BMJ Open

Influence of work hours and commute time on food practices: a longitudinal analysis of the Household, Income and Labour Dynamics in Australia Survey

Laura Helena Oostenbach ,[1] Karen Elaine Lamb ,[2] David Crawford,[1] Lukar Thornton [1,3]

To cite: Oostenbach LH, Lamb KE, Crawford D, *et al*. Influence of work hours and commute time on food practices: a longitudinal analysis of the Household, Income and Labour Dynamics in Australia Survey. *BMJ Open* 2022;**12**:e056212. doi:10.1136/bmjopen-2021-056212

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2021-056212).

Received 09 August 2021
Accepted 10 April 2022

[1]Institute for Physical Activity and Nutrition, School of Exercise and Nutrition Sciences, Deakin University, Burwood, Victoria, Australia
[2]Melbourne School of Population and Global Health, University of Melbourne, Melbourne, Victoria, Australia
[3]Department of Marketing, Faculty of Business and Economics, University of Antwerp, Antwerp, Belgium

Correspondence to
Laura Helena Oostenbach;
loostenbach@deakin.edu.au

ABSTRACT

Objectives Work hours and commute time are key contributors to time scarcity, with potential detrimental implications for healthy eating. This study examined (1) associations between work and commute hours with food practices and (2) within-individual associations between changes in work and commute hours with changes in food practices.

Design Longitudinal study

Setting Australia

Participants Data were from 14 807 respondents in waves 7 (2007), 9 (2009), 13 (2013) and 17 (2017) of the Household, Income and Labour Dynamics in Australia Survey. The sample for this analysis included individuals who were in paid employment in at least one of the four waves.

Primary and secondary outcome measures Outcomes included frequency of out-of-home food purchasing for breakfast, lunch, dinner and all three summed eating occasions, and fruit and vegetables consumption.

Results Results indicated the longer individuals spent working and commuting, the more likely they were to purchase out-of-home foods (frequency of total out-of-home food purchasing: incidence rate ratio (IRR)=1.007 (95% CI 1.007 to 1.008)), and the less they consumed fruit and vegetables, although reductions in fruit and vegetables servings were minimal (fruit: β=−0.002 (95% CI −0.003 to −0.001), vegetables: β=−0.002 (95% CI −0.003 to −0.001)). Similar results regarding associations with out-of-home food purchasing were observed when examining within-individual changes (IRR=1.006 (95% CI 1.005 to 1.007)).

Conclusions Results suggest employment-related time demands push towards more frequent out-of-home food purchasing. In the long term, this may have negative health consequences as out-of-home foods tend to be less healthy than home-prepared foods.

Strengths and limitations of this study

- ⇒ This study used mixed effects and fixed effects models to analyse data from four waves of a nationally representative survey.
- ⇒ Work hours and commute time were examined separately as well as combined, providing a more accurate assessment of work-related time demands.
- ⇒ Outcome measures, frequency of out-of-home food purchasing and fruit and vegetables intake, were self-reported, under-reporting and over-reporting can therefore not be excluded.

INTRODUCTION

Time scarcity refers to people lacking enough time (or the perception that they do not have enough time) to undertake day-to-day activities.[1] Work patterns, including paid work hours and commute time, are key contributors to time scarcity.[2] This is of critical importance as demonstrated by a meta-analysis which found that in 2016 over 745 000 deaths could be attributed to long work hours.[3] In Australia, over 40% of adults report feeling scarce for time,[4] with paid work reported as the main source of time scarcity.[5] While average work hours have remained stable in high-income countries,[6] time spent commuting has increased,[7–9] primarily due to urban sprawl and traffic congestion.[10 11]

Time scarcity can reduce the time left to individuals to engage in health-related activities[2] and may monopolise attention at the expense of other activities,[12] such as engagement in healthy food practices[13–15] (i.e., the selection, purchasing, preparation and consumption of food[16]). Over time, evidence suggests changes in work-related time demands have been paralleled by changes in food practices.[8 17] For example, prior studies have demonstrated a trend towards less time spent preparing and cooking at home[17] and that this was concurrent with decreased spending on unprocessed foods and ingredients, and increased spending on meals outside the home.[17 18] Out-of-home meals are potentially associated with poorer diet quality.[19 20] Understanding contributing factors to less healthy dietary habits is important, especially given the impact of suboptimal diet on health problems such as obesity, type II diabetes and cardiovascular disease.[21 22] However, the current evidence on the role of work hours and commute time in food practices is mixed and mainly drawn from cross-sectional studies[23–25] and mostly from the USA.[26–29]

