (2011)	Country/region: Forsyth County, North Carolina, US Dataset: all births in the county in a given time period Sample selection: a random sample	$N=179$ Gender: all female Age range: ≥ 18 years old Other criteria: working ≥ 30 h/week, and planning on returning to work ≥ 30 h by 4 months postpartum	(1) Non-standard work schedules (measured at 4 months postpartum)[f]: standard (8 am–5 pm) OR non-standard	Mental health (measured at 8 months postpartum): mental component score from SF-12 Health Survey Cutoff point: no Timeframe: NR (typically past 4 weeks)	★☆
De Raeve et al. (2007)	Country/region: Maastricht, Netherlands Dataset: Maastricht Cohort study Sample selection: NR	$N=4861$ Gender: all male Age range: NR Other criteria: work 36–40 h/week; excluded those with multiple jobs or psychological distress at baseline	(1) Work schedules[f]: day work → day work OR shift work → day work OR shift work → shift work OR day work → shift work	Psychological distress case: General Health Questionnaire (GHQ-12) Cutoff point: ≥ 4 Timeframe: NR (typically 'current' symptoms)	★★★

Table 1 (continued)

First author (year)	Study populations	Sample sizes and compositions	Shift work measure	Mental health measure	Study quality
Driesen et al. (2011)	Country/region: Maastricht, Netherlands Dataset: Maastricht Cohort study Sample selection: NR	$N=6073$ Gender: 4474 men and 1569 women Age range: NR Other criteria: completed 10-year follow-up. Excluded if working < 26 h/week, multiple jobs, pregnant, absent, not working night shifts, depressed baseline	(1) Shift work[f]: former or/and current shift workers OR never shift workers	Depressive disorder: whether a depressive disorder is present and being treated Cutoff point: yes or no Timeframe: ever	★★★☆
Grzywacz et al. (2016)	Country/region: US Dataset: the Women, Work and Wee Ones project Sample selection: NR	$N=253$ Gender: all female Age range: NR Other criteria: delivered a live birth in past 3 months, intended to return to work ≥ 27 h/week, and household earnings within 185% of poverty thresholds	(1) Evening/night schedule (measured at 3, 6 and 9 months postpartum)[a]: number of occasions worked an evening/night schedule (2) Irregular work schedule (measured at 3, 6 and 9 months postpartum[c]: number of occasions worked with an irregular schedule	Depressive symptoms (at months 6, 9 months): the Center for Epidemiologic Studies Depression Scale (CES-D) Cutoff point: no Timeframe: NR (typically past 7 days)	★☆
Kleiner and Pavalko (2010)	Country/region: US Dataset: National Longitudinal Survey of Youth 1979 (at age 40) Sample selection: nationally representative	$N=5341$ Gender: 48% female Age range: 38.42 ± 0.57 Other criteria: employed	(1) Night shifts (measured at time 1, prior to aged 40) [a]: fixed night schedule OR day/evening/irregular schedule (2) Irregular (measured at time 1, prior to aged 40)[c]: rotating/irregular schedule OR fixed day/evening/night/split shift	(1) Mental health (at time 2, after aged 40): Subscale SF-12 Health Survey Cutoff point: no Timeframe: NR (typically past 4 weeks) (2) Psychological distress: the Center for Epidemiologic Studies Depression Scale (CES-D) Cutoff point: no Timeframe: NR (typically past 7 days)	★★★

Table 1 (continued)

First author (year)	Study populations	Sample sizes and compositions	Shift work measure	Mental health measure	Study quality
Llena-Nozal (2009)	Country/region: UK, Australia, Canada, Switzerland Dataset: British Household Panel Survey (BHPS), Household, Income, Labour Dynamics in Australia (HILDA), The National Population Health Survey (NPHS), Swiss Household Panel (SHP) Sample selection: nationally representative	*N* = NR Gender: NR Age range: 15–64 years Other criteria: individuals who are studying or retired are excluded. Only individuals with complete labour market and health histories and present for at least three consecutive waves are included	(1) Transition to shift work[f]: (in Australia, Switzerland and UK): individuals who transitioned to shift work OR who did not (2) Transition from shift work (in Australia, Switzerland and UK)[f]: individuals transitioned to no-shift work OR stayed in shift work (3) Transition to non-standard schedule[c]: (in Canada) Individuals who transitioned to rotating/split shift OR transitioned to irregular schedule/on-call OR transitioned to other irregular schedule OR stayed on the same schedule (4) Transition from non-standard schedule [c]: (in Canada) individuals who transitioned to regular schedule/shift OR stayed in irregular schedules	Mental health distress: (1) General Health Questionnaire (GHQ12) in UK Cutoff point: > 4 Timeframe: NR (typically 'current' symptoms). (2) Subscale from Short-Form General Health Survey (SF-36) in Australia Cutoff point: 58 Timeframe: NR (typically past 4 weeks) (3) Kessler-6 in Canada Cutoff point: ≥ 5 Timeframe: NR (typically past 4 weeks) (4) Frequency of depression, anxiety, blues in Switzerland Cutoff point: no Timeframe: NR (typically 'current' symptoms)	★★★★
Perry-Jenkins et al. (2007)	Country/region: Western New England, US Dataset: recruited from prenatal classes at hospitals Sample selection: fairly representative sample of first-time, working-class, new parents	*N* = 132 couples Gender: 50% female, 50% male Age range: 19–41 years Other criteria: heterosexual couples, both employed full time prior to baby's birth and planned to return to full time within 6 months, first child, "working class", married or cohabiting	(1) Both fathers' and mothers' schedules (measured in the 3rd trimester except in the case of the seven couples who changed shifts)[a,d,e]: fixed day shift OR fixed evening/night shift OR rotating shift	Depressive symptoms: The Center for Epidemiologic Studies Depression Scale (CES-D) Cutoff point: no Timeframe: during the past 7 days Measured across 5 time points from the 3rd trimester to when the baby was 1	★★★☆

Table 1 (continued)

First author (year)	Study populations	Sample sizes and compositions	Shift work measure	Mental health measure	Study quality
Shields (2002)	Country/region: Canada Dataset: the National Population Health Survey (NPHS) Sample selection: nationally representative	(1) Cross-sectional sample $N=6117$ Gender: 3111 men and 3006 women Age range: 18–54 years old Other criteria: worked the year before 94/95 interview (2) Longitudinal sample: In 1996/97: $N=4301$ Gender: 2151 men and 2150 women In 1998/99: $N=4298$ Gender: 2150 men and 2148 women Age range: 18–54 years old Other criteria: in all three cycles (94/95, 96/97, 98/99)	(1) Work schedule[a,c,d]: evening shift OR rotating shift OR irregular shift (split shift, on call, irregular schedule and other) (2) Weekend work (usually worked weekends at their main job)[b]: yes OR no	Psychological distress: Kessler-6 Cutoff point: no Timeframe: during the past month	★★★★
Shepherd-Banigan et al. (2016)	Country/region: 10 US cities Dataset: 1–24 months post-birth from the National Institute of Child Health and Human Development (NICHD) Study of Early Child Care and Youth Development (SECCYD) Sample selection: represents families with infants residing in the catchment areas	$N=570$ Gender: all female Age range: 18–43 years old Other criteria: including women employed part time but excluding those who were students only	(1) Work schedule (measured at child age 6, 15, 24 months old)[a,c] Dayshift (7 am–7 pm) OR not dayshift (7 pm–7 am) OR variable schedule	Depressive symptoms (measured at child age 1, 6, 15, 24 months old): The Center for Epidemiologic Studies Depression Scale (CES-D) Cutoff point: no Timeframe: NR (typically past 7 days)	★★★☆

NR not reported

[#]Mean ± SD

[a]"Night shift" (Table 3)

[b]"Weekends/holidays work" (Table 4)

[c]"Irregular schedules" (Table 5)

[d]"Other characteristics of work schedules" (Table 6)

[e]"Joint work schedules" of "other indicators of shift work" (Table 7)

[f]"Broad binary indicators of shift work" (Table 2)

National Longitudinal Survey of Youth, 1979 in US (Kleiner and Pavalko 2010) and the BHPS (Bara and Arber, 2009).

Another seven studies reported using random samples from either a national (Niedhammer et al. 2015; Takahashi et al. 2011; Vallieres et al. 2014) or a regional population (Bildt and Michelsen 2002; Carlson et al. 2011; Joyce et al. 2013; Marchand et al. 2016). In addition, three studies conducted by Marchand et al. (2003a, b, 2005) reported their sample as representative of a regional population and both Perry-Jenkins et al. (2007) and Shepherd-Banigan et al. (2016) reported their samples as representative of new parents/families within specific regions. Specific details about the sample selection were unclear in seven studies (De Raeve et al. 2007; Driesen et al. 2011; Grzywacz et al. 2016; Kawabe et al. 2015; Takada et al. 2009; Takusari et al. 2011; van de Ven et al. 2016).

Sample sizes and compositions

The sample sizes of the 33 studies ranged from 132 to more than 50,000. Twenty-six studies (79%) were identified as having samples larger than 1000 participants [although the specific sample sizes were unclear in Llena-Nozal (2009) and Rosenbaum and Morett (2009)]. The 7 studies (23%) with fewer than 1000 participants typically focused on new parents. Five studies adopted single-gender samples—two all male (Cooklin et al. 2015; De Raeve et al. 2007) and three all female (Carlson et al. 2011; Grzywacz et al. 2016; Shepherd-Banigan et al. 2016). The remaining studies included both females and males, although some samples were male dominant (> 90% male) (van de Ven et al. 2016) or female dominant (> 90% female) (Strazdins et al. 2006).

Several studies applied additional selection criteria consistent with the specific aims of the studies. For example, nine studies were conducted only among parents. Participants were also occasionally excluded due to other reasons, such as health issues (Kawabe et al. 2015; Marchand et al. 2015; Takada et al. 2009), and employment characteristics (Lee et al. 2015; Llena-Nozal 2009). The vast majority of studies included both shift workers and non-shift workers, except van de Ven et al. (2016) (where all participants were shift workers, and differences were tested based on different characteristics of shift work).

Shift work measure

The measurement of shift work varied between studies as described clearly in Table 1. Twelve studies included a broad binary indicator of shift work, with work schedules classified into two groups: shift work and non-shift work. However, definitions and explanations of what was 'shift work' differed somewhat even between these twelve studies. In three studies, the term 'shift work' was not defined beyond a simple 'shift work' or 'non-shift work' dichotomy (Llena-Nozal 2009; Takusari et al. 2011; Park et al. 2016). Joyce et al. (2013) focused on fly-in fly-out (FIFO) workers, and the concept of 'shift work' was defined as distinct from fly-in fly-out work. In Wirth et al. (2017), shift work was defined as a combination of night/evening shifts and rotating shifts. In the remaining seven studies, a regular daytime schedule was identified as a standard schedule (non-shift work), while all other schedules were identified as shift work.

Twelve studies measured night or evening shifts. In most cases, working night/evening shifts was compared with dayshifts, but in Kawabe et al. (2015) and Takusari et al. (2011) day-to-night shift and day/night mixed shift were also included. Tables 1 and 4 show that seven studies considered weekend work, although two of these studies did not recognize weekend work explicitly as shift work (Shields 2002; Takada et al. 2009).

Work schedule irregularity typically refers to the unpredictability of work schedules (Marchand et al. 2015, 2016) and was measured in thirteen studies. Irregular schedules were defined in a number of ways, including split shifts, being on call, varied patterns of shifts or other irregular schedules (Bara and Arber 2009; Llena-Nozal 2009; Marchand et al. 2003b; Shepherd-Banigan et al. 2016; Shields 2002). In some studies, working rotating or alternate shifts was also described as an 'irregular schedule' (Kleiner and Pavalko 2010; Llena-Nozal 2009; Marchand et al. 2003b), although some scholars may disagree, arguing that rotating shifts are predictable (Niedhammer et al. 2015).

Rotating shifts were measured in five studies (Niedhammer et al. 2015; Perry-Jenkins et al. 2007; Shields 2002; Vallieres et al. 2014; Wirth et al. 2017). In these studies, rotating shifts were contrasted with fixed permanent shift schedules. Some 'other' characteristics of shift work were also considered. In Kawabe et al. (2015) 'shift work' was categorised as one of four work types (i.e., different from fixed night work, day-to-night work and daytime work), with little further information offered. In contrast, van de Ven et al. (2016) focussed on detailed characteristics of work schedules—consecutive shifts, early starts, consecutive working days, direction of rotation, weekends off and recovery days. Three other studies (Perry-Jenkins et al. 2007; Rosenbaum and Morett 2009; Strazdins et al. 2006) measured couples' joint work schedules.

Mental health measure

Despite the variety of terms entered into the database searches, the measures used to assess mental health outcomes were relatively limited. The majority of the studies focused on general mental health (psychological distress) and/or depression. Validated psychometric scales were used

in all but two studies that relied on self-report of diagnoses from doctors (Driesen et al. 2011; Joyce et al. 2013).

In terms of general mental health, four studies (Cooklin et al. 2015; Llena-Nozal 2009; Marchand et al. 2015; Shields 2002) reported using the Kessler-6 which assesses nonspecific psychological distress. Several studies used the Short-Form General Health Survey, either SF-36 or SF-12 (Carlson et al. 2011; Dockery et al. 2009; Kawabe et al. 2015; Kleiner and Pavalko 2010; Llena-Nozal 2009; Vallieres et al. 2014; van de Ven et al. 2016). Five studies adopted 12-item General Health Questionnaire (Bara and Arber 2009; Bildt and Michelsen 2002; De Raeve et al. 2007; Llena-Nozal 2009; Takusari et al. 2011). In addition, three studies using data from the same survey (Marchand et al. 2003a, b, 2005) measured psychiatric symptoms using the Ilfeld Psychiatric Symptoms Index.

In terms of depression, the Centre for Epidemiological Studies Depression Scale (CES-D) was the dominant measure (Grzywacz et al. 2016; Kleiner and Pavalko 2010; Perry-Jenkins et al. 2007; Rosenbaum and Morett, 2009; Shepherd-Banigan et al. 2016; Strazdins et al. 2006; Takada et al. 2009; Takahashi et al. 2011), followed by the Beck Depression Inventory (BDI) and WHO Wellbeing Scale. The former was used in two Canadian studies (Marchand et al. 2016; Vallieres et al. 2014), while the latter was used in two Korean studies which share the same dataset (Lee et al. 2015; Park et al. 2016). In addition, Kopp et al. (2008) reported using both of these scales. In Bildt and Michelsen (2002), sub-clinical depression was defined as a high value on the Nottingham life-quality questionnaire. The other two depression scales adopted were the Composite International Diagnostic Interview (CIDI)-Short form (Haines et al. 2008) and the 9-item module from the Patient Health Questionnaire (PHQ-9) (Wirth et al. 2017). Niedhammer et al. (2015) used the Hospital Anxiety and Depression Scale to measure depression and anxiety symptoms. One further study measured anxiety using the State-Trait Anxiety Inventory (Vallieres et al. 2014).

Study quality

The number of stars each study was awarded for study quality varied greatly—ranging from 0.5 to 3 for cross-sectional research and from 1.5 to 4 for longitudinal research. The median level was 1.5 for cross-sectional studies and 3.5 for longitudinal studies. This shows that compared to cross-sectional studies, a larger proportion of longitudinal studies demonstrated higher methodological quality (regardless of the extra star given for their longitudinal status).

Associations between shift work and mental health

Tables 2, 3, 4, 5, 6 and 7 summarise the results of all the studies, with similar types/schedules of shift work grouped together. Out of the 33 studies identified, 22 found shift work was significantly associated (statistically) with mental health using at least one measure.

Broad binary indicator of shift work

Overall, based on studies adopting a broad binary indicator of shift work, shift workers had more mental health problems than non-shift workers. As indicated in Table 2, four of the seven cross-sectional studies and three of the five longitudinal studies that measured shift work with a broad binary indicator, found significant associations between working shifts and poor mental health. Furthermore, of the six studies that rated two stars or above, five showed significant results. The only exception was De Raeve et al. (2007), who examined transitions between day work and shift work on psychological distress. The results of four of the longitudinal studies were synthesized in a meta-analysis (the exception was Llena-Nozal (2009)—see measures section above for further detail). The results supported the conclusion that shift work is significantly associated with greater mental health problems (OR 1.32, 95% CI [1.01, 1.73]), such that those who reported being in shift work were 32% more likely to experience depression and/or psychological distress than those who reported not being in shift work (see the forest plot in Fig. 2 for further details). In addition, data from the studies showed a symmetrical funnel-shaped distribution (i.e., funnel plot) indicating that publication bias was unlikely.

In terms of potential gender differences, eight of the twelve studies analysed the results for males and females separately. Three of these studies, all longitudinal studies rated 3.5 or 4 stars (Bildt and Michelsen 2002; Driesen et al. 2011; Llena-Nozal 2009), reported gender differences with significant effects found only for females. In the remaining studies, the effects were significant either for both females and males (Dockery et al. 2009; Park et al. 2016), or for neither (Haines et al. 2008; Takusari et al. 2011; Wirth et al. 2017). Overall, the results provide some evidence that females are more vulnerable to shift work, but they are far from conclusive.

Night or evening work as shift work

There was no strong evidence of a consistent, significant association between night/evening work and mental health, although it was evident that several high-quality studies have been conducted exploring this association (Table 3). Out of the six cross-sectional studies, two showed significant associations—Kawabe et al. (2015) found day-to-night work

Table 2 Broad binary indicators of shift work—associations with mental health

First author (year)	Statistical test	Statistical association	Other factors considered	
			General	Work related
Cross-sectional data/associations reported				
Dockery et al. (2009) ★	*T* test or ANOVA	Mental health mean: standard schedule vs. non-standard schedule. Fathers: 52.7 vs. 51.6 **; Mothers: 51.9 vs. 50.2 **	None	
Haines et al. (2008) ★★★	SEM saturated model	Direct effect of shift work on depression: coefficients: 0.19 (SE = 0.09), $t = 2.07$*; total effect: 0.27 (SE = 0.09), indirect effect via work-to-family conflict: 0.08 (SE = 0.02) (correlation coefficients 0.15**) In women, total effect: 0.28 (SE = 0.13), $t = 2.11$*; direct effect: 0.18 (SE = 0.13), $t = 1.37$ (ns); indirect effect: 0.10 (SE = 0.03), $t = 3.46$**; In men, total effect: 0.27 (SE = 0.13) (ns), $t = 0.13$; direct effect: 0.20 (SE = 0.13), $t = 1.58$ (ns); indirect effect: 0.06 (SE = 0.02), $t = 3.07$**	Gender, age, education, spouse/partner employment, number of children, and the age of the youngest child	Type of work contract, work hours, work-to-family conflict
Joyce et al. (2013) ★☆	χ^2	Current mental health problem % (95% CI): shift worker: 13.2 (10.3–16.1) % (ns); other employment: 13.0 (12.1–13.9) % (ns)	None	
Park et al. (2016) ★★	Logistic regression	Depressive symptoms and shift work OR (95% CI): 1.12 (1.04–1.20)*; in male, 1.09 (1.00–1.19)*, in female, 1.16 (1.02–1.33)* (χ^2 result also reported, $p < 0.001$)	Gender, age, education, income, smoking status, drink frequency, self-rated health	Work hours, occupation type, career duration, deadlines, work stress, hazard exposure
Takahashi et al. (2011) ★☆	ANCOVA	Depressive symptoms and work schedule (shift work) in final model: $p = 0.523$ (ns)	Age, gender, income, marital status, children ≤ 15 years, smoking and alcohol status, exercise	Employment status, job type, occupation, and weekly work hours
Takusari et al. (2011) ★	Univariate logistic regression	CMD and shift work OR(95% CI): in males 1.119 (0.879–1.425), $p = 0.360$ (ns); in females 1.373 (0.962–1.961), $p = 0.081$ (ns)	None	

Table 2 (continued)

First author (year)	Statistical test	Statistical association	Other factors considered	
			General	Work related
Wirth et al. (2017) ★☆	Logistic regression	Presence of depressive symptomatology and SW in adjusted model OR (95% CI): day shift as ref, combined night/rotating 1.13 (0.86–1.50) (ns); in female 1.08 (0.74–1.57) (ns); in male 1.17 (0.73–1.90) (ns) (for a cutoff point of 5, combined night/rotating 1.22 [1.04–1.43]*)	Marital status, sleep duration, health, infections, BMI, waist circumference, smoking status, family history of heart disease and cancer	
Longitudinal data/associations reported				
Bildt and Michelsen (2002) ★★★☆	Logistic Regression (multivariate and bivariate analyses)	Sub-clinical depression and shift work RR (CI) (only sig reported): Bivariate analyses results: sub-clinical depression: shift work in women, 3.3 (1.5–7.2)*, in men 2.2 (1.0–5.2)*. Multivariate results: in women, 2.4 (1.0–5.8)*	Age group, living alone, low frequency of social contacts, demanding life events, smoking, physical inactivity, high perceived load outside work	Perceived workload, overtime, temporary work, occupational pride, stimulation, social support, job strain, opportunities for development, training at employer's expense
Carlson et al. (2011) ★☆	Correlation	Mental health (good) and non-standard work schedule: r = –0.03 (ns)	None	
Driesen et al. (2011) ★★★☆	Logistic regression	Depressive disorder OR (95% CI): former or current shift workers among men, 1.16 (0.81–1.65) (ns); among women, 1.63 (1.05–2.55)*	Age, education	
De Raeve et al. (2007) ★★★	Logistic regression	Psychological distress case OR (95% CI) in the final model: day work → day work as ref, shift work → day work, 1.62 (0.99–2.67) (ns); shift work → shift work, 0.89 (0.70–1.13) (ns); day work → shift work, 0.67 (0.23–1.89) (ns)	Age, education, functional mobility	Job demands, decision latitude, supervisory support, co-worker support, physical demands
Llena-Nozal (2009) ★★★★	Fixed effect regression	Mental health distress increases coefficient: individuals who did not change schedules as ref: non-shift work → shift work: in Australia, men 0.577, women − 0.321 (ns); in Switzerland, men − 0.028 (ns), women − 0.110 (ns); in UK, men 0.050 (ns), women 0.109*	Age, marital status, region of residence, and number of children, life events and health information	Industry and occupation

ref reference category, *ns* not significant, *nr* not reported

*$p < .05$, **$p < .01$, ***$p < .001$

Table 3 Night shift—associations with mental health

First author (year)	Statistical test	Statistical association	Other factors considered	
			General	Work related
Longitudinal data/associations reported				
Cooklin et al. (2015) ★	Correlation	Psychological distress and works night shifts: $r = -0.01$ (ns)	None	
Kawabe et al. (2015) ☆	Multiple regression	Mental health (β, 95% CI): night vs daytime: 1.58 (−0.60, 3.76) (ns); day to night vs daytime −2.34 (−3.57, −1.12)**	Lifestyle, age, gender, physical activity, sleep hours, smoking status	
Niedhammer et al. (2015) ★☆	Generalized linear model	Each work factor studied separately, depression symptoms and night work (β, 95% CI): in women 0.20 (−0.18, 0.60) (ns), in men −0.11 (−0.32, 0.09) (ns) Anxiety symptoms and night work (β, 95% CI): in women 0.04 (−0.35, 0.43) (ns), in men −0.16 (−0.39, 0.07) (ns)	Adjusted for age. Based on weighted data using gender, age, nationality, volunteering, frequency of occupational health visits	Adjusted for occupation and economic activity Based on weighted data also using full/part time, company size. Psychosocial work factors considered[a]
Vallieres et al. (2014) ☆☆	Randomized analysis of variance	No significant differences were found between night work and other schedules for these variables (no coefficients reported) (ns)	Good sleepers or individuals with insomnia symptoms	
Takusari et al. (2011) ★	Logistic regression	CMD and working hour distribution: univariate analysis results in females: day dominant as reference, day/night mixed shift pattern 1.34 (0.94–1.90), $p = 0.111$ (ns); night dominant: 5.37 (1.03–27.92), $p = 0.046$*. In adjusted model (only females, night dominant) OR (95% CI): 2.62 (0.31–22.07), $p = 0.375$ (ns). All findings, ns for males	Age, marital status, alcohol use, demand and use for mental health resources, sleep duration	Type of business, years of continuous employment, overtime work
Wirth et al. (2017) ★☆	Logistic regression	Presence of depression and SW in adjusted model OR (95% CI): day shift as ref, evening or night shifts 1.33 (0.90–1.96) (ns); in female 1.24 (0.75–2.06) (ns); in male 1.41 (0.74–2.68) (ns) (for a cutoff point of 5, OR [95% CI]:1.29 [1.06–1.58]*)	Marital status, health, infections, smoking status, family history of heart disease and cancer, sleep duration, BMI, waist length	

Table 3 (continued)

First author (year)	Statistical test	Statistical association	Other factors considered	
			General	Work related
Longitudinal data/associations reported				
Shields (2002) (also cross-sectional) ★★★★	Multivariate regression analyses	(1) Psych distress levels in 94/95 (β, 95% CI): regular daytime as ref, evening shift in men, 0.02 (−0.46, 1.08) (ns), in women, −0.02 (−0.71, 0.27) (ns) (2) Changes in psychological distress levels between 94/95 and 96/97 (*β*, 95% CI): regular daytime as ref, evening shift in men, 0.07* (0.14, 1.57), in women, 0.04* (0.01, 1.22) (3) Changes in psych distress levels between 94/95 and 98/99 (*β*, 95% CI): regular daytime as ref, evening shift in men 0.03 (−0.34, 1.21) (ns), in women 0.03 (−0.27, 1.19) (ns)	Age, married, children under age 12 in household, postsecondary graduation, lower household income, psychosocial factors, health behaviours	Occupation, weekly work hours, weekend work, self-employed, work stress
Bara and Arber (2009) ★★★★	Logistic regression	GHQ caseness OR(95% CI): 0 years working nightshifts as ref, in men, 1 year 0.97 (0.56–1.71), 2–3 years 1.03 (0.49–2.16), 4–10 years 2.58 (1.22–5.48)*; in women 1 year 0.93 (0.56–1.54), 2–3 years 1.03 (0.58-1.83), 4–10 years 1.06 (0.49–2.27)	Age, marital status, education, GHQ caseness at baseline	Number of waves working in six occupational categories
Grzywacz et al. (2016) ★☆	Structural equation model	Depressive symptoms did not differ by exposure to evening/night schedules (no coefficients reported)	Mother's age, ethnicity, education, marital status and infant's gender and prematurity status	
Kleiner and Pavalko (2010) ★★★	OLS regression	(1) Distress and night shift regression coefficients: model 1: 0.43, model 2: 0.09, model 3: 0.05 (ns) (2) Mental health and night shift regression coefficients: model 1: −0.71, model 2: −0.50, model 3: −0.45 (ns)	Model 2: race, gender, education, age, number children, children aged > 6, income Model 3: model 2 + if health limited work	Model 2: job tenure, job satisfaction, occupation type, job sector, spouse's hours Model 3: model 2 + if health limited work
Perry-Jenkins et al. (2007) ★★★☆	Multilevel linear modelling	(1) Level of depressive symptoms (coefficient) at 6 months postpartum: intraspouse evening/night shift fathers: 0.053*, mothers: 0.123**. (2) Rate of change in depressive symptoms over time: (ns)	Marital status, age, marital conflict	Intraspouse work hours, cross-spouse work hours

Table 3 (continued)

First author (year)	Statistical test	Statistical association	Other factors considered	
			General	Work related
Shepherd-Banigan et al. (2016) ★★★☆	Linear fixed effects models	Fixed effects change in depression score, β(SE), day shift as ref, not day shift: 1.22 (0.67) (ns) (correlation also reported, ns)	Family income-to-needs ratio, partner status, life and parenting stress, number children at home	Maternal employment changes associated with work, partner employment status and work hours

ref reference category, *ns* not significant, *nr* not reported

*$p < .05$, **$p < .01$, ***$p < .001$

[a]Psychosocial work factors includes: (1) job strain (i.e., high demands and low decision latitude); (2) iso-strain (i.e., high demands, low decision latitude and low social support); (3) reward and its sub-dimensions: esteem, job security and job promotion; (4) working time variables: long working hours, night work, shift work, unsociable work days and predictability; (5) workplace violence (i.e., bullying or assault); (6) demands for responsibility

(but not fixed night work) was associated with poor mental health and Wirth et al. (2017) found working at nights or evenings was associated with mild depression. As for the six longitudinal studies, three showed significant results, Shields (2002) found that working evening shifts at baseline was associated with an increase in psychological distress 2 years later, however, after another 2 years, this association no longer remained. Bara and Arber (2009) found that men who had been working night shifts for more than 4 years were more likely to have poor mental health. Perry-Jenkins et al. (2007) indicated that fathers and mothers who worked evening/night shifts during the transition to parenthood had significantly higher levels of depressive symptoms. Notably, although few in number, the three longitudinal studies with significant results were high quality compared to those studies with no association.

Weekend work as shift work

There was little evidence supporting an association between weekend work and mental health. Only two out of the seven studies included found significant associations with mental health (Table 4). The two studies (Lee et al. 2015; Takada et al. 2009) were both cross-sectional studies, with relatively low study quality ratings (two and one star). Overall, the studies reporting data on the association with weekend work received relatively low-quality scores—with only one longitudinal study that received four stars.

Shift work as irregular/unpredictable schedules

Interestingly, the majority of studies that examined the association between irregular/unpredictable schedules and poorer mental health found some evidence of an association. Out of seven cross-sectional studies, six showed significant effects. However, when looking at the findings for the longitudinal studies, there were three (out of six) high-quality studies (with 3–4 stars) that found no evidence of an association (i.e., Kleiner and Pavalko 2010; Shepherd-Banigan et al. 2016; Shields 2002).

In terms of potential gender differences, of the nine studies that showed significant results, four studied females and males separately and only Takusari et al. (2011) found the relationship was significant in both females and males. Niedhammer et al. (2015) found a significant association among males only, while in Bara and Arber (2009), the relationship was only significant among females who had been working varied shifts for more than 4 years. Llena-Nozal (2009) found only men who changed their schedules from regular to "other irregular schedules" (distinct from rotating/split shift and irregular schedule or on call, but not further defined) experienced significantly higher distress. Grzywacz et al. (2016) focused on new mothers and found women working

Table 4 Weekends/holidays work—associations with mental health

First author (year)	Statistical test	Statistical association	Other factors considered	
			General	Work related
Cooklin et al. (2015) ★	Correlation	Psychological distress and works weekend shifts: $r = -0.02$ (ns)	None	
Kopp et al. (2008) ★★	Multiple linear regression	Correlation coefficients reported. For women: BDI and weekend work hours 0.094**, WHO wellbeing and weekend work hours −0.051**. For men: all correlations, ns (detail nr) Ns in the final model (no coefficients reported)	Negative affect, hostility, perceived social support from family, demographic (education, age)	Control at work, job security, dissatisfaction with work and boss, job-related troubles, social support at work, weekday work hours, personal income
Lee et al. (2015) ★★	Multiple logistic regression	Depressive symptoms OR(95% CI) in final model: "no weekend work" as ref, in male, 1–4 days: 1.36 (1.18–1.57)*, > 4 days 1.45 (1.19–1.78)*; in female, 1–4 days: 1.32 (1.12–1.58)*, > 4 days 1.36 (1.07–1.73)*	Gender, age group, marital status, education level, and income	Type of employment contract, occupation, hours worked per week, size of company and presence or absence of nightshift work
Niedhammer et al. (2015) ★☆	Generalized linear model	Each work factor studied separately, depression symptoms and unsociable work days (β, 95% CI): in women 0.14 (−0.02, 0.31) (ns), in men −0.05 (−0.18, 0.10) (ns) Anxiety symptoms and unsociable work days (β, 95% CI): in women 0.06 (−0.13, 0.25) (ns), in men −0.05 (−0.20, 0.11) (ns)	Adjusted for age. Based on weighted data using gender, age, nationality, volunteering, frequency of occupational health visits	Adjusted for occupation and economic activity Based on weighted data also using full/part time, company size. Psychosocial work factors considered[a]
Takada et al. (2009) ★	Multivariate logistic regression	Depressive symptom and working on holidays OR (95% CI): none as ref, in men (ns, not reported); in women 1–2 days: 1.12 (0.68–1.84) (ns), 3–4 days: 0.74 (0.27–2.01) (ns), ≥ 5 days 33.27 (2.24–494.48)**	Age, smoking status, alcohol consumption, sleep, exercise, meals, confidants and family, and stress reduction behaviours	Working time/day, overtime worked/month, job stressors
van de Ven et al. (2016) ☆	Univariate multilevel analyses	Mental health B (95% CI): weekends off: > 10.4 as ref, ≤ 10.4: −0.71 (−2.14 to 0.73) (ns)	Age, gender and care for children	

Table 4 (continued)

First author (year)	Statistical test	Statistical association	Other factors considered	
			General	Work related
Longitudinal data/associations reported				
Shields (2002) (also cross-sectional) ★★★★	Multivariate regression analyses	(1) Psychological distress levels in 94/95 (β, 95% CI): for weekend workers, men, 0.02 (−0.11, 0.32) (ns), women, −0.03 (−0.47, 0.11) (ns) (2) Changes in psychological distress levels between 94/95 and 96/97 (β, 95% CI): for weekend workers, men, −0.02 (−0.32, 0.15) (ns), women, 0.01 (−0.26, 0.35) (ns) (3) Changes in psychological distress levels between 94/95 and 98/99 (β, 95% CI): for weekend workers, men, −0.03 (−0.43, 0.13) (ns), women, −0.04 (−0.60, 0.04) (ns)	Age, married, children under age 12 in household, postsecondary graduation, lower household income, psychosocial factors, health behaviours	Occupation, weekly work hours, weekend work, self-employed, work stress

ref reference category, *ns* not significant, *nr* not reported

*$p < .05$, **$p < .01$, ***$p < .001$

[a]Psychosocial work factors includes: (1) job strain (i.e., high demands and low decision latitude); (2) iso-strain (i.e., high demands, low decision latitude and low social support); (3) reward and its sub-dimensions: esteem, job security and job promotion; (4) working time variables: long working hours, night work, shift work, unsociable work days and predictability; (5) workplace violence (i.e., bullying or assault); (6) demands for responsibility