Very few prior studies have explored associations between work hours and commute time with food practices in Australia.[30 31] One study suggested minimal differences in dietary intakes between women living with children working different hours, with findings indicating greater alcohol and caffeine intake but no differences in intake of most nutrients when comparing those working 25 hours or more per week to those working less hours or not working.[30] Another study found no association between work hours and commute time with diet quality among dieters in Australia.[31] That study only considered work hours and commute time separately and used hourly wage as a proxy for work hours,[31] so any conclusions drawn from this analysis need to be interpreted cautiously, since its measure of work hours reflects income rather than hours worked.

This study aims to longitudinally examine associations between both work hours and commute time with food practices, using data from the nationally representative Household, Income and Labour Dynamics in Australia (HILDA) Survey.[32] The study first examines associations between work and commute hours with out-of-home food purchasing and fruit and vegetables consumption across individuals. It then assesses whether changes in an individual's work and commute hours over time are associated with changes in out-of-home food purchasing and fruit and vegetables consumption. The findings of this study will enhance our understanding of food practices among working individuals, potentially informing strategies and policies related to workers' health and flexible work arrangements.

METHODS

Data source

This study used data from the HILDA Survey.[32] HILDA is a longitudinal study of a nationally representative sample of Australian households randomly selected through a multi-stage sampling approach.[33] The survey has been conducted annually since 2001, collecting information on aspects of life in Australia relating to household and family life, employment, education, income, expenditure, health and well-being. Information is also collected less frequently on other topics including food practices.[34] HILDA collects data using a combination of face-to-face interviews with trained interviewers and self-reported questionnaires.[33] Between 2001 and 2010, over 13 000 persons (from over 7000 households) were interviewed each year. From 2011 onwards, this figure increased to over 17 000 persons (from over 9 000 households) due to the inclusion of a top-up sample, allowing immigrants who had arrived after 2001 to enter the survey sample.[34]

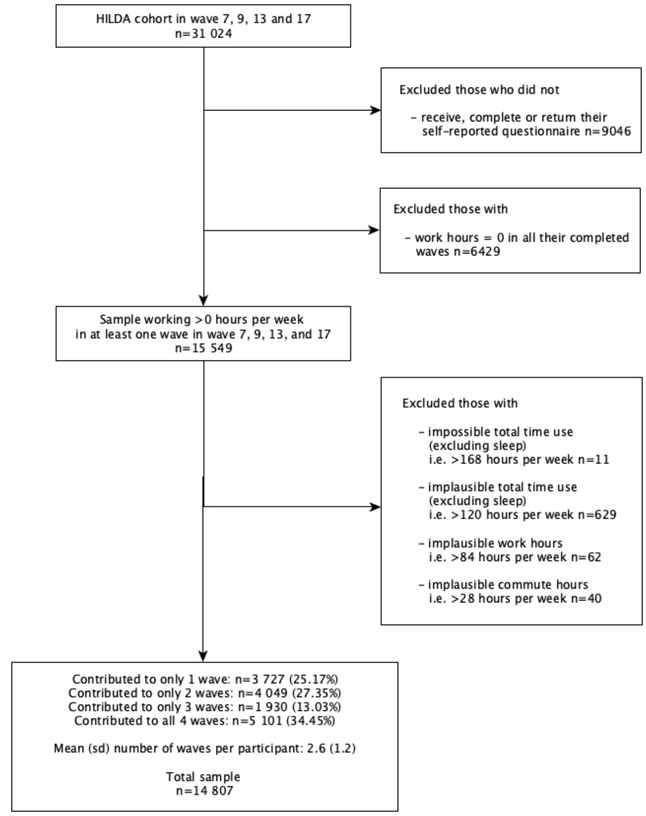

Figure 1 Flowchart of HILDA participants included in the study. HILDA, Household, Income and Labour Dynamics in Australia.