Table 5 Irregular (unpredictable) schedules—associations with mental health

First author (year)	Statistical test	Statistical association	Other factors considered	
			General	Work related
Cross-sectional data/associations reported				
Marchand et al. (2003a) ★★	Multilevel logistic regression	Psychological distress and irregular work schedule OR(95% CI) in final model: 1.23** (1.09–1.39)	Demographics (gender, age); type of drinker	Task internal strains (i.e., skill utilization, decision authority, psych demands, exposure to physical risks and chemical-organic substances); task external strains (i.e., work hours, job status, remuneration type)
Marchand et al. (2003b) ★★	Multivariate variance component model	Psychological distress and work schedule (regular) B in final model −0.222**	Gender, age	Job seniority, hours work, 16 occupations
Marchand et al. (2005) ★★	Multilevel regression	Psychological distress and work schedule irregularity B in final model 0.089*	Marital status, number of minor children, household income, strained marital and parental relations, social network, gender, age, physical health, alcohol use, cigarettes, physical activities, childhood stressful events	Task design (skill utilization, decision authority), work demands (physical, psychological, hours), Social (harassment, unionization), Gratifications (job insecurity, performance pay, prestige)
Marchand et al. (2015) ★	Correlation	Psychological distress and irregular work schedule: $r = -0.03$**	None	
Marchand et al. (2016) ★☆	Multilevel path analyses	Depressive symptoms and work schedule (irregular) *B*: 0.048, in men, 0.296; in women −0.282 (ns)	Age, smoking, alcohol intake, physical activities, chronic diseases, social support outside work and internal locus of control. Single-parent, income, couple-related and child-related problems, home tasks, caregiving	Skill utilization, decision authority, work hours, psychological and physical demands, support from colleagues, support from supervisor, conflict, abusive supervision, recognition career perspectives, job insecurity

Table 5 (continued)

First author (year)	Statistical test	Statistical association	Other factors considered	
			General	Work related
Niedhammer et al. (2015) ★☆	Generalized linear model	Each work factor studied separately: (1) depression symptoms and low predictability of schedules (β, 95% CI): in women 0.18 (0.03, 0.33)*, in men 0.38 (0.26, 0.50)***. (2) Anxiety symptoms and low predictability of schedules (β, 95% CI): in women 0.20 (0.02, 0.39)*, in men 0.50 (0.36, 0.63)*** All work factors studied simultaneously[b]: (1) depression symptoms and low predictability of schedules (β, 95% CI): in women −0.05 (−0.19, 0.08) (ns), in men 0.12 (0.01, 0.24)*. (2) Anxiety symptoms and predictability of schedules (β, 95% CI): in women −0.03 (−0.20, 0.15) (ns), in men 0.19 (0.06, 0.32)**	Adjusted for age. Based on weighted data using gender, age, nationality, volunteering, frequency of occupational health visits	Adjusted for occupation and economic activity Based on weighted data also using full/part time, company size. Psychosocial work factors considered[a]
Takusari et al. (2011) ★	Multivariate logistic regression	CMD and work schedule irregularity OR (95% CI) in adjusted model: in males 1.612 (1.234–2.107), $p < 0.001$***; in females 2.218 (1.259–3.908), $p = 0.006$**	Males: age, alcohol use, sleep duration, mental health resources Females: age, marital status, alcohol use, sleep duration, mental health resources	Males: business type, employment status, years of continuous employment, days off work, overtime work. Females: business type, years of continuous employment, work hour distribution, overtime

Table 5 (continued)

First author (year)	Statistical test	Statistical association	Other factors considered	
			General	Work related
Longitudinal data/associations reported				
Shields (2002) (also cross-sectional) ★★★★	Multivariate regression analyses	(1) Psych distress levels in 94/95 (β, 95% CI): regular daytime as ref, irregular shift in men 0.00 (−0.31, 0.33) (ns), in women, 0.02 (−0.19, 0.60) (ns) (2) Changes in psych distress levels between 94/95 and 96/97 (β, 95% CI): regular daytime as ref, irregular shift in men 0.03 (−0.10, 0.57) (ns), in women, 0.03 (−0.25, 0.88) (ns) (3) Changes in psych distress between 94/95 and 98/99 (β, 95% CI): regular daytime as ref, irregular shift in men 0.00 (−0.47, 0.39) (ns), in women, −0.01 (−0.65, 0.49) (ns)	Age, married, children under age 12 in household, postsecondary graduation, lower household income, psychosocial factors, health behaviours	Occupation, weekly work hours, weekend work, self-employed, work stress
Bara and Arber (2009) ★★★★	Logistic regression	GHQ caseness OR(95% CI): 0 years working varied shifts as ref, in men, 1 year 0.81 (0.55–1.19) (ns), 2–3 years 1.21 (0.69–2.14) (ns), 4–10 years 0.52 (0.11–2.37) (ns); in women 1 year 1.16 (0.89–1.53) (ns), 2–3 years 1.07 (0.69–1.66) (ns), 4–10 years 4.17 (1.45–11.98)*	Age, marital status, education, GHQ caseness at baseline	Number of waves working in six occupational categories
Grzywacz et al. (2016) ★☆	Structural equation model	Women working irregular schedules at more observations across the child's first year of life had higher depressive symptoms ($\beta = 0.25$)*. (Correlation also reported 0.24*.)	Mother's age, ethnicity, education, marital status and infant's gender and prematurity status	
Kleiner and Pavalko (2010) ★★★	OLS regression	(1) Distress and rotating or irregular schedule regression coefficients: model 1: 0.32*, model 2: 0.38*, model 3: 0.29 (ns). (2) Mental health and rotating or irregular schedule regression coefficients: model 1: −0.50, model 2: −0.63, model 3: −0.51 (ns)	Model 2: race, gender, education, age, number of children, children > 6 in household, income Model 3: model 2 + if health limited work	Model 2: job tenure, job satisfaction, occupational type, job sector, spouse's hours Model 3: model 2 + if health limited work

Table 5 (continued)

First author (year)	Statistical test	Statistical association	Other factors considered	
			General	Work related
Llena-Nozal (2009) ★★★★	Fixed effect regression	Mental health distress increases coefficient: individuals who did not change schedules as ref: (1) in Canada, regular schedule → rotating or split shift, men -0.004, women 0.044 (ns); regular schedule → irregular schedule or on call, men −0.013, women −0.009 (ns); regular schedule → other irregular schedule, men 0.956**, women −0.378 (ns). (2) In Canada, other schedules → regular schedule or shift men −0.018, women −0.005 (ns)	Demographic variables, such as age, marital status, region of residence, and number of children. Other life events and health information	Industry and occupation
Shepherd-Banigan et al. (2016) ★★★☆	Linear fixed effects models	Fixed effects change in depression score, β (SE), day shift as ref, variable −0.20 (0.71) (ns) (correlation also reported, not sig)	Family income-to-needs ratio, partner status, life and parenting stress, number children at home	Maternal employment changes associated with work, partner employment status and work hours

ref reference category, *ns* not significant, *nr* not reported

*$p < .05$, **$p < .01$, ***$p < .001$

[a]Psychosocial work factors includes: (1) job strain (i.e., high demands and low decision latitude); (2) iso-strain (i.e., high demands, low decision latitude and low social support); (3) reward and its sub-dimensions: esteem, job security and job promotion; (4) working time variables: long working hours, night work, shift work, unsociable work days and predictability; (5) workplace violence (i.e., bullying or assault); (6) demands for responsibility

[b]In multivariate analyses, the associations between work factors and depression and anxiety symptoms were studied using both main dimensions and sub-dimensions of the job strain model and reward scale. Results when using main dimensions are reported—refer to the original study for further information

Table 6 Other characteristics of work schedules—associations with mental health

First author (year)	Statistical test	Statistical association	Other factors considered	
			General	Work related
Kawabe et al. (2015) ☆	Multiple regression	Mental health (β, 95% CI) : shift vs daytime[a]: −1.31 (−2.01, 0.63)**	Lifestyle, age, gender, physical activity, sleep hours, smoking status	
Niedhammer et al. (2015) ★☆	Generalized linear model	Each work factor studied separately, (1) depression symptoms and rotating shift (β, 95% CI): in women 0.01 (−0.15, 0.18) (ns), in men 0.09 (− 0.07, 0.24) (ns). (2) Anxiety symptoms and rotating shift (β, 95% CI): in women −0.13 (−0.34, 0.07) (ns), in men −0.14 (−0.31, 0.03) (ns)	Adjusted for age. Based on weighted data using gender, age, nationality, volunteering, frequency of occupational health visits	Adjusted for occupation and economic activity Based on weighted data also using full/part time, company size. Psychosocial work factors considered[b]
Vallieres et al. (2014) ☆☆	Randomized analysis of variance	No significant differences were found between rotating work and other schedules for these variables (no coefficients reported)	Good sleepers or individuals with insomnia symptoms	
van de Ven et al. (2016) ☆	Univariate multilevel analyses	Mental health *B* (95% CI): consecutive shifts: 3–4 as ref, ≤ 2: −1.11 (−2.82 to 0.60) (ns), ≥ 5: −0.24 (−3.15 to 2.67) (ns); early starts: ≥ 7:00 h as ref, < 7:00 h: 1.05 (−0.92 to 3.03) (ns); consecutive working days: ≤ 5 as ref, ≥ 6: −1.11 (−2.89 to 0.68) (ns); direction of rotation: forward as ref, backward: 0.37 (−1.60 to 2.34) (ns); recovery days: 3 as ref, ≤ 2: 1.41 (−1.74 to 4.57) (ns), ≥ 4: −0.10 (−2.46 to 2.27) (ns); rest days: ≥ 1 as ref, < 1: −1.11 (−2.89 to 0.68) (ns)	Age, gender and care for children	
Wirth et al. (2017) ★☆	Logistic regression	Presence of depressive symptomatology and SW in adjusted model OR (95% CI): day shift as ref, Rotating 0.90 (0.64–1.26) (ns); in female 0.91 (0.59–1.39) (ns); in male 0.80 (0.43–1.49) (ns)	Marital status, health, infections, smoking status, family history of heart disease and cancer, sleep duration, BMI, waist length	

Table 6 (continued)

First author (year)	Statistical test	Statistical association	Other factors considered	
			General	Work related
Longitudinal data/associations reported				
Shields (2002) (also cross-sectional) ★★★★	Multivariate regression analyses	(1) Psychological distress levels in 94/95 (β, 95% CI): regular daytime as ref, rotating shift in men 0.00 (−0.34, 0.35) (ns), in women, 0.00 (−0.48, 0.44) (ns) (2) Changes in psychological distress levels between 94/95 and 96/97 (β, 95% CI): regular daytime as ref, rotating shift in men 0.01 (−0.34, 0.45) (ns), in women, 0.02 (−0.37, 0.76) (ns) (3) Changes in psychological distress levels between 94/95 and 98/99 (β, 95% CI): regular daytime as ref, rotating shift in men −0.04 (−0.67, 0.05) (ns), in women, 0.04 (−0.33, 1.13) (ns)	Age, married, children under age 12 in household, postsecondary graduation, lower household income, psychosocial factors, health behaviours	Occupation, weekly work hours, weekend work, self-employed, work stress
Perry-Jenkins et al. (2007) ★★★☆	Multilevel linear modelling	(1) Level of depressive symptoms coefficient: Intraspouse rotating (ns). (2) Rate of change in depressive symptoms: (ns)	Marital status, respondent age, marital conflict	Intraspouse work hours, cross-spouse work hours

ref reference category, *ns* not significant, *nr* not reported

*$p < .05$, **$p < .01$, ***$p < .001$

[a]This is not identified as a binary variable as the study excludes daytime and night time work in the categorisation of shift work—unclear and non-inclusive

[b]Psychosocial work factors includes: (1) job strain (i.e., high demands and low decision latitude); (2) iso-strain (i.e., high demands, low decision latitude and low social support); (3) reward and its sub-dimensions: esteem, job security and job promotion; (4) working time variables: long working hours, night work, shift work, unsociable work days and predictability; (5) workplace violence (i.e., bullying or assault); (6) demands for responsibility

Table 7 Joint work schedules—associations with mental health

First author (year)	Statistical test	Statistical association	Other factors considered	
			General	Work related
Cross-sectional data/associations reported				
Rosenbaum and Morett (2009) ★	*T* test	Depression mean: both work day shifts vs. either/both work non-day shifts: mother: 3.23 vs. 4.13***, father: 2.96 vs. 3.83***	None	
Strazdins et al. (2006) ★★	Multiple regression analysis	Parent depressive symptoms: both standard as ref, father non-standard, $B = 0.22$, SE $B = 0.18$, $\beta = 0.05$, (ns), mother non-standard, $B = 0.39$, SE $B = 0.20$, $\beta = 0.09$, (ns), both non-standard, $B = 0.70$, SE $B = 0.19$, $\beta = 0.16$**	Child age, household socioeconomic status, number of children in household, mother and father age, child care use	Parents' work intensity
Longitudinal data/associations reported				
Perry-Jenkins et al. (2007) ★★★☆	Multilevel linear modelling	(1) Level of depressive symptoms coefficient: cross-spouse evening/night, cross-spouse rotating: (ns). (2) Rate of change in depressive symptoms: (ns)	Marital status, respondent age, marital conflict	Intraspouse work hours, cross-spouse work hours

ref reference category, *ns* not significant, *nr* not reported
*$p < .05$, **$p < .01$, ***$p < .001$

more irregular schedules across the child's first year of life had higher depressive symptoms. On balance, there are no consistent findings as to the influence of gender.

'Other' types and contexts of shift work

Other types of shift work, not previously covered, were rarely found to be related to mental health problems. As shown in Table 6, several studies examined the association between rotating shifts and mental health (Niedhammer et al. 2015; Perry-Jenkins et al. 2007; Shields 2002; Vallieres et al. 2014; Wirth et al. 2017). None of these studies found evidence for a significant association. In addition, van de Ven et al. (2016), which assessed a range of shift schedule characteristics found no impacts of any of these characteristics on mental health. Kawabe et al. (2015) found that compared to daytime workers, shift workers had significantly worse mental health. But this study received only one star, and "shift work" was not clearly defined in the study.

Joint work schedules of couples

No conclusions can be drawn as to the effect of couples' joint work schedules, as only three studies were in this category and their findings all differed. The three studies all focused on parents. In cross-sectional research by Rosenbaum and Morett (2009), both parents had significantly higher depression levels when one or both of them worked a non-day shift. While in Strazdins et al. (2006), parents had significantly higher depressive symptoms only when they and their partners both worked non-standard schedules. However, the cross-spouse effect (i.e., the impact from one spouse's shift work on the other spouse's depression levels) was not found in Perry-Jenkins et al. (2007)—the only longitudinal study examining couples' work schedules.

Discussion

To our knowledge, this is the first systematic review dedicated to summarising the research investigating the association between shift work and mental health that has concurrently drawn attention to different shift work schedule types. All studies recruited from a wide range of occupations and organizations and at least 26 used randomly selected, population-based samples of workers. Therefore, this review provides a useful summary of findings relevant to the general working population. The majority of studies also controlled (or adjusted) for potential covariates (occupational and non-occupational).

Overall, the review demonstrates reasonable evidence in the existing literature that shift work is associated with poorer mental health across occupation types when

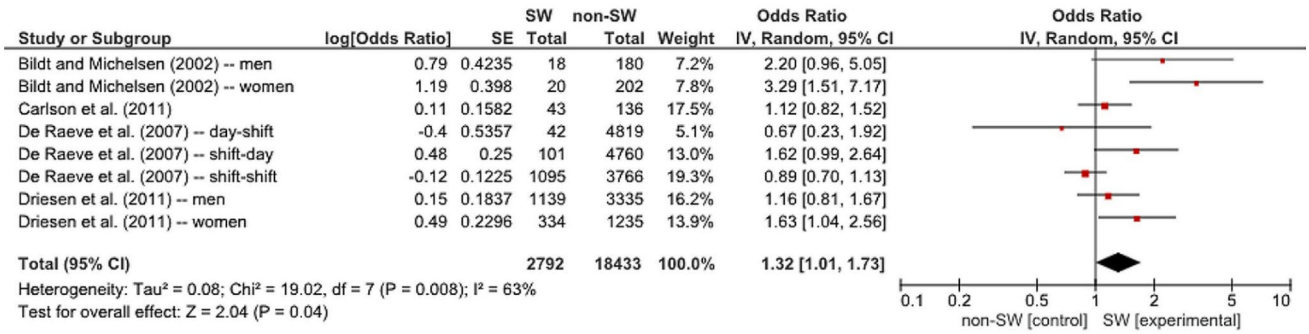

Fig. 2 The odds ratios of longitudinal studies with a broad binary measure of shift work and pooled meta-analysis results

measured by a broad binary indicator, particularly for women. However, there is a lack of consistency and less evidence when studies are categorised into specific shift work types. The evidence in terms of night work and mental health is mixed. It appears that night work is more likely to be associated with mental health problems after a certain period of time (Shields 2002; Bara and Arber 2009) or during sensitive periods, such as the transition to parenthood (Perry-Jenkins et al. 2007). The findings on the longitudinal studies accord with previous review (Angerer et al. 2017) which found evidence of an elevated risk of depression after several years of night shift work in occupations outside the health sector (i.e., general population). There was some evidence that working irregular schedules were associated with poor mental health. This finding may indicate it is particularly difficult for individuals who work irregular schedules to adapt and maintain homeostasis in life. The unpredictable nature of work schedules for these individuals may mean that their circadian rhythms, eating habits, as well as family and social lives, are continually disrupted, resulting in loss of control. Lack of perceived control has long been established as relevant to negative emotional states, particularly anxiety (Bara and Arber 2009; Fenwick and Tausig 2004; Gallagher et al. 2014; Olsen and Dahl 2010). However, there was little evidence of a link between mental health and other types of shift work, such as weekend shift and rotating shift.

The systematic review showed mixed findings in terms of gender differences. Seventeen studies examined women and men separately—11 of them reported similarities between gender, while one (Niedhammer et al. 2015) only reported a significant impact among men, and three (Bildt and Michelsen 2002; Driesen et al. 2011; Takada et al. 2009) only among women. In two studies that adopted multiple measures of shift work type (Bara and Arber, 2009; Llena-Nozal 2009), there was no clear pattern as to which schedule (i.e., irregular work or night work) was more likely to have an impact on women or men. Of the five single-gender studies, only Grzywacz et al. (2016), found significant association between mothers' working irregular schedules and depressive symptoms. While overall, the balance of all the extant research available supports that shift work has a greater association with women's mental health, no conclusions can be drawn without further formal testing. In addition, we are unable to say whether specific types of shift work schedules (e.g., night work) have specific or increased effects on women as opposed to men's mental health.

Study limitations

The results should be interpreted in light of the review's limitations. Primarily, this systematic review highlights the complexities in comparing and combining research studies about shift work. The inconsistency, and sometimes ambiguity, of the exact nature of shift work in each study limited our ability to compare between studies. To reflect (and in some way address) this, we have described the studies (and study measures adopted) as accurately as possible in Table 1. It should also be noted that while there was no evidence of publication bias in the longitudinal studies included in the meta-analysis, there may be undetected publication bias in cross-sectional research and studies examining other shift work types (i.e., irregular work, night work, weekend work, etc.), such that studies with negative findings are less likely to be published. In addition, given the studies focused on active workers, the 'healthy worker effect' could be a source of selection bias. The healthy worker effect typically means that relatively healthy individuals are more likely to gain and remain employed in good quality work than those with health problems (Pearce et al. 2007). Thus, the negative impacts of shift work may be underestimated as unhealthy workers leave their jobs (and are no longer captured in research). A final limitation is that given the focus on broad, population-based research, this systematic review provides little details of the shift workers at most risk (e.g., young or older people, working parents, immigrant workers, and particular occupation categories).

Conclusions

This systematic review provides some evidence that shift work, in particular irregular shift work, is associated with poorer mental health. While, there was also some evidence that ongoing night work may impact adversely on mental health, there was insufficient evidence to support a link with weekend work and other shift work types (including regular rotating shifts and joint couple work schedules). Shift work is often variable—making it difficult to measure and classify, conduct meta-analyses and draw general conclusions. Despite this, there is a need for continued investigation adopting clear and consistent measures. Although a considerable body of anecdotal evidence suggests that shift work is a stressful work arrangement, rigorous studies are still needed to provide robust evidence and quantify the impacts at the population level. This evidence is necessary to better understand the difficulties confronting shift workers and their families, and to identify where support is needed to protect workers' mental health.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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Appendix 2

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Parents' Shift Work in Connection with Work–Family Conflict and Mental Health: Examining the Pathways for Mothers and Fathers

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Abstract

Shift work might aggravate work–family conflict and mental health. The current study used moderated-mediation analyses to investigate the association between shift work and mental health, whether work–family conflict explained this association, and whether the pathways differed between genders. The sample included 756 mothers and 452 fathers participating in the "Families at Work" survey, an online nationwide community-based survey of employed parents. The findings highlight the complex interplay between parents' work schedules, work–family conflict and psychological distress. They show some evidence that working irregular shifts was associated with higher work–family conflict in connection with higher psychological distress, with fathers at greater risk. Working regular shifts was associated with poorer mental health, but this was not related to increased work–family conflict, and this association was stronger for mothers. As the labor force becomes increasingly fractured, it is critical that the impacts of non-standard work schedules continue to be considered.

Keywords

Shift work, work–family conflict, mental health, psychological distress, gender

Introduction

Society has seen an increase in maternal labor force participation, with a steady growth in the proportion of dual-earner families. Now in most OECD countries, less than 30% of couple families have only fathers working, ranging from 5% in Norway to just under 30% in the United States, and greater than 40% only in Chile and Mexico. In Australia, the proportion is just under 25% (OECD, 2017). Accordingly, the traditional mothers-as-"caregivers"/fathers-as-"breadwinners" family structure has been challenged, with employed fathers and mothers increasingly experiencing the demands and pressures of both work and family. Parents undertake the practical, emotional, and time-intensive aspects of caring for children at a life stage when they are also striving to build and stabilize their careers (Erickson et al., 2010). Active involvement in both work and family are widely viewed as crucial for both well-being and quality of life; yet it is often difficult to strike a balance between the two, and the conflicts between them are

known to be detrimental to individuals and families (Nilsen et al., 2017; Allen et al., 2019).

Additionally, in recent years, the world has been transitioning to a 24-hrs/7-days economy. This transition has been accompanied by an increasing demand for flexibility in work routines—including a growing demand for shift workers (Pagnan et al., 2011; Presser, 2003). Shift work, also known as nonstandard schedules, typically means that a considerable proportion of work hours falls outside the typical 8/9 am to 4/5 pm, Monday to Friday schedule (Li et al., 2014; Presser, 2003). Examples of types of shift work include regular morning, afternoon, evening or night shifts, rotating shifts, irregular (or unpredictable) shifts, and split shifts. In general, about 16% of the employee population in Australia undertake shift work and about 15% in the United Kingdom (Australian Bureau of Statistics [ABS], 2012; Office for National Statistics, 2011). Interestingly, the proportion of shift workers may be higher among parents than among nonparents (Pagnan et al., 2011). In 2007, about half of all dual-earner families with children in Australia had one or both parents working variable hours or being "on call" (ABS, 2009). A national study in the United States found that in dual-earner families, the presence of children, particularly children under the age of 5, increased the likelihood that at least one spouse worked a nonstandard schedule (Presser, 2003). Furthermore, when asked why they undertook shift work, the most common reason given by 40% of mothers with children younger than 5 years was "better child care arrangements" (Presser, 2003, p71).

While shift work might assist parents to accommodate their work and child care responsibilities, there is also reason to suggest it may have a a negative impact—including on work–family conflict and mental health (Hertz & Charlton, 1989; Joshi & Bogen, 2007; Mills & Täht, 2010; Zhao et al., 2019). Shift workers usually adopt a care-providing strategy known as "tag-team parenting"—where one partner takes care of the children while the other works. One of the commonly cited benefits of "tag-team parenting" is fathers' increased participation in childcare (Pagnan et al., 2011). However, many couples who tag-team do not spend enough time together, which may lead to relationship dissatisfaction and poor well-being (Hattery, 2001; Liu et al., 2011; Presser, 2003; Wight et al., 2008).

Shift Work and Mental Health for Parents

In contrast to the well-established link between shift work and physical health (Kecklund & Axelsson, 2016), the evidence for an association

between shift work and workers' mental health is inconsistent and different across types of shift work (Zhao et al., 2019). Several studies have found that irregular/unpredictable shift work is associated with depression, anxiety, and general mental ill-health (Bara & Arber, 2009; Grzywacz et al., 2016; Niedhammer et al., 2015), while there is less evidence of the same for night/evening shifts, weekend shifts, and rotating shifts. Given that poor mental health has in recent decades been acknowledged as a major public health issue globally, with enormous social and economic burden (Whiteford et al., 2013), it is vital to continue research clarifying the association between shift work and employees' mental health.

Clarifying the association between shift work and mental health may be particularly important for parents, given that parental mental health is critical to support developmental outcomes for children (Gupta & Ford-Jones, 2014). Very few studies have specifically examined shift working parents' mental health, and those that have, lack consistency. For example, Grzywacz et al., (2016) found that working an irregular schedule across the child's first year of life was associated with maternal depressive symptoms. On the contrary a study conducted by Shepherd-Banigan et al. (2016), also focusing on mothers of infants, didn't find an association. Even within the same study, results are often different across various types of shift work. Grzywacz et al., (2016) found irregular shifts, but not night shifts, were associated with maternal depression, while Perry-Jenkins et al. (2007) found that, night shifts, but not rotating shifts, were associated with parents' depression. The paucity of studies examining the impacts of shift work on parents' mental health, the inconsistency in those studies that are available, and the likelihood that shift work is growing in parent populations, demonstrates the need for more knowledge on this issue.

From a psychosocial perspective, there are multiple explanations for why shift work might be linked with mental health problems. First, factors such as being a single parent or lower education level, may simultaneously contribute to (or co-occur with) mental health problems and working shifts—in part explaining the association (Han, 2008; Kuruvilla & Jacob, 2007). Related to these correlated vulnerabilities, individuals who undertake shift work may be more vulnerable to mental health problems (i.e. a health selection perspective). Second, associations between shift work and unfavorable working conditions (e.g. high job demands and low flexibility) may explain the link with poorer mental health (Vogel et al., 2012; Wittmer & Martin, 2010). This potential is acknowledged in a number of studies by controlling for job

characteristics (De Raeve et al., 2007; Shields, 2002). Third, and most relevant to parent populations, is the interference of nonstandard work schedules in family routines (Gassman-Pines, 2011). This may harm family relationships and compromise shift workers' mental health. The current study focuses on this third pathway (conflict between work and family responsibilities) as a hypothesis for how shift work impacts on parents' mental health.

Shift Work, Work–Family Conflict and Mental Health for Parents

Work–family conflict is defined as a form of inter-role conflict in which the general demands of, time devoted to, and strain created by the job interfere with performing family-related responsibilities, and vice versa (Netemeyer & Boles, 1996). Shift work may simultaneously increase time-based and strain-based work–family conflict. Shift workers usually have to work at nights and/or weekends—the times typically reserved for family life. They may frequently miss out on routine family events. Working nonstandard hours often also leads to sleep deprivation and fatigue (Oyane et al., 2013; Shen et al., 2006), which, in turn, leads to irritability and strain in family interactions. This may comprise shift working parents' emotional capacity to fulfill family responsibilities—reflective of strain-based work–family conflict (Gassman-Pines, 2011; Shen et al., 2006). Despite parents' perceptions that shift work may help them balance work and family life, a number of studies (Davis et al., 2008; Fenwick & Tausig, 2001; Staines & Pleck, 1984) have demonstrated that working a nonstandard schedule is associated with higher levels of work–family conflict.

While work–family conflict is associated with mental health problems, such as depression, anxiety, mood disorders and substance abuse (Allen et al., 2000; Wang et al., 2012), little research that has examined the relationship between shift work, work–family conflict, and parents' mental health inclusively. Cooklin et al. (2015) showed that for fathers, while night work was not directly associated with psychological distress, it did indirectly impact via increases in work–family conflict. In another study (Haines III et al., 2008), shift work was found to have both direct and indirect effects (via work-to-family conflict) on depression. These few studies indicate there may be important inter-relationships between shift work, work–family conflict, and mental health.

Variation in Mothers and Fathers

In considering the pathways between shift work, work–family conflict, and associated poor mental health, the impacts of shift work may differ for mothers and fathers. Research conducted by Cooklin et al. (2016) broadly explored job characteristics most salient for mothers' and fathers' work–family conflict and found that women were more vulnerable than fathers when working longer hours (i.e. mothers had lower work hour thresholds for "entering" into work–family conflict) and insecure work. However, like many other studies, Cooklin et al. analysed mothers and fathers separately with no formal test of gender differences, and shift work was not specifically explored. Overall, very few studies have examined the role played by gender in the association between shift work and work–family conflict. To our knowledge, only Jansen et al. (2003) has investigated gender differences, finding that shift work significantly increased the risk of work–family conflict for men but not women (although this study also analysed men and women separately). In contrast, research that has focused on the association between shift work and mental health suggests the association may be stronger for women (Bildt & Michelsen, 2002; Driesen et al., 2011), although none of this research has explored the role of work-family conflict, and formal tests of gender differences are again rare (see Zhao et al. 2019 for a review).

Overall, while there is reason to propose that the interrelationships between shift work, work–family conflict and mental health may show different patterns for mothers and fathers, the existing literature is scant. Also, the overarching context is one in which many work- and family-related factors differ between mothers and fathers. Many mothers curtail their workforce participation and work part-time to meet the needs of children and their partners (Cha, 2010). and the jobs that male and female shift workers are in are often different (i.e. Australian data from 2012 [ABS, 2012] show that the highest proportion of male shift workers are in "Mining" [47%], while for women they are in "Accommodation and food services" [33%] and "Health care and social assistance" [30%]). In an attempt to more confidently isolate and identify the potential gender differences in shift work from the related contextual factors, the current study controls for a range of work and family covariates.

The Present Study

Many parents assume that working shifts assists their goal of balancing work and family demands, but the disparate evidence available suggests

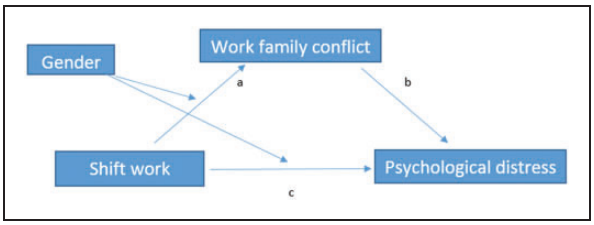

Figure 1. The conceptual moderated mediation model.

this may not be the case. The current study investigated whether shift work is associated with psychological distress for parents through the mediation effect of work–family conflict and whether gender moderated these associations. We also explore potential differences based on the type of shift work undertaken (e.g. regular, irregular, and rotating shifts), given the reviewed research suggests the impacts on mental health may differ.

As illustrated in Figure 1, we conceptualised a moderated-mediation model to depict the relationship between shift work, work–family conflict, gender and psychological distress. Path *a* represents the relationship between shift work and work–family conflict, and path *b* represents the relationship between work–family conflict and psychological distress; therefore *a***b* is the indirect (mediation) effect of shift work on distress. Path *c* represents the direct effect of shift work on psychological distress independent of the effect of work–family conflict. Based on existing studies, we also explore whether gender might moderate the relationship between shift work and work–family conflict (path *a*), and the relationship between shift work and psychological distress (path *c*). However, due to the paucity of evidence, we do not hypothesize whether effects will be stronger for fathers or mothers.

Based on the proposed model, we aim to test the following specific hypotheses:

1. Shift work will be associated with higher work–family conflict (i.e. path *a*) and psychological distress (i.e. path *c*) in parents of children less than18 years of age (associations may differ based on the type of shift work undertaken).
2. The association between shift work and parents' higher psychological distress will be mediated by increased work–family conflict (i.e. path *a* * path *b*).

3. Gender will moderate the association between shift work and work–family conflict (i.e. path *a*), and the association between shift work and psychological distress (i.e. path *c*).
4. The indirect effect of shift work on psychological distress transmitted by work–family conflict (i.e. path a*b) will be moderated by gender.

Methods

Study Context

Data for the current study is drawn from the "Families at Work" survey, an online nationwide community-based survey about employed parents' working conditions, caring responsibilities and well-being. Eligible participants for the survey were required to (a) be $\leq$18 years, (b) reside in Australia, (c) be in paid employment, and (d) have at least one child $\geq$18. Ethical approval was granted by the La Trobe University Human Ethics Sub-Committee. The data were collected from August–November, 2016, with parents recruited using a comprehensive online recruitment strategy (Bennetts et al., 2019). The Families at Work sample was found to be broadly representative of parents in the Australian population based on comparisons with the nationally representative Longitudinal Study of Australian Children, although it included more tertiary educated parents (65% vs 44%; $p<.001$), fewer parents born outside Australia (18% vs 23%; $p<.001$), and the sample lived in less disadvantaged neighborhoods (SEIFA score mean 1018.7 vs mean 1011.1; $p<.001$) (Bennetts et al., 2019).