The household response rate of the main sample was 66% at wave 1, 87% at wave 2 and over 90% for each subsequent wave. For the top-up sample, the initial household response rate was 69%, and above 90% for all the following waves.[34] At the individual-level, the response rate was above 87% for all the waves for both the main and top-up sample.[34]

Sample

The data used in this study were from waves 7 (2007), 9 (2009), 13 (2013) and 17 (2017) of the HILDA Survey. These were the only waves that captured the food practices outcomes of interest in this study. The sample of this study included individuals who were in paid employment in at least one of the four waves. Therefore, all participants included in the study had positive work hours in at least one of the four waves. If participants had 0 work hours at one (or up to three) wave(s), they were classified as not working (0 hours) for that (or those) particular wave(s). Those who had 0 work hours at all four waves were not part of the analysed sample. Figure 1 provides a flowchart of the HILDA participants included in the study.

Outcome variables

Six self-reported variables were used to measure food practices. Four variables assessed weekly frequency of out-of-home food purchasing (i.e., food bought from restaurant, café, fast food outlet or any other place that prepares

Table 1 Descriptive characteristics of participants across all four waves

Variables	Wave 2007 n=7701 Median (p25, p75)* (n)	Wave 2009 n=8083 Median (p25, p75)* (n)	Wave 2013 n=10 779 Median (p25, p75)* (n)	Wave 2017 n=11 456 Median (p25, p75)* (n)
Weekly frequency of oohf purchasing for breakfast	0.00 (0.00, 0.00) (n=7701)	0.00 (0.00, 0.00) (n=8083)	0.00 (0.00, 0.00) (n=10 779)	0.00 (0.00, 0.00) (n=11 456)
Weekly frequency of oohf purchasing for lunch	1.00 (0.00, 3.00) (n=7701)	1.00 (0.00, 2.00) (n=8081)	1.00 (0.00, 2.00) (n=10 777)	1.00 (0.00, 2.00) (n=11 452)
Weekly frequency of oohf purchasing for dinner	1.00 (0.00, 2.00) (n=7701)	1.00 (0.00, 1.00) (n=8080)	1.00 (0.00, 1.00) (n=10 777)	1.00 (0.00, 1.00) (n=11 452)
Total weekly frequency of oohf purchasing (breakfast, lunch and dinner)	2.00 (1.00, 4.00) (n=7701)	2.00 (1.00, 4.00) (n=8077)	2.00 (1.00, 4.00) (n=10 774)	2.00 (1.00, 4.00) (n=11 451)
Average daily fruit servings	1.00 (0.43, 2.00) (n=7701)	1.00 (0.43, 2.00) (n=8081)	1.00 (0.43, 2.00) (n=10 777)	1.00 (0.43, 2.00) (n=11 451)
Average daily vegetable servings	2.00 (1.43, 3.00) (n=7700)	2.00 (1.29, 3.00) (n=8080)	2.00 (1.29, 3.00) (n=10 776)	2.00 (1.29, 3.00) (n=11 452)
Weekly work hours	38.00 (19.00, 44.00) (n=7582)	38.00 (15.00, 42.00) (n=7905)	37.00 (15.00, 40.00) (n=10 601)	37.00 (15.00, 40.00) (n=11 236)
Weekly commute hours	2.00 (0.50, 5.00) (n=7393)	2.00 (0.50, 5.00) (n=7770)	2.00 (0.50, 5.00) (n=10 445)	2.00 (0.50, 5.00) (n=11 061)
Combined weekly work and commute hours	40.50 (20.50, 50.00) (n=7379)	40.00 (18.00, 48.00) (n=7747)	40.00 (16.00, 48.00) (n=10 439)	40.00 (17.00, 48.00) (n=11 040)
Age (years)	39.00 (26.00, 49.00) (n=7701)	39.00 (26.00, 50.00) (n=8083)	40.00 (27.00, 53.00) (n=10 779)	42.00 (29.00, 55.00) (n=11 456)
	n (%)	**n (%)**	**n (%)**	**n (%)**
Categorical work hours				
Not working (0 hours)	787 (10.2)	1046 (12.9)	1635 (15.2)	1701 (14.8)
Working up to full-time (1–38 hours/week)	3447 (44.8)	3559 (44.0)	4795 (44.5)	5107 (44.6)
Working overtime (>38 hours/week)	3348 (43.5)	3300 (40.8)	4171 (38.7)	4428 (38.7)
Missing	119 (1.5)	178 (2.2)	178 (1.7)	220 (1.9)
Sex				
Male	3824 (49.7)	4059 (50.2)	5358 (49.7)	5722 (49.9)
Female	3877 (50.3)	4024 (49.8)	5421 (50.3)	5734 (50.1)
Education				
No tertiary education	5739 (74.5)	5952 (73.6)	7601 (70.5)	7772 (67.8)
Tertiary education	1961 (25.5)	2128 (26.3)	3174 (29.4)	3681 (32.1)
Missing	1 (<1)	3 (<1)	4 (<1)	3 (<1)
Household composition				
Single person†	952 (12.4)	1035 (12.8)	1409 (13.1)	1614 (14.1)
Single parent‡	131 (1.7)	139 (1.7)	169 (1.6)	190 (1.7)
Multi-person without children§	3780 (49.1)	4246 (52.5)	5799 (53.8)	6236 (54.4)
Multi-person with children¶	2838 (36.9)	2663 (32.9)	3402 (31.6)	3416 (29.8)
Remoteness				
Major cities of Australia	5150 (66.9)	5428 (67.2)	7548 (70.0)	7857 (68.6)
Inner regional Australia	1614 (21.0)	1707 (21.1)	2110 (19.6)	2405 (21.0)
Outer regional Australia	799 (10.4)	791 (9.8)	978 (9.1)	1045 (9.1)
Remote or very remote Australia	138 (1.8)	157 (1.9)	142 (1.3)	147 (1.3)
Missing			1 (<1)	2 (<1)
Neighbourhood SES				
Lowest decile	543 (7.1)	561 (6.9)	768 (7.1)	889 (7.8)
2nd decile	677 (8.8)	701 (8.7)	1011 (9.4)	1011 (8.8)
3rd decile	749 (9.7)	802 (9.9)	987 (9.2)	1072 (9.4)
4th decile	715 (9.3)	738 (9.1)	980 (9.1)	1102 (9.6)
5th decile	771 (10.0)	851 (10.5)	1139 (10.6)	1244 (10.9)
6th decile	750 (9.7)	819 (10.1)	1158 (10.7)	1150 (10.0)
7th decile	798 (10.4)	846 (10.5)	1115 (10.3)	1227 (10.7)