Sample

The sample included 5,163 eligible employed parents. Among them, 5,099 (98.8%) answered the question about shift work and 1,013 (19.6%) reported they were undertaking some type of shift work—419 (8.1%) in regular shifts, 238 (4.6%) in rotating shifts, and 356 (6.9%) in irregular shifts. Because the sample size included far more individuals who were not shift workers than those who were (as is also found in the general population), 10% of all non-shift workers (n = 343) were randomly selected to compare with the three shift-worker groups. After this random selection, 1,431 individuals in total remained in the sample. Of them, 221 were excluded due to missing data on items of interest. This left 1,210 (84.6%) individuals, with two individuals who didn't disclose their gender also excluded, leaving 452 fathers and 756

mothers in the final sample. The 221 individuals with missing data were compared to the sample with complete data using univariate analyses. No differences, except for occupation type, were found between those with and without missing data. There were no differences in level of work–family conflict ($t = .042$, $p = .967$) and psychological distress ($t = -.800$, $p = .424$). Additional supplementary analyses comparing the final current analyses sample and parents from the Longitudinal Study of Australian Children (LSAC) showed that samples did not differ on the proportion of single parents, although the current sample included more educated parents (54.3% had a Bachelor's degree compared to 44% in LSAC).

Variables and Measures

The measures retained for the present study included shift work status/type, work–family conflict, psychological distress symptoms, and a series of demographic and work-related variables.

Shift work. Participants were asked the following: "*In a usual week in your job/business, do you work…?*" Responses included "*shift-work, regular roster,*" "*shift-work, rotating roster,*" "*shift-work, irregular roster,*" and "*no shift work.*" This variable was based on the shift work item in the Australian Longitudinal Study of Australian Children. Participants were categorised into four groups: "Regular shift," "Rotating shift," "Irregular shift," and "No shift work".

Psychological distress symptoms were measured with Kessler-10 scale (Kessler et al., 2002). Participants were asked ten items about how often they felt a range of psychological symptoms in the last four weeks on a 5-point scale (1 = none of the time; 5 = all of the time; range 10-50).

Work–family conflict was assessed using a four-item, five-point scale (1 = strongly disagree, 5 = strongly agree) that measured both the degree to which work interfered with family and the degree to which family interfered with work. Higher scores indicated higher work–family conflict (Marshall & Barnett, 1993).

Demographic variables measured in the study included the following: *Gender* (i.e. Male or Female), *Single parent status* (i.e. partnered parents [including parents who are married or de facto] or single parents [including those divorced, separated, widowed, or never married]), *Pre-tax income* (i.e. cut-off point was set at $800 per week, which is $\sim$120% of the median weekly personal income for people aged $\leq$15 years in Australia; ABS, 2016), *Highest level of education* (Bachelor's

or higher degree vs. Below Bachelor's), *Number of children* (one or two children vs. at least three children), and *The age of the youngest child.*

A series of *employment characteristics* were also included in the study: *Occupations* consisted of: Manager/Administrator (e.g. business owner and managing director); Professional/Associate professional (e.g. nurse, teacher, and accountant); Trades person (e.g. electrician and plumber); Clerical or service worker (e.g. reception, retail or sales, and office coordinator); Labourers and related worker (e.g. construction and road worker) and Other. *Job quality* was estimated based on four items reflecting job flexibility, job security, autonomy, and leave access. Each of the four items was responded to with a binary response (Yes/No), and an overall count of these working conditions was summed to represent job quality. The job quality score was then categorized into a binary variable based on the median score, that is, high job quality (if score ≤ 3) or low job quality (if score <3). *Work hours per week* (under 20 hours, 20–40 hours or above 40 hours), and *Permanency* (Permanent ongoing position; or fixed term contract/causal basis/some other basis/don't know) were also measured.

Statistical analysis

In the current analyses, first, to describe and compare individuals working different types of schedules, univariate analyses assessed the association of each demographic and work-related variable (including work–family conflict—informing hypothesis 1) with shift work (i.e. chi-squared tests and ANOVAs). All demographic and work-related variables found to be significantly associated with shift work (as presented in Table 1) were controlled for in the subsequent simple mediation, simple moderation, and moderated mediation analyses, except for tertiary education, which was significantly correlated with both single parents status (Spearman $\rho = .103$, $p < .001$) and income (Spearman $\rho = .112$, $p < .001$) (i.e. potential collinearity). Based on this, variables controlled for in all the multivariate analyses were single parent status, income, number of children, job quality, work hours, occupation type and permanent position.

Second, Preacher and Hayes "test of mediation" (Hayes, 2009; Preacher & Hayes, 2004) was applied to assess the mediation effect of work–family conflict in the association between shift work and psychological distress (hypothesis 2). This test utilizes bootstrapping to "generate a reference distribution, which is then used for confidence interval estimation and significance testing" (MacKinnon et al., 2007,

Table 1. Descriptive and Univariate Analyses for the Sample

		No Shift	Regular	Rotating	Irregular	Total
Total Number of Workers		342 (28.3%)	358 (29.7%)	209 (17.3%)	299 (24.8%)	1208 (100.0%)
Demographic Variables						
Gender[a,***]	Males	78 (22.8%)	149 (41.6%)	119 (56.9%)	106 (35.5%)	452 (37.4%)
	Females	264 (77.2%)	209 (58.4%)	90 (43.1%)	193 (64.5%)	756 (62.6%)
Single parents[a,*]	Married parents	297 (86.8%)	296 (82.7%)	184 (88.0%)	240 (80.3%)	1017 (84.2%)
	Single parents	45 (13.2%)	62 (17.3%)	25 (12.0%)	59 (19.7%)	191 (15.8%)
Income[a,***]	≥$800/week	290 (84.8%)	263 (73.5%)	181 (86.6%)	217 (72.6%)	951 (78.7%)
	<800/week	52 (15.2%)	95 (26.5%)	28 (13.4%)	82 (27.4%)	257 (21.3%)
Tertiary education[a,***]	Bachelor's or higher	253 (74.0%)	160 (44.7%)	86 (41.1%)	157 (52.5%)	656 (54.3%)
	Below bachelor's	89 (26.0%)	198 (55.3%)	123 (58.9%)	142 (47.5%)	552 (45.7%)
Number of children[a,**]	2 children or less	275 (80.4%)	273 (76.3%)	144 (68.9%)	211 (70.6%)	903 (74.8%)
	3 or more children	67 (19.6%)	85 (23.7%)	65 (31.1%)	88 (29.4%)	305 (25.2%)
Youngest child age[b] NS		6.25 (5.02)	6.20 (4.77)	5.33 (4.29)	6.32 (4.74)	6.09 (4.77)
Work-related Variables						
Occupational type[a,***]	Manager/Administrator	48 (14.0%)	24 (6.7%)	17 (8.1%)	11 (3.7%)	100 (8.3%)
	Professional	214 (62.6%)	144 (40.2%)	87 (41.6%)	165 (55.2%)	610 (50.5%)
	Trades person	6 (1.8%)	30 (8.4%)	27 (12.9%)	10 (3.3%)	73 (6.0%)
	Clerical/service worker	44 (12.9%)	71 (19.8%)	26 (12.4%)	31 (10.4%)	172 (14.2%)
	Labourer or related worker	2 (0.6%)	23 (6.4%)	14 (6.7%)	9 (3.0%)	48 (4.0%)
	Other	28 (8.2%)	66 (18.4%)	38 (18.2%)	73 (24.4%)	205 (17.0%)
Work hours[a,***]	Work 20 hours or less per week	37 (10.8%)	42 (11.7%)	10 (4.8%)	33 (11.0%)	122 (10.1%)
	Work 20-40 hours per week	151 (44.2%)	164 (45.8%)	67 (32.1%)	125 (41.8%)	507 (42.0%)

(continued)

Table 1. Continued

		No Shift	Regular	Rotating	Irregular	Total
Total Number of Workers		342 (28.3%)	358 (29.7%)	209 (17.3%)	299 (24.8%)	1208 (100.0%)
	Work more than 40 hours per week	154 (45.0%)	152 (42.5%)	132 (63.2%)	141 (47.2%)	579 (47.9%)
Employment type[a,***]	Permanent	285 (83.3%)	301 (84.1%)	185 (88.5%)	196 (65.6%)	967 (80.0%)
	Not permanent	57 (16.7%)	57 (15.9%)	24 (11.5%)	103 (34.4%)	241 (20.0%)
Job quality[a,***]	High quality	269 (78.7%)	228 (63.7%)	102 (48.8%)	122 (40.8%)	721 (59.7%)
	Low quality	73 (21.3%)	130 (36.3%)	107 (51.2%)	177 (59.2%)	487 (40.3%)
Work-family conflict (1-5)[b,***]		3.40 (.79)	3.37 (.81)	3.52 (.70)	3.60 (.71)	3.46 (.77)
Health & Well-being						
Distress symptoms (10-50)[b,*]		18.68 (6.85)	20.10 (7.69)	20.04 (8.03)	20.37 (8.15)	19.76 (7.66)

*Note: [a]N (% within the column); Pearson Chi-Square test.[b] Mean (SD); One-way ANOVA. *p<0.05 level; ** p<0.01 level; ***p< 0.001 level; NS not significantly association*

p. 601). Bootstrapping overcomes the normality assumptions necessary in other tests of mediation, such as the Sobel test (Sobel, 1982); and other limitations of Baron and Kenny's "causal steps approach." Third, we adopted simple moderation models to examine the moderating effect of gender on the association between shift work and work–family conflict, controlling for covariates, and the moderating effect of gender on the association between shift work and psychological distress, controlling for covariates and work–family conflict (hypothesis 3).

Finally, the moderated mediation model, also known as "conditional process analysis" (Hayes, 2013), was applied to assess whether or not the mediation effect of work–family conflict on the association between shift work and psychological distress is moderated by gender (hypothesis 4). In other words, this final step assessed whether the mediation effect was different for fathers and mothers.

It's important to note that in the approaches taken in these analyses, a significant association between independent variable X and dependent variable Y is not a necessary prerequisite for a mediation/moderation effect between X and Y. Similarly, the simple mediation model is not a necessary precursor for a moderated mediation model (Hayes, 2009; Parker et al., 2011; Preacher & Hayes, 2004). This is because Preacher and Hayes (Hayes, 2009; Preacher & Hayes, 2004) argue that in multivariate models, there could be more than one pathway (or mediating variable) to carry the effect from X through to Y, and multiple paths may operate in opposite directions (if this is the case an association between X and Y may not be observed).

All analyses were performed using SPSS 25.0. The simple mediation, simple moderation and the moderated mediation analyses were performed using PROCESS, which is a statistical macro for conducting mediation and moderation analyses in SPSS (Hayes, 2013; Hayes & Preacher, 2014; Preacher & Hayes, 2004).

Results

Sample Characteristics for Parents Working Different Schedules

The results of the descriptive and univariate analyses are presented in Table 1. Compared to non-shift workers, shift workers were more likely to be male, single parents, and have at least three children. The proportion of workers with a bachelor's or higher degree, or with an income higher than $800/week was lower for shift workers. Shift workers were less likely to be in a permanent position or a high-quality job.

Importantly, the univariate analyses showed that shift work was significantly associated with higher work–family conflict and psychological distress (showing support for hypotheses 1). All variables with a significant univariate association (except education level) were taken into account in subsequent analyses.

The Mediation Effect of Work–Family Conflict

Table 2 illustrates the results from the simple mediation model examining the indirect (mediation) effect of work–family conflict, both before and after controlling for covariates. The indirect effect is quantified as the product of the direct effect of shift work on work–family conflict (path *a*), and the direct effect of work–family conflict on psychological distress (path *b*). It's clear that the association between irregular shift work and higher psychological distress was explained by greater work–family conflict, both before (*Coeff* = .66, 95%CI [.27 to 1.08]) and after controlling for covariates (*Coeff* = .39, 95%CI [.00 to .79]) (hypothesis 2 partially supported). The coefficients from all other pathways were no longer statistically significant after taking the covariates into consideration.

Before formally testing the moderated-mediation model (i.e. the mediation effect conditional on gender), the direct and indirect effects of shift work were first examined separately for fathers and mothers in separate stratified mediation models. The results are displayed respectively for regular, rotating, and irregular shift in Figures 2–4. For regular shift work, the indirect effect via work–family conflict was not significant for either mothers or fathers. For both genders, the direct effect was significant, and it was stronger for mothers (*Coeff* = 4.21, $p<.05$) than for fathers (*Coeff* = 1.54, $p<.05$) (reflecting the simple moderation effect). As in Figure 3, the indirect effect of rotating shift work on psychological distress via work–family conflict was significant for fathers (*Coeff* = .77, 95%CI [.08 – 1.48]), but not for mothers (*Coeff* = .02, 95%CI [−.56 – .61]). And when the effect of work–family conflict was controlled for, the direct effect of rotating shift on psychological distress was not significant for fathers (*Coeff* = .52, $p>.05$) or mothers (*Coeff* = 2.43, $p>.05$). Similarly, the indirect effect of *irregular shift work* was also significant for fathers (*Coeff* = 1.00, 95% CI [.29 – 1.74]) but not mothers (*Coeff* = .21, 95%CI [−.26 – .71]), as shown in Figure 4. The direct effect was not significant for either gender (*fathers: Coeff* = −.16, *mothers: Coeff* = .04, both $p>.05$).

Table 2. Simple Mediation Model

	Crude Model[1]								
	Total Effect			Direct Effect			Indirect Effect		
	Effect	SE	t	Effect	SE	t	Effect	BootSE	95%BootCI
Regular	**1.41**	**.58**	**2.45***	**1.53**	**.54**	**2.82****	−.12	.21	−.52 – .30
Rotating	**1.35**	**.67**	**2.02***	.97	.63	.13	.39	.22	−.04 – .83
Irregular	**1.69**	**.60**	**2.79****	1.03	.57	1.80†	**.66**	**.21**	**.27 – 1.08**
	Adjusted Model[2]								
	Total Effect			Direct Effect			Indirect Effect		
	Effect	SE	t	Effect	SE	t	Effect	BootSE	95%BootCI
Regular	.76	.59	1.30	.86	.56	1.54	−.10	.20	−.48 – .29
Rotating	.34	.70	.49	.14	.67	.21	.20	.22	−.23 – .63
Irregular	.43	.63	.69	.05	.60	.08	**.39**	**.20**	**.00 – .79**

Note: [1]Before adjusting for covariates. [2] Adjusting for single parent status, income, number of children, job quality, work hours, occupation type and permanent position. †$p<0.1$ *level;* *$p<0.05$ *level;* ** $p<0.01$ *level.*

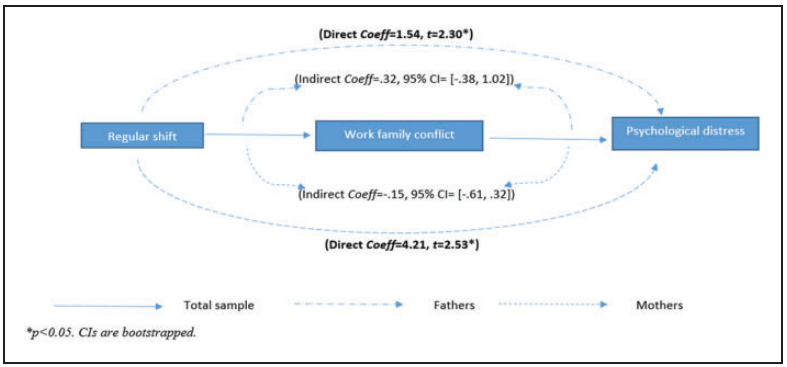

Figure 2. Indirect and direct effect of *regular shift work* conditional on gender for each shift work type.

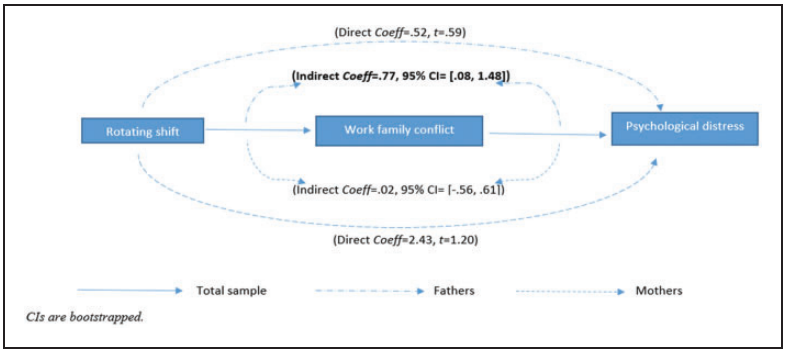

Figure 3. Indirect and direct effect of *rotating shift work* conditional on gender for each shift work type.