Continued

Table 1 Continued

	n (%)	n (%)	n (%)	n (%)
8th decile	821 (10.7)	899 (11.1)	1197 (11.1)	1246 (10.9)
9th decile	970 (12.6)	928 (11.5)	1159 (10.8)	1194 (10.4)
Highest decile	907 (11.8)	936 (11.6)	1261 (11.7)	1316 (11.5)
Missing		2 (<1)	4 (<1)	5 (<1)
Work schedule				
Regular daytime schedule	5120 (66.5)	5177 (64.0)	6747 (62.6)	7269 (63.5)
Other**	1676 (21.8)	1714 (21.2)	2188 (20.3)	2274 (19.8)
Missing	905 (11.8)	1192 (14.7)	1844 (17.1)	1913 (16.7)

*25th percentile, 75th percentile.
†Single person: one person aged >15 years, no children <15 years.
‡Single parent: one person aged >15 years, at least one child <15 years.
§Multi-person without children: two or more people aged >15 years, no children <15 years.
¶Multi-person with children: two or more people aged >15 years, at least one child <15 years.
**Other: evening shift, night shift, rotating shift, split shift, on call, irregular schedule or other.
oohf, out-of-home food; SES, socioeconomic status.

and sells meals) for (1) breakfast (0–7 times/week), (2) lunch (0–7 times/week), (3) dinner (0–7 times/week) and (4) a derived variable representing the total of all three eating occasions (0–21 times/week). Two variables examined average daily intake of fruit and vegetables (0–6 serves/day). The corresponding HILDA questions are detailed in online supplemental file 1.

Exposure variables

Exposure variables included continuous measures of self-reported weekly work hours, commute hours, and the combination of the two (online supplemental file 1).[35]

Confounders

Potential confounders included age, sex, education, work schedule, household composition, remoteness area and neighbourhood socioeconomic status (SES) (online supplemental file 1).