The Moderating Effect of Gender

Two simple moderation models tested the moderating effect of gender on the association between shift work and work–family conflict (path *a*), and the association between shift work and psychological distress (path *c*), respectively. The coefficients from the models are displayed in Table 3. The association between shift work and work–family conflict was stronger for fathers, such that the interaction between irregular shift work and gender showed a trend towards a statistically significant effect ($Coeff = -.97$, $p < .1$). On the contrary, the association between

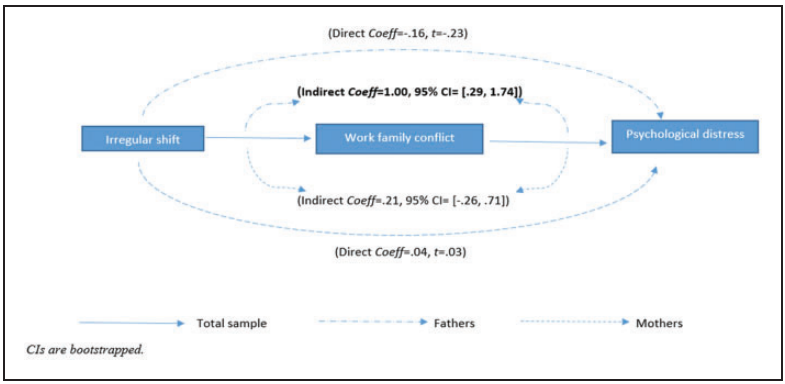

Figure 4. Indirect and direct effect of *irregular shift work* conditional on gender for each shift work type.

shift work and psychological distress was stronger for mothers, as shown by the significant interaction between regular shift work and gender ($Coeff = 2.67$, $p < .05$). The results show some support for hypothesis 3.

The Moderated Mediation Effect

The results regarding the formal test of the moderated mediation effect and the indexes are shown in Table 4. In contrast to the results describing gendered effects in Figures 2–4, none of the three types of shift work showed a statistically significant difference of the indirect effects between genders (*Regular: Index* = −.47, 95%CI [−1.29 – .37]; *Rotating: Index* = -.75, 95%CI [−1.60 – .17]; I*rregular: Index* = −.79, 95%CI [−1.62 – .05]), although the difference of the indirect effect of irregular shift work showed a trend towards significance between fathers and mothers (*Index* = −.79, 90%CI [−1.53 – −.11].

Overall, there was mixed support shown for hypothesis 4. In the simple mediation analyses stratified by gender, both rotating and irregular shift work showed significant indirect/mediation effects on psychological distress through work–family conflict for fathers but not mothers. However, the summary results for the formal moderated mediation model suggested that the differences in the indirect effect between fathers and mothers did not reach statistical significance for any of the three types of shift work. A trend was shown for irregular shift work, such that the association between irregular shift work and greater

Table 3. Regression Coefficients from Simple Moderation Models (*Path a and Path c*) Controlling for All Demographic and Employment Characteristics

	Work–Family Conflict			Psychological Distress		
	Coeff	*SE*	*t*	*Coeff*	*SE*	*t*
Regular shift[a]	.39	.42	.93	−1.12	1.02	−1.10
Rotating shift[b]	**.94**	**.44**	**2.13***	−1.38	1.07	−1.30
Irregular shift[c]	**1.22**	**.45**	**2.73****	−.37	1.09	−.34
Work–family conflict	/	/	/	**.82**	**.07**	**11.67*****
Gender[d]	**1.06**	**.39**	**2.74****	**−2.60**	**.94**	**−2.78****
Regular shift X gender	−.57	.50	−1.15	**2.67**	**1.20**	**2.21***
Rotating shift X gender	−.91	.56	−1.62	1.91	1.36	1.40
Irregular shift X gender	−.97	.52	−1.86†	.20	1.27	.16
Single parents[e]	**1.27**	**.24**	**5.39*****	**1.96**	**.57**	**3.41*****
Number of children[f]	**.63**	**.20**	**3.21****	.63	.48	1.32
Income[g]	−.42	.25	−1.64	1.13	.61	1.86†
Part-time work[h]	**−1.23**	**.31**	**−3.90*****	−.34	.76	−.44
Over-time work[i]	**.45**	**.21**	**2.17***	.12	.50	.24
Trades person[j]	−.43	.47	−.93	−1.38	1.13	−1.22
Professional[k]	**.83**	**.33**	**2.56***	**−1.67**	**.79**	**−2.12***
Clerical or service worker[l]	**.86**	**.39**	**2.20***	−.45	.94	−.48
Labourer[m]	−.12	.53	−.23	−.78	1.28	−.61
Other[n]	.32	.37	.87	−.96	.90	−1.07
Job quality[o]	**.80**	**.19**	**4.18*****	**1.80**	**.46**	**3.89*****
Permanent position[p]	−.28	.23	−1.18	.05	.56	.10

Note: [a]Regular shift: 0 = day shift or other shift work, 1 = regular shift work; [b]Rotating shift: 0 = day shift or other shift work, 1 = rotating shift work; [c]Irregular shift: 0 = day shift or other shift work, 1 = irregular shift work; [d]Gender: 0 = male, 1 = female; [e]Single parents: 0 = married parents, 1 = single parents; [f]Number of children: 0 = 2 children or less; 1 = 3 or more children; [g]Income: 0= more than $800/week or prefer not to say, 1 = less than $800/week; [h]Part-time work: 0 = work more than 20 hours/week, 1 = work less than 20 hours/week; [i]Over-time work: 0 = work less than 40 hours/week, 1 = work more than 40 hours/week; [j]Trades person: 0 = any other occupation, 1 = Trades person; [k]Professional: 0 = any other occupation, 1 = Professional; [l]Clerical or service worker: 0= any other occupation, 1 = Clerical or service worker; [m]Labourer: 0= any other occupation, 1 = labourer; [n]Other: 0 = Managers/Administrators, Trades person, Professional, Clerical or service worker, or Labourer; 1 = other occupations.[o]Job quality: 0=high quality, 1=low quality; [p]Permanent position: 0= permanent position, 1= not permanent position. *†p<0.1; *p<0.05; ** p<0.01; ***p< 0.001*.

Table 4. Index of Moderated Mediation (Difference between Conditional Indirect Effects)

	Index	BootSE	95%BootCI	90%BootCI
Regular shift	−.47	.42	−1.29 – .37	−1.14 – .23
Rotating shift	−.75	.45	−1.60 – .17	−1.50 – .00
Irregular shift	−.79	.43	−1.62 – .05	−1.53 – −.11

psychological distress via work–family conflict was relatively stronger for fathers than mothers.

Supplementary Data and Analyses

Supplementary analyses provided additional information about socio-demographic, work-related, and well-being-related covariates separately for mothers and fathers (see Supplemental Tables S1 and S2) to show the broad contextual differences by gender. Additional gender interaction effects tested for each covariate, predicting psychological distress and work–family conflict, showed few significant gender differences. Only the association between low income and psychological distress was stronger for men as was the association between non-permanent employment and psychological distress. These findings suggest gender differences in the covariates were not a dominant factor in driving gender differences in the main analyses (results not shown). Also, the findings for the covariates in the mediation and moderated-mediation analyses may be of interest and are shown in Supplemental Table S3 and S4.

Discussion

The results of this study show some evidence of an association between undertaking shift work and higher psychological distress. This association was found to be either direct, or indirect via work–family conflict depending on the type of shift work undertaken. All effects were substantially reduced after controlling for related work and family covariates, pointing towards the interplay between shift work and other job characteristics. The findings suggest different patterns for fathers and mothers; however, for the most part, these gender differences did not reach traditional cut-points for statistical significance. Working irregular shifts was associated with higher work–family conflict and subsequently higher psychological distress, and fathers were at greater risk

(although this finding only showed a trend towards statistical significance). Working regular shifts was associated with poorer mental health, but this was not because of increased work–family conflict, and this association was stronger for mothers. The findings are set against a backdrop of the literature that typically discusses gender differences in job characteristics and work–family conflict by stratifying analyses for men and women separately rather than formally testing for interaction effects.

Interpreting the Simple Mediation Model—For the Whole Sample

Initially, before gender differences were explored, the simple mediation model showed that working in irregular shift work (but not regular or rotating shift work) was associated with greater work–family conflict, which in turn mediated the association between irregular shift work and higher psychological distress. These results align with a previous systematic review conducted by Zhao et al. (2019), which found evidence that irregular shift work has a negative impact on workers' mental health. The current results suggest that irregular/unpredictable shift work may disrupt family routines and is a barrier to forming consistent patterns in work and family roles, and this work-family disruption is connected to greater psychological distress over and above the other stressors involved in working irregular shifts (i.e. lower income, lack of permanency, and poorer job quality).

Interpreting the Simple Moderation and Moderated-mediation Models—The Role of Gender

Gender similarities and differences emerged in the simple moderation and the moderated-mediation models. After accounting for potential confounders (including indicators of job quality), regular shift work was found to be associated with greater mental health problems for both genders, but not because of higher levels of work–family conflict. Instead, other adversities related to shift work, such as sleep-related problems, fatigue, or obesity, may explain experiences of psychological distress for these workers (Saksvik et al., 2011). Importantly, the association was stronger for mothers. Future research should continue to isolate the mechanisms that explain the association between regular shift work and mental health – especially for mothers. It may be that mothers' high hours of unpaid domestic work and care (Craig & Mullan, 2011; Craig & Powell, 2018) is a mechanism for their greater psychological distress in the context of also undertaking shift work, but

that mothers do not perceive their high load of family responsibilities as in conflict with their work duties (and thus it isn't captured by the work–family conflict measure). Unpaid work was not assessed in the current study to explore this further and so this is an avenue for future research.

The results regarding rotating and irregular shift work showed some similarities. The gendered effects in the simple mediation models showed that rotating and irregular shift working fathers' greater psychological distress could potentially be explained by greater work–family conflict, while none of the results suggested that mothers who worked in rotating or irregular shifts experienced higher work–family conflict or psychological distress. However, these gender differences are somewhat speculative as the overall test of moderated mediation showed no statistically significant differences between mothers and fathers (although there was a trend towards a significant effect for irregular shift).

The potential gender differences highlighted in the current study show some similarities, and also some interesting contrasts, when compared with past research. Consistent with Haines III et al's. (2008) research investigating shift working fathers, the current results point towards an association between shift work, work–family conflict, and mental health among fathers. One interpretation is that in our modern society, where gender equality is improving and the meaning of "being a husband/father" is moving beyond "breadwinner," shift-working fathers (particularly those in irregular and rotating shift work) remain less able to participate in family/home-based activities, resulting in higher work–family conflict. This idea aligns with research by Craig and Powell (2011) who found that shift working fathers' participation in domestic work is very low. The opportunity (or lack of opportunity) for family-friendly work arrangements specifically for shift working fathers should be further investigated. Interestingly, the current findings for mothers contrast with several studies. Both Haines III et al., (2008) and Carlson et al., (2011) found that mothers working nonstandard hours experienced higher work-to-family conflict and poorer mental health than mothers working standard hours, However our study, in line with Jansen et al. (2003), found no association between mothers' shift work and their work–family conflict. The current results may indicate that for mothers, shift work as a deliberate strategy to balance work and family is in part successful, despite the other potential drawbacks for their mental health. However, considering that the gender differences in the current study should be interpreted with caution

(due to low statistical significance), more research is necessary to further probe the role played gender.

Strengths and Limitations

The current study used a large Australian sample of employed parents (both mothers and fathers) from a range of occupations with children across diverse age groups to investigate the association between different shift working schedules and parents' psychological distress—and the mediating role of work–family conflict. The broad sample provides a more comprehensive (population-based) understanding of the experience of shift working parents compared to past studies, which have often focused solely on mothers or fathers, parents of infants, or have been restricted to certain occupations. The current study is one of the first to investigate gender differences in relation to shift work, work—family conflict, and mental health by formally testing the moderating effect of gender, and the first to formally test for gender differences using a moderated-mediation model. The results indicate that although the effect was descriptively different between genders, there was no statistically significant gender differences at the $p<.05$ level. More research is needed to further explore the gender differences highlighted as potentially important. A further strength is the broad range of potential confounders adjusted for including job-related factors such as work hours and job quality, allowing us to examine the association between the main variables of interest independent of potential confounders.

There are also limitations that need to be acknowledged. First, the online recruitment methodology used could lead to queries about sample representation. Comparisons have been made between the Families at Work sample and a nationally representative sample of parents within the Longitudinal Study of Australian Children (LSAC). These analyses found that parents in the Families at Work sample were largely comparable to those in LSAC; however, they were more likely to be single parents, with tertiary education and living in less disadvantaged neighborhoods. In addition, our own supplemental analyses comparing the current analysis sample with the LSAC sample found that the current sample was more advantaged socioeconomically. While the research suggests that overall, Facebook is still a feasible, low-cost means to recruit large national samples (Bennetts et al., 2019), we acknowledge that shift workers in the current sample may be more socioeconomically advantaged than shift workers in the general population. On the other hand, this research could be seen as complimentary

to past evidence focusing on parents with low incomes (Grzywacz et al., 2016), demonstrating that the negative impact of shift work on work–family conflict and mental health is not restricted to workers with low socioeconomic status. .

A further potential limitation is that the relationship between shift work and parents' mental health was assessed without considering the job characteristics of partners. Possibly, it is not individuals' work schedules, but the couples' joint work schedules that most greatly influences parents' work–family conflict and mental health (Perry-Jenkins et al., 2007; Strazdins et al., 2006). Quality time with families is essential for our mental well-being. For each family, the time they spend together is not only dependent on each individual's work hours, but also on the couples' combined work hours. Therefore, the detrimental effect of shift work may not be exerted by shift work itself, but by the lack of synchronicity between the work schedule of the couple (Muurlink et al., 2014). An in-depth investigation of couple's work schedules may shed more light on the reasons for gender differences between mothers and fathers. For example, mothers who work shifts may choose to do so to fit around their partners' work schedules and to balance work and family needs, whereas fathers may be more likely to undertake shift work as a non-optional job requirement. This highlights the need for further research that examines the impact of couples' work schedule combinations.

Finally, the cross-sectional design of the study limits investigating the links between working shifts, work–family conflict, and mental health in a "causal framework" or over the longer term. There is a possibility that the impacts of shift work on parental mental health only emerge after several years' accumulation (Bara & Arber, 2009). These "temporal" questions can only be tackled robustly using longitudinal data, tracking employed parents over time. We also acknowledge that the sample size may also have limited our ability to detect statistically significant effects, and therefore we provide a balanced approach to discussing both statistically significant finds and important trends that might inform future research.

Conclusion

The current study highlights the complex interplay between parents' work schedules and their experiences of work–family conflict and psychological distress. The findings provide further impetus to explore gender differences in these work and well-being-related experiences.

Parents, especially fathers, who work irregular shifts may be at greater risk of work–family conflict and psychological distress, whilst for parents working regular shifts, their poorer mental health does not appear to be because of work–family conflict, and this effect is stronger for mothers. As the labour force becomes increasingly fractured, in terms of working schedules, work hours, and workplace locations, it is critical that the potential impacts of nonstandard work hours on families and workers' mental health continues to be identified.

Declaration of Conflicting Interests

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Supplemental material

Supplemental material for this article is available online.

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Appendix 3

LA TROBE UNIVERSITY

COLLEGE OF SCIENCE, HEALTH & ENGINEERING

MEMORANDUM

To: **Amanda Cooklin**

From: **Secretariat, SHE College Human Ethics Sub-Committee (SHE CHESC)**

Reference: **S16-112 - Ethics application for modification to project - Approved**

Title: **Families at Work: An online survey of employed Australian parents.**

Date: **20 March, 2017**

Thank you for submitting your modification request for ethics approval to the SHE College Human Ethics Sub-Committee (SHE CHESC) for the project referred to above. The CHESC has reviewed and approved the following modification/s which may commence now:

Additional student investigators - Yixuan Zhao & Janeen Stewart.

Please note that your request has been reviewed by a sub-committee of the UHEC to facilitate a decision before the next Committee meeting. This decision will require ratification by the UHEC and it reserves the right to alter conditions of approval or withdraw approval at that time. However, you may commence prior to ratification and you will be notified if the approval status of your project changes.

The following standard conditions apply to your project:

- **Limit of Approval.** Approval is limited strictly to the research proposal as submitted in your application while taking into account any additional conditions advised by the SHE CHESC.
- **Variation to Project.** Any subsequent variations or modifications you wish to make to your project must be formally notified to the SHE CHESC for approval in advance of these modifications being introduced into the project. This can be done using the appropriate form: *Ethics - Application for Modification to Project* which is available on the Research Services website at http://www.latrobe.edu.au/researchers/starting-your-research/human-ethics. If the SHE CHESC considers that the proposed changes are significant, you may be required to submit a new application form for approval of the revised project.
- **Adverse Events.** If any unforeseen or adverse events occur, including adverse effects on participants, during the course of the project which may affect the ethical acceptability of the project, the Chief Investigator must immediately notify the chesc.she@latrobe.edu.au. Any complaints about the project received by the researchers must also be referred immediately to the SHE CHESC Secretary.
- **Withdrawal of Project.** If you decide to discontinue your research before its planned completion, you must advise the SHE CHESC and clarify the circumstances.
- **Monitoring.** All projects are subject to monitoring at any time by the SHE CHESC.
- **Annual Progress Reports.** If your project continues for more than 12 months, you are required to submit an *Ethics - Progress/Final Report Form* annually, **on or just prior to 12 February**. The form is available on the Research Services website (see above address). Failure to submit a Progress Report will mean

approval for this project will lapse.

- **Auditing**. An audit of the project may be conducted by members of the SHE CHESC.
- **Final Report.** A Final Report (see above address) is required within six months of the completion of the project**.**

If you have any queries on the information above or require further clarification please contact me at chesc.she@latrobe.edu.au.

Ms Kate Ferris
Human Ethics Officer
Secretariat – SHE College Human Ethics Sub-Committee
Ethics and Integrity / Research Office
La Trobe University Bundoora, Victoria 3086
E: cCHESC.she@latrobe.edu.au
P: (03) 9479 – 3370
http://www.latrobe.edu.au/researchers/ethics/human-ethics

Appendix 4

ADA Dataverse: You have been granted access to dataset: "Growing Up in Australia: Longitudinal Study of Australian Children (LSAC) Release 7.1 (Waves 1-7)>"

ada@anu.edu.au <ada@anu.edu.au>
Fri 2019-03-01 15:29
To: Yixuan Zhao <Yixuan.Zhao@anu.edu.au>

Hello,

You recently applied for access to controlled access files in dataset: Growing Up in Australia: Longitudinal Study of Australian Children (LSAC) Release 7.1 (Waves 1-7). We are pleased to advise that your application for access has been approved.

Your obligations as an Authorised Data User are contained in the Terms and Conditions of Use.

You can now view and download files from the dataset at this link: https://dataverse.ada.edu.au/dataset.xhtml?persistentId=doi:10.26193/F2YRL5.

(Please note that you will need to login to Dataverse to see your updated access, and to download controlled access files.)

If you have any queries in relation to the data please refer to the supporting documentation for Growing Up in Australia: Longitudinal Study of Australian Children (LSAC) Release 7.1 (Waves 1-7), or click on the email icon from anywhere in Dataverse to submit a query.

Thank you,
The Australian Data Archive

Appendix 5

Table S1 The results of univariate analyses on differences between different types of workers for fathers.

		No shift	Regular	Rotating	Irregular	Total
Total number of workers		78 (17.3%)	149 (33.0%)	119 (26.3%)	106 (23.5%)	452 (100.0%)
Demographic Variables						
Single Parents [a] NS	Married parents	71 (91.0%)	131 (87.9%)	110 (92.4%)	91 (85.8%)	403 (89.2%)
	Single parents	7 (9.0%)	18 (12.1%)	9 (7.6%)	15 (14.2%)	49 (10.8%)
Income [a] *	≥$800/week	72 (92.3%)	134 (89.9%)	115 (96.6%)	91 (85.8%)	412 (91.2%)
	<&800/week	6 (7.7%)	15 (10.1%)	4 (3.4%)	15 (14.2%)	40 (8.8%)
Tertiary Education [a] ***	Bachelor's or higher	50 (64.1%)	38 (25.5%)	28 (23.5%)	27 (25.5%)	143 (31.6%)
	Below bachelor's	28 (35.9%)	111 (74.5%)	91 (76.5%)	79 (74.5%)	309 (68.4%)
Number of Children [a] NS	≤2 children	62 (79.5%)	114 (76.5%)	87 (73.1%)	79 (74.5%)	342 (75.7%)
	≥3 or more	16 (20.5%)	35 (23.5%)	32 (26.9%)	27 (25.5%)	110 (24.3%)
Youngest child age [b] NS		5.50 (4.27)	5.93 (4.07)	4.81 (3.34)	5.24 (3.36)	5.40 (3.78)
Work-related Variables						
Occupational Type [a] ***	Manager/Administrator	13 (16.7%)	15 (10.1%)	11 (9.2%)	5 (4.7%)	44 (9.7%)
	Professional	46 (59.0%)	34 (22.8%)	31 (26.1%)	34 (32.1%)	145 (32.1%)
	Trades person	6 (7.7%)	27 (18.1%)	26 (21.8%)	9 (8.5%)	68 (15.0%)
	Clerical/service worker	2 (2.6%)	11 (7.4%)	12 (10.1%)	6 (5.7%)	31 (6.9%)
	Labourer or related worker	2 (2.6%)	21 (14.1%)	13 (10.9%)	6 (5.7%)	42 (9.3%)
	Other	9 (11.5%)	41 (27.5%)	26 (21.8%)	46 (43.4%)	122 (27.0%)
Work Hours [a] *	Work 40 hour or less per week	18 (23.1%)	49 (32.9%)	19 (16.0%)	22 (20.8%)	108 (23.9%)
	Work more than 40 hours per week	60 (76.9%)	100 (67.1%)	100 (84.0%)	84 (79.2%)	344 (76.1%)
Employment Type [a]**	Permanent	67 (85.9%)	134 (89.9%)	108 (90.8%)	79 (74.5%)	388 (85.8%)
	Not permanent	11 (14.1%)	15 (10.1%)	11 (9.2%)	27 (25.5%)	64 (14.2%)
Job Quality [a] ***	High quality	63 (80.8%)	96 (64.4%)	58 (48.7%)	48 (45.3%)	265 (58.6%)
	Low quality	15 (19.2%)	53 (35.6%)	61 (51.3%)	58 (54.7%)	187 (41.4%)
Work-family conflict (1-5) [b] **		3.22 (.79)	3.28 (.79)	3.48 (.66)	3.58 (.67)	3.39 (.74)
Health & Wellbeing						
Distress Symptoms (10-50) [b] NS		19.95 (8.29)	19.59 (7.63)	20.13 (8.39)	21.70 (8.99)	20.29 (8.29)

*[a] N (% within the column); Pearson Chi-Square test. [b] Mean (SD); One-way ANOVA. *p<0.05; ** p<0.01;***p< 0.001. NS not significantly associated.*

Table S2 The results of univariate analyses on differences between different types of workers for mothers.

		No shift	Regular	Rotating	Irregular	Total
Total number of workers		264 (34.9%)	209 (27.6%)	90 (11.9%)	193 (25.5%)	756 (100.0%)
Demographic Variables						
Single Parents [a] NS	Married parents	226 (85.6%)	165 (78.9%)	74 (82.2%)	149 (77.2%)	614 (81.2%)
	Single parents	38 (14.4%)	44 (21.1%)	16 (17.8%)	44 (22.8%)	142 (18.8%)
Income [a] ***	≥$800/week	218 (82.6%)	129 (61.7%)	66 (73.3%)	126 (65.3%)	539 (71.3%)
	<&800/week	46 (17.4%)	80 (38.3%)	24 (26.7%)	67 (34.7%)	217 (28.7%)
Tertiary Education [a] ***	Bachelor's or higher	203 (76.9%)	122 (58.4%)	58 (64.4%)	130 (67.4%)	513 (67.9%)
	Below bachelor's	61 (23.1%)	87 (41.6%)	32 (35.6%)	63 (32.6%)	243 (32.1%)
Number of Children [a] **	≤2 children	213 (80.7%)	159 (76.1%)	57 (63.3%)	132 (68.4%)	561 (74.2%)
	≥3 or more	51 (19.3%)	50 (23.9%)	33 (36.7%)	61 (31.6%)	195 (25.8%)
Youngest child age [b] NS		6.48 (5.21)	6.39 (5.22)	6.03 (5.23)	6.91 (5.26)	6.51 (5.22)
Work-related Variables						
Occupational Type [a] ***	Manager/Administrator	35.9 (13.3%)	9 (4.3%)	6 (6.7%)	6 (3.1%)	56 (7.4%)
	Professional	168 (63.6%)	110 (52.6%)	56 (62.2%)	131 (67.9%)	465 (61.5%)
	Trades person	0 (0.0%)	3 (1.4%)	1 (1.1%)	1 (0.5%)	5 (0.7%)
	Clerical/service worker	42 (15.9%)	60 (28.7%)	14 (15.6%)	25 (13.0%)	141 (18.7%)
	Labourer or related worker	0 (0.0%)	2 (1.0%)	1 (1.1%)	3 (1.6%)	6 (0.8%)
	Other	19 (7.2%)	25 (12.0%)	12 (13.3%)	27 (14.0%)	83 (11.0%)
Work Hours [a] NS	Work 40 hour or less per week	170 (64.4%)	157 (75.1%)	58 (64.4%)	136 (70.5%)	521 (68.9%)
	Work more than 40 hours per week	94 (35.6%)	52 (24.9%)	32 (35.6%)	57 (29.5%)	235 (31.1%)
Employment Type [a] ***	Permanent	218 (82.6%)	167 (79.9%)	77 (85.6%)	117 (60.6%)	579 (76.6%)
	Not permanent	46 (17.4%)	42 (20.1%)	13 (14.4%)	76 (39.4%)	177 (23.4%)
Job Quality [a] ***	High quality	206 (78.0%)	132 (63.2%)	44 (48.9%)	74 (38.3%)	456 (60.3%)
	Low quality	58 (22.0%)	77 (36.8%)	46 (51.1%)	119 (61.7%)	300 (39.7%)
Work-family conflict (1-5) [b] NS		3.46 (.79)	3.43 (.82)	3.56 (.75)	3.60 (.73)	3.50 (.78)
Health & Wellbeing						
Distress Symptoms (10-50) [b] *		18.31 (6.33)	20.46 (7.73)	19.92 (7.55)	19.65 (7.58)	19.44 (7.25)

*[a] N (% within the column); Pearson Chi-Square test. [b] Mean (SD); One-way ANOVA.*p<0.05; ** p<0.01;***p< 0.001. NS not significantly associated.*

Table S3 The effect of covariates on psychological distress via work-family conflict (simple mediation model)

	Total effect			*Direct effect*			*Indirect effect*		
	Effect	*SE*	*t*	*Effect*	*SE*	*t*	*Effect*	*SE*	*95%CI*
Single parents [a]	**2.89**	**.60**	**4.84*** **	**1.83**	**.57**	**3.20****	**1.05**	**.21**	**.66 – 1.49**
Number of children [b]	**1.11**	**.50**	**2.22***	.61	.48	1.27	**.50**	**.17**	**.19 – .84**
Income [c]	.79	.64	1.24	1.12	.61	1.84†	-.33	.21	-.75 – .08
Part-time work [d]	-1.41	.80	-1.77†	-.47	.76	-.62	**-.94**	**.29**	**-1.54 – -.38**
Over-time work [e]	.83	.50	1.67†	.58	.47	1.21	.26	.16	-.05 – .57
Trades person [f]	-1.52	1.17	-1.30	-1.06	1.11	-.95	-.46	.36	-1.21 – .22
Professional [g]	-1.02	.83	-1.24	**-1.73**	**.79**	**-2.20***	**.71**	**.26**	**.20 – 1.23**
Clerical or service worker [h]	.30	.99	.30	-.45	.94	-.48	**.75**	**.33**	**.14 – 1.42**
Labourer [i]	-.77	1.34	-.58	-.57	1.27	-.45	-.20	.43	-1.01 – .68
Other [j]	-.42	.94	-.44	-.64	.90	-.72	.23	.29	-.34 – .82
Job quality [k]	**2.45**	**.49**	**5.04*** **	**1.82**	**.46**	**3.91*****	**.63**	**.16**	**.32 – .94**
Permanent position [l]	-.21	.59	-.35	.01	.56	.02	-.22	.20	-.63 – .16

[a] Single parents: 0 = married parents, 1 = single parents; [b] Number of children: 0 = 2 children or less; 1 = 3 or more children; [c] Income: 0= more than $800/week or prefer not to say, 1 = less than $800/week; [d] Part-time work: 0 = work more than 20 hours/week, 1 = work less than 20 hours/week; [e] Over-time work: 0 = work less than 40 hours/week, 1 = work more than 40 hours/week; [f] Trades person: 0 = any other occupation, 1 = Trades person; [g] Professional: 0 = any other occupation, 1 = Professional; [h] Clerical or service worker: 0= any other occupation, 1 = Clerical or service worker; [i] Labourer: 0= any other occupation, 1 = labourer; [j] Other: 0 = Managers/Administrators, Trades person, Professional, Clerical or service worker, or Labourer; 1 = other occupations; [k] Job quality: 0=high quality, 1=low quality; [l] Permanent position: 0= permanent position, 1= not permanent position.

*† p<0.1; *p<0.05; ** p<0.01;***p< 0.001*

Table S4 The effect of covariates on psychological distress via work-family conflict, conditional on genders (moderated-mediation model)

Conditional Direct effect	*Fathers*			*Mothers*		
	Effect	*SE*	*t*	*Effect*	*SE*	*t*
Single parents [a]	**1.65**	**.67**	**2.45***	.45	1.72	.26
Number of children [b]	.49	.60	.82	.09	1.42	.06
Income [c]	.45	.66	.68	**-3.70**	**1.70**	**-2.18***
Part-time work [d]	-.55	.79	-.69	-2.55	2.73	-.94
Over-time work [e]	.71	.60	1.18	2.22	1.40	1.58
Trades person [f]	-1.53	3.28	-.47	-1.47	6.50	-.23
Professional [g]	-1.49	.86	-1.74†	-1.28	1.52	-.84
Clerical or service worker [h]	-.35	.99	-.35	.43	2.04	-.21
Labourer [i]	-4.65	3.00	-1.55	-8.79	5.98	-1.47
Other [j]	-.70	1.11	-.63	-.33	2.02	-.16
Job quality [k]	**1.45**	**.57**	**2.52***	.63	1.29	.49
Permanent position [l]	-.58	.65	-.89	-2.80	1.57	-1.78†

Conditional Indirect effect	*Fathers*			*Mothers*			*Differences between fathers and mothers*		
	Effect	*SE*	*95%CI*	*Effect*	*SE*	*95%CI*	*Index*	*SE*	*95%CI*
Single parents [a]	**1.09**	**.39**	**.33 – 1.85**	**1.00**	**.24**	**.53 – 1.48**	-.09	.44	-.93 – .77
Number of children [b]	.40	.26	-.10 – .93	**.56**	**.21**	**.16 – .98**	.17	.33	-.47 – .81
Income [c]	-.68	.43	-1.51-- .15	-.30	.23	-.76 – .15	.38	.46	-.51 – 1.29
Part-time work [d]	-1.48	1.27	-3.96 – 1.02	**-.93**	**.28**	**-1.52 – -.39**	.54	1.27	-2.02 – 3.03
Over-time work [e]	.49	.28	-.05 – 1.07	.30	.20	-.09 – .72	-.19	.34	-.86 – .48
Trades person [f]	-.29	.38	-1.05 – .45	-.71	1.07	-2.96 – 1.31	-.42	1.09	-2.71 – 1.70
Professional [g]	**.75**	**.34**	**.10 – 1.46**	**.62**	**.29**	**.08 – 1.22**	-.12	.32	-.75 – .51
Clerical or service worker [h]	**1.43**	**.57**	**.34 – 2.58**	.54	.33	-.09 – 1.20	-.90	.56	-2.00 – .18
Labourer [i]	-.20	.48	-1.15 – .76	.83	.65	-.38 – 2.16	1.02	.73	-.35 – 2.54
Other [j]	.00	.34	-.67 – .65	.70	.38	-.04 – 1.44	.70	.38	-.05 – 1.45
Job quality [k]	**.67**	**.23**	**.23 – 1.13**	**.64**	**.21**	**.24 – 1.06**	-.03	.29	-.61 – .53
Permanent position [l]	-.14	.39	-.91 – .63	-.27	.23	-.72 – .17	-.13	.43	-.99 – .74

[a] Single parents: 0 = married parents, 1 = single parents; [b] Number of children: 0 = 2 children or less; 1 = 3 or more children; [c] Income: 0= more than $800/week or prefer not to say, 1 = less than $800/week; [d] Part-time work: 0 = work more than 20 hours/week, 1 = work less than 20 hours/week; [e] Over-time work: 0 = work less than 40 hours/week, 1 = work more than 40 hours/week; [f] Trades person: 0 = any other occupation, 1 = Trades person; [g] Professional: 0 = any other occupation, 1 = Professional; [h] Clerical or service worker: 0= any other occupation, 1 = Clerical or service worker; [i] Labourer: 0= any other occupation, 1 = labourer; [j] Other: 0 = Managers/Administrators, Trades person, Professional, Clerical or service worker, or Labourer; 1 = other occupations; [k] Job quality: 0=high quality, 1=low quality; [l] Permanent position: 0= permanent position, 1= not permanent position.