Statistical analysis

Mixed effects models with random intercepts for study participant and robust SEs were fitted to examine associations between each of the three exposures with each of the six food practices. Exposure and outcome at the same time point were used in the mixed effects models. Poisson mixed models were fitted for the out-of-home food purchasing outcomes and linear mixed models for the fruit and vegetables outcomes. In the mixed effects models, the estimate of each exposure represents the average difference in outcome (i.e., incidence rate ratio (IRR) for frequency of out-of-home food purchasing, and number of servings for fruit and vegetables intake) given a one-unit (i.e., 1 hour) difference in the exposure between individuals. An IRR of 1 represents the null value. Values smaller than 1 represent a percentage decrease as the exposure increases (e.g., an IRR of 0.85 means a 15% decrease for each unit increase in the exposure). Values greater than 1 represent a percentage increase as the exposure increases (e.g., an IRR of 1.06 means a 6% increase for each unit increase in the exposure). Fixed effects models with robust SEs were fitted to examine whether change in each exposure was associated with change in each of the food practices, again using Poisson models for the out-of-home food purchasing outcomes and linear models for the fruit and vegetables outcomes. Change in exposure represents a difference in exposure within the same individual across waves (e.g., increase or decrease of their work hours) as opposed to no change, where the exposure remains constant across waves (e.g., same work hours across waves). We did not manually compute a variable capturing change versus no change. Fixed effects models automatically capture whether an individual's exposure has changed as well as the magnitude and direction of that change. Fixed effects models assess within-individual change, where each respondent acts as their own control.[36 37] Therefore, fixed effects models controlled for all stable (i.e., 'fixed') measurable and non-measurable characteristics of the respondent.[36 37] In the fixed effects models, the estimate of each exposure represents the average change in outcome (i.e., IRR for frequency of out-of-home food purchasing, and number of servings for fruit and vegetables intake) for a one-unit (hour) within-individual change in exposure. Both the mixed and fixed models were fitted with robust SEs, therefore correcting for any potential overdispersion in the Poisson regressions. Linearity assumption of the linear models was assessed by examining scatterplots of the relationship between continuous outcome and exposure. All models were adjusted for the aforementioned potential confounders. As a sensitivity analysis, we explored associations between work hours and food outcomes, comparing those not working (0 hours) to those working up to full-time (1–38 hours/week) and those working overtime (>38 hours/week), with cut-off points guided by the Australian Government Fair Work's definition of full-time and overtime hours.[38 39] Additional analyses included models also adjusting for household income (results not shown).