Bold for significance. † $p<0.1$; *$p<0.05$;

Appendix 6

Table S5 Between- and Within-individual effects of all variables on mothers' psychological distress *(6-30)*

	Model 1 (n[#]=6146)		**Model 2** (n=6146)		**Model 3** (n=6141)		**Model 4** (n=5995)	
	Coeff	*t*	*Coeff*	*t*	*Coeff*	*t*	*Coeff*	*t*
Within-own shift work	-0.05	-0.49	-0.04	-0.40	-0.04	-0.40	-0.11	-1.00
Between-own shift work	0.21	1.24	0.20	1.21	0.18	1.06	-0.01	-0.06
Covariates								
Within-partner's shift work			-0.14	-1.23	-0.14	-1.23	-0.11	-0.91
Within-number of children					0.05	0.43	0.01	0.10
Within-infant at home					-0.11	-0.90	-0.17	-1.30
Within-Socioeconomic status					-0.11	-0.81	-0.12	-0.83
Within-age					-0.09	-1.12	-0.07	-0.91
Within-more domestic work					0.09	1.09	0.09	1.11
Within-less domestic work					0.54	2.48*	0.50	2.27*
Within-working part-time							0.07	0.79
Within-partner working part-time							0.06	0.26
Within-working over time							0.08	0.58
Within-partner working over time							0.05	0.60
Within-job quality							-0.14	-3.20**
Within-Professionals[‡]							-0.20	-1.54
Within-Technicians							-0.04	-0.15
Within-Service Workers							-0.17	-0.94
Within-Clericals							-0.35	-2.55*
Within-Sales workers							-0.22	-1.02

Within-Operators					-0.04	-0.06
Within-Labourers					-0.19	-0.66
Between-partner's shift work	0.05	0.28	-0.02	-0.13	-0.09	-0.53
Between-number of children			0.00	0.04	-0.04	-0.59
Between-infant at home			-0.52	-1.44	-0.22	-0.60
Between-Socioeconomic status			-0.17	-1.36	-0.15	-0.99
Between-age			-0.27	-1.78†	-0.30	-2.05*
Between-more domestic work			0.08	0.53	0.10	0.68
Between-less domestic work			2.12	4.27***	1.94	3.98***
Between-working part-time					-0.35	-2.21*
Between-partner working part-time					0.02	0.04
Between-working over time					0.19	0.77
Between-partner working over time					-0.06	-0.41
Between-job quality					-0.79	-9.99***
Between-Professionals					-0.54	-2.38*
Between-Technicians					0.13	0.32
Between-Service Workers					-0.58	-2.06*
Between-Clericals					-0.47	-1.83†
Between-Sales workers					-0.47	-1.32
Between-Operators					-1.61	-2.29*
Between-Labourers					-0.91	-2.14*

[#]In this table, n represents number of observations [‡] For occupation, Managers are reference group † sig at 0.1 level, * sig at 0.05 level, **sig at 0.01 level

Model 1: own shift work. Model 2: including variables in Model 1 + partner's shift work. Model 3: including variables in Model 2 + number of children, infant at home, socioeconomic status, age, share of domestic work. Model 4: including variables in Model 3 + work hours, partner's work hours, job quality and occupation.

Table S6 Between- and Within-individual effects of all variables on fathers' psychological distress *(6-30)*

	Model 1 (n[#]=6120)		**Model 2** (n=6120)		**Model 3** (n=6069)		**Model 4** (n=5878)	
	Coeff	*t*	*Coeff*	*t*	*Coeff*	*t*	*Coeff*	*t*
Within-own shift work	0.14	1.23	0.15	1.31	0.16	1.42	0.16	1.40
Between-own shift work	0.10	0.58	0.08	0.47	0.14	0.81	-0.09	-0.47
Covariates								
Within-partner's shift work			-0.11	-1.09	-0.12	-1.15	-0.11	-0.99
Within-number of children					0.22	1.97*	0.12	0.98
Within-infant at home					0.03	0.21	0.02	0.15
Within-Socioeconomic status					0.06	0.44	0.08	0.52
Within-age					-0.30	-3.64***	-0.34	-3.95***
Within-more domestic work					0.26	2.08*	0.21	1.67†
Within-less domestic work					0.45	4.77***	0.37	3.92***
Within-working part-time							-0.02	-0.09
Within-partner working part-time							0.09	1.05
Within-working over time							0.10	1.25
Within-partner working over time							0.10	0.77
Within-job quality							-0.17	-3.85***
Within-Professionals[‡]							0.10	0.75
Within-Technicians							-0.03	-0.22
Within-Service Workers							0.06	0.18
Within-Clericals							0.11	0.68
Within-Sales workers							0.16	0.75
Within-Operators							-0.19	-0.84
Within-Labourers							0.07	0.29

Between-partner's shift work	0.19	1.14	0.17	1.03	0.18	1.11
Between-number of children			0.14	2.02*	0.14	2.11*
Between-infant at home			-0.00	-0.01	-0.12	-0.35
Between-Socioeconomic status			0.17	1.40	0.21	1.42
Between-age			-0.06	-0.38	-0.19	-1.32
Between-more domestic work			0.50	2.10*	0.50	2.16*
Between-less domestic work			0.56	3.73***	0.51	3.48***
Between-working part-time					-0.33	-0.75
Between-partner working part-time					-0.14	-0.92
Between-working over time					-0.14	-1.02
Between-partner working over time					-0.15	-0.65
Between-job quality					-0.70	-8.24***
Between-Professionals					0.12	0.70
Between-Technicians					-0.24	-1.25
Between-Service Workers					-0.37	-1.22
Between-Clericals					0.23	0.76
Between-Sales workers					0.25	0.70
Between-Operators					-0.18	-0.63
Between-Labourers					-0.54	-1.64

[#]In this table, n represents number of observations [‡] For occupation, Managers are reference group † sig at 0.1 level, * sig at 0.05 level, **sig at 0.01 level

Model 1: own shift work. Model 2: including variables in Model 1 + partner's shift work. Model 3: including variables in Model 2 + number of children, infant at home, socioeconomic status, age, share of domestic work. Model 4: including variables in Model 3 + work hours, partner's work hours, job quality and occupation.

Table S7 Between- and within-individual effects of all variables on mothers' work-family conflict (*1-5*)

	Model 1 (n[#]=6054)		**Model 2** (n=6054)		**Model 3** (n=6048)		**Model 4** (n=5967)	
	Coeff	*t*	*Coeff*	*t*	*Coeff*	*t*	*Coeff*	*t*
Within-own shift work	0.01	0.38	0.01	0.45	0.02	0.59	0.03	0.95
Between-own shift work	-0.13	-2.73**	-0.12	-2.63**	-0.10	-2.11*	-0.04	-0.87
Covariates								
Within-partner's shift work			-0.03	-0.89	-0.03	-0.87	-0.04	-1.16
Within-number of children					0.09	2.92**	0.10	3.34***
Within-infant at home					-0.07	-2.07*	-0.04	-1.25
Within-Socioeconomic status					0.02	0.46	-0.03	0.82
Within-age					0.04	1.97*	0.00	0.04
Within-more domestic work					0.05	2.15*	0.05	2.37*
Within-less domestic work					-0.03	-0.43	-0.05	-0.88
Within-working part-time							-0.23	-9.36***
Within-partner working part-time							-0.03	-0.48
Within-working over time							0.11	3.08**
Within-partner working over time							0.00	0.11
Within-job quality							-0.06	-4.92***
Within-Professionals[‡]							-0.05	-1.44
Within-Technicians							-0.01	-0.10
Within-Service Workers							-0.10	-2.02*
Within-Clericals							-0.07	-1.94†
Within-Sales workers							-0.04	-0.75
Within-Operators							-0.14	-0.77
Within-Labourers							-0.09	-1.24

Between-partner's shift work	-0.05	-1.04	0.00	0.08	0.01	0.23
Between-number of children			0.00	0.10	0.02	1.07
Between-infant at home			-0.06	-0.61	0.04	0.46
Between-Socioeconomic status			0.31	9.18***	0.19	4.70***
Between-age			0.09	2.29*	0.08	1.99*
Between-more domestic work			0.06	1.66†	0.09	2.54*
Between-less domestic work			0.31	2.32*	0.14	1.06
Between-working part-time					-0.46	-11.13***
Between-partner working part-time					-0.16	-1.42
Between-working over time					0.06	0.90
Between-partner working over time					-0.05	-1.34
Between-job quality					-0.18	-8.34***
Between-Professionals					0.02	0.25
Between-Technicians					-0.04	-0.39
Between-Service Workers					-0.18	-2.43*
Between-Clericals					-0.18	-2.70**
Between-Sales workers					-0.09	-1.01
Between-Operators					-0.12	-0.67
Between-Labourers					-0.09	-0.82

[#]In this table, n represents number of observations [‡] For occupation, Managers are reference group † sig at 0.1 level, * sig at 0.05 level, **sig at 0.01 level, ***sig at 0.001 level

Model 1: own shift work. Model 2: including variables in Model 1 + partner's shift work. Model 3: including variables in Model 2 + number of children, infant at home, socioeconomic status, age, share of domestic work. Model 4: including variables in Model 3 + work hours, partner's work hours, job quality and occupation.

Table S8 Between- and within-individual effects of all variables on fathers' work-family conflict (*1-5*)

	Model 1 (n[#]=6104)		**Model 2** (n=6104)		**Model 3** (n=6051)		**Model 4** (n=5925)	
	Coeff	*t*	*Coeff*	*t*	*Coeff*	*t*	*Coeff*	*t*
Within-own shift work	0.04	1.28	0.03	1.17	0.03	1.17	0.03	0.93
Between-own shift work	0.13	3.22**	0.13	3.37***	0.14	3.60***	0.08	1.71†
Covariates								
Within-partner's shift work			0.04	1.40	0.04	1.57	0.04	1.38
Within-number of children					0.12	4.39***	0.12	4.41***
Within-infant at home					-0.08	-2.67**	-0.06	-2.00*
Within-Socioeconomic status					0.07	2.12*	0.10	2.84**
Within-age					-0.01	-0.45	-0.02	-0.77
Within-more domestic work					-0.04	-1.14	-0.03	-1.01
Within-less domestic work					0.07	3.16**	0.06	2.66**
Within-working part-time							-0.23	-3.78***
Within-partner working part-time							-0.01	-0.31
Within-working over time							0.05	2.64**
Within-partner working over time							0.02	0.46
Within-job quality							-0.03	-2.45*
Within-Professionals[‡]							-0.01	-0.30
Within-Technicians							0.02	0.58
Within-Service Workers							0.07	0.92
Within-Clericals							0.11	2.77**
Within-Sales workers							0.08	1.56
Within-Operators							0.17	3.05**
Within-Labourers							0.09	1.61

Between-partner's shift work	-0.07	-1.72†	-0.07	-1.92†	-0.06	-1.50
Between-number of children			0.02	1.11	0.01	0.64
Between-infant at home			0.02	0.28	0.02	0.23
Between-Socioeconomic status			0.03	1.11	0.04	1.16
Between-age			0.01	0.40	0.00	0.01
Between-more domestic work			-0.04	-0.67	-0.03	-0.55
Between-less domestic work			0.19	5.38***	0.17	4.80***
Between-working part-time					-0.28	-2.79**
Between-partner working part-time					-0.04	-1.04
Between-working over time					0.16	4.87***
Between-partner working over time					-0.01	-0.23
Between-job quality					-0.15	-7.73***
Between-Professionals					0.03	0.84
Between-Technicians					-0.02	-0.53
Between-Service Workers					0.03	0.48
Between-Clericals					-0.02	-0.27
Between-Sales workers					-0.04	-0.49
Between-Operators					-0.05	-0.74
Between-Labourers					-0.14	-1.81†

[#]In this table, n represents number of observations [‡] For occupation, Managers are reference group † sig at 0.1 level, * sig at 0.05 level, **sig at 0.01 level, ***sig at 0.001 level

Model 1: own shift work. Model 2: including variables in Model 1 + partner's shift work. Model 3: including variables in Model 2 + number of children, infant at home, socioeconomic status, age, share of domestic work. Model 4: including variables in Model 3 + work hours, partner's work hours, job quality and occupation.

Table S9 Between- and within-individual effects of all variables on mothers' relationship quality (*1-5*)

	Model 1 (n[#]=6135)		**Model 2** (n=6135)		**Model 3** (n=6129)		**Model 4** (n=5982)	
	Coeff	*t*	*Coeff*	*t*	*Coeff*	*t*	*Coeff*	*t*
Within-own shift work	0.04	2.07*	0.04	2.11*	0.04	1.78†	0.03	1.26
Between-own shift work	-0.06	-1.39	-0.06	-1.36	-0.07	-1.59	-0.08	-1.84†
Covariates								
Within-partner's shift work			-0.01	-0.60	-0.01	-0.52	-0.02	-0.87
Within-number of children					-0.02	-1.08	-0.03	-1.29
Within-infant at home					0.06	2.41*	0.07	2.56*
Within-Socioeconomic status					-0.05	-1.90†	-0.05	-1.64
Within-age					-0.03	-2.12*	-0.02	-1.41
Within-more domestic work					-0.11	-6.62***	-0.11	-6.69***
Within-less domestic work					0.00	0.08	0.02	0.37
Within-working part-time							0.05	2.52*
Within-partner working part-time							0.02	0.38
Within-working over time							-0.06	-2.34*
Within-partner working over time							0.02	1.45
Within-job quality							0.02	1.78†
Within-Professionals[‡]							0.00	0.13
Within-Technicians							-0.07	-1.13
Within-Service Workers							0.03	0.87
Within-Clericals							0.03	1.07
Within-Sales workers							0.09	2.00*
Within-Operators							-0.17	-1.21
Within-Labourers							-0.03	-0.46

Between-partner's shift work	-0.01	-0.17	-0.02	-0.42	0.00	0.00
Between-number of children			0.03	1.78†	0.03	1.56
Between-infant at home			0.02	0.23	-0.03	-0.33
Between-Socioeconomic status			0.03	1.00	0.03	0.68
Between-age			-0.17	-4.47***	-0.16	-4.34***
Between-more domestic work			-0.31	-8.57***	-0.33	-8.94***
Between-less domestic work			-0.19	-1.48	-0.03	-0.26
Between-working part-time					0.13	3.17
Between-partner working part-time					-0.12	-1.06
Between-working over time					-0.10	-1.59
Between-partner working over time					0.12	3.25**
Between-job quality					0.09	4.50***
Between-Professionals					0.03	0.46
Between-Technicians					0.06	0.56
Between-Service Workers					0.04	0.55
Between-Clericals					-0.06	-0.90
Between-Sales workers					-0.01	-0.13
Between-Operators					0.08	0.41
Between-Labourers					0.01	0.11

[#]In this table, n represents number of observations [‡] For occupation, Managers are reference group † sig at 0.1 level, * sig at 0.05 level, **sig at 0.01 level, ***sig at 0.001 level

Model 1: own shift work. Model 2: including variables in Model 1 + partner's shift work. Model 3: including variables in Model 2 + number of children, infant at home, socioeconomic status, age, share of domestic work. Model 4: including variables in Model 3 + work hours, partner's work hours, job quality and occupation.

Table S10 Between- and within-individual effects of all variables on fathers' relationship quality (*1-5*)

	Model 1 (n[#]=6153)		**Model 2** (n=6153)		**Model 3** (n=6098)		**Model 4** (n=5907)	
	Coeff	*t*	*Coeff*	*t*	*Coeff*	*t*	*Coeff*	*t*
Within-own shift work	-0.04	-1.72†	-0.04	-1.72†	-0.04	-1.75†	-0.05	-2.20*
Between-own shift work	-0.01	-0.34	-0.01	-0.25	-0.02	-0.50	0.02	0.51
Covariates								
Within-partner's shift work			0.00	0.05	-0.01	-0.42	-0.02	-0.94
Within-number of children					-0.07	-3.25**	-0.07	-2.97**
Within-infant at home					0.09	3.85***	0.07	2.93**
Within-Socioeconomic status					-0.03	-1.10	-0.01	-0.53
Within-age					-0.04	-2.44*	-0.03	-1.83†
Within-more domestic work					-0.07	-2.93**	-0.07	-2.71**
Within-less domestic work					-0.03	-1.51	-0.04	-2.13*
Within-working part-time							0.02	0.41
Within-partner working part-time							0.05	2.79**
Within-working over time							0.02	1.25
Within-partner working over time							-0.02	-0.88
Within-job quality							0.02	1.77†
Within-Professionals[‡]							-0.00	-0.02
Within-Technicians							-0.03	-1.11
Within-Service Workers							0.04	0.72
Within-Clericals							-0.06	-1.85†
Within-Sales workers							-0.01	-0.16
Within-Operators							0.03	0.65
Within-Labourers							0.05	1.07

Between-partner's shift work	-0.04	-0.96	-0.05	-1.36	-0.07	-1.66†
Between-number of children			0.02	0.94	0.01	0.54
Between-infant at home			-0.07	-0.89	-0.06	-0.75
Between-Socioeconomic status			-0.02	-0.57	-0.05	-1.39
Between-age			-0.12	-3.55***	-0.12	-3.34***
Between-more domestic work			-0.38	-6.61***	-0.38	-6.65***
Between-less domestic work			-0.11	-3.18**	-0.12	-3.20**
Between-working part-time					0.02	0.17
Between-partner working part-time					0.06	1.60
Between-working over time					0.05	1.45
Between-partner working over time					0.06	1.06
Between-job quality					0.06	2.98**
Between-Professionals					-0.04	-0.92
Between-Technicians					-0.07	-1.53
Between-Service Workers					-0.06	-0.83
Between-Clericals					-0.10	-1.35
Between-Sales workers					0.02	0.18
Between-Operators					-0.11	-1.63
Between-Labourers					0.03	0.43

[#]In this table, n represents number of observations [‡] For occupation, Managers are reference group † sig at 0.1 level, * sig at 0.05 level, **sig at 0.01 level, ***sig at 0.001 level

Model 1: own shift work. Model 2: including variables in Model 1 + partner's shift work. Model 3: including variables in Model 2 + number of children, infant at home, socioeconomic status, age, share of domestic work. Model 4: including variables in Model 3 + work hours, partner's work hours, job quality and occupation.