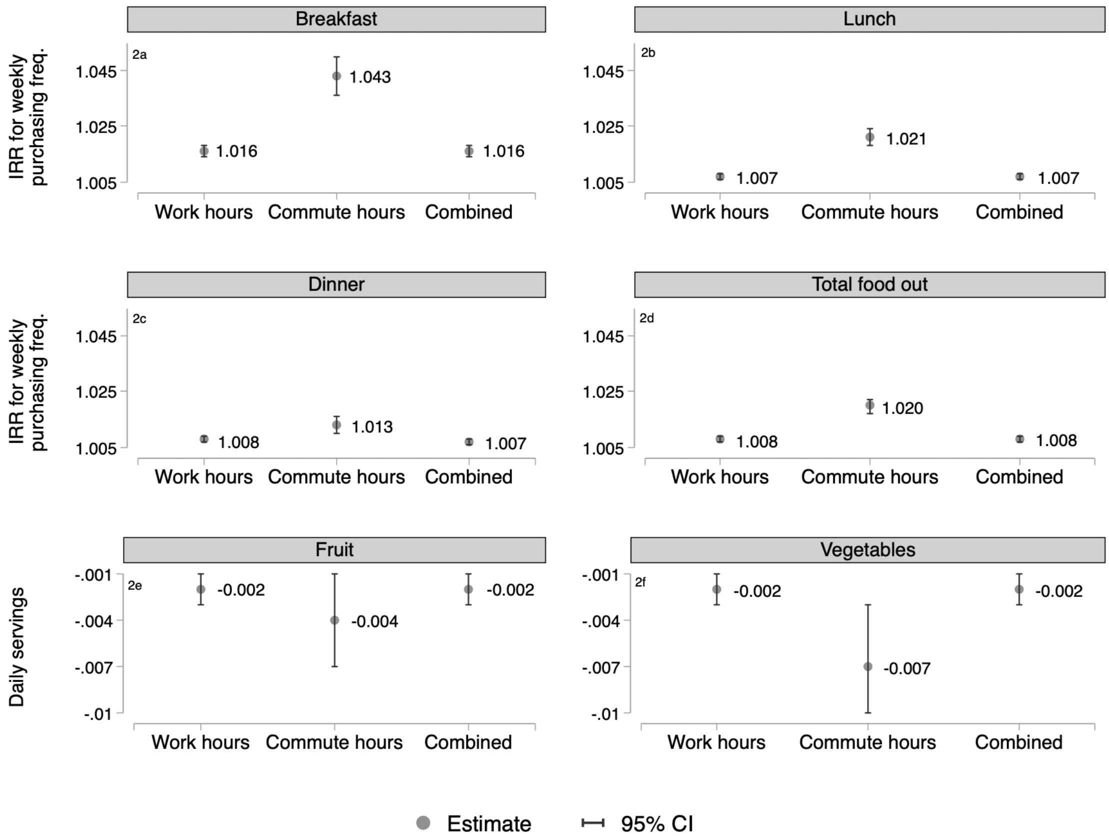

Figure 2 The estimated incidence rate ratio (IRR) for the weekly frequency of out-of-home food purchasing (breakfast, lunch, dinner, total) and the estimated number of daily servings of fruit and vegetables by weekly work and commute hours from adjusted mixed models. The estimate of each exposure represents the average difference in outcome (i.e., IRR for frequency of out-of-home food purchasing, and number of servings for fruit and vegetables intake) given a one-unit (i.e., 1 hour) difference in the exposure between individuals.

Analyses were conducted in Stata V.16 using the commands *mepoisson*, *mixed*, *xtpoisson* and *xtreg* with *fe* option for the fixed effects models. Sample sizes for each analysis are shown in online supplemental file 2.

Patient and public involvement

Patients or public were not involved in the design, conduct or reporting of this study.

RESULTS

Table 1 presents the sample characteristics across the four waves. Online supplemental file 3 presents the within-individual variation in exposures and outcomes across waves.

Associations between work and commute hours with food practices

Figure 2 shows the estimates and CIs from the adjusted mixed models. Greater work hours was associated with a higher IRR for the frequency of total out-of-home food purchasing by a factor of 1.008 (95% CI 1.007 to 1.009). Greater commute hours was associated with a higher IRR for the frequency of total out-of-home food purchasing by a factor of 1.020 (95% CI 1.017 to 1.022). When considered in combination, greater work and commute hours was associated with a higher IRR for the frequency of total out-of-home food purchasing by a factor of 1.008 (95% CI 1.007 to 1.009). Overall, similar results were obtained when exploring out-of-home food purchasing for eating occasions separately, although IRRs were larger for out-of-home food purchasing for breakfast than for lunch and dinner (figure 2).

When looking at fruit and vegetables intake, greater work hours was associated with fewer daily servings of fruit (−0.002, 95% CI −0.003 to −0.001) and vegetables (−0.002, 95% CI −0.003 to −0.001) (figure 2E,F). Similar results regarding lower fruit and vegetables intakes were observed when considering work hours in combination with commute hours. When exploring commute hours separately, greater commute hours was associated with fewer daily servings of fruit (−0.006, 95% CI −0.009 to −0.003) and vegetables (−0.009, 95% CI −0.012 to −0.005) (figure 2E,F). The IRRs from the adjusted Poisson mixed effects models for each out-of-home food outcomes and the estimates from the adjusted linear mixed effects models for fruit and vegetables are presented in online supplemental file 4.

Sensitivity analysis examined associations between work hours and food outcomes, comparing those not working (0 hours) to those working up to full-time (1–38 hours/

Table 2 Sensitivity analysis: Poisson and linear mixed effects models* of weekly out-of-home food purchasing and daily fruit and vegetables consumption, comparing those not working (0 hours) to those working up to full-time (1–38 hours/week) and those working overtime (>38 hours/week)

	Reference group: not working	IRR	95% CI	P value
Breakfast	Up to full-time	1.351	(0.994 to 1.835)	0.055
	Overtime	1.853	(1.365 to 2.515)	<0.001
Lunch	Up to full-time	1.282	(1.132 to 1.451)	<0.001
	Overtime	1.473	(1.301 to 1.668)	<0.001
Dinner	Up to full-time	1.160	(1.051 to 1.281)	0.003
	Overtime	1.338	(1.211 to 1.478)	<0.001
Total food out	Up to full-time	1.239	(1.128 to 1.362)	<0.001
	Overtime	1.437	(1.307 to 1.579)	<0.001
		Coef.	**95% CI**	**P value**
Fruit	Up to full-time	0.022	(–0.068 to 0.113)	0.630
	Overtime	1×10^{-4}	(–0.091 to 0.091)	0.998
Vegetables	Up to full-time	–0.083	(–0.194 to 0.028)	0.144
	Overtime	–0.084	(–0.196 to 0.029)	0.144

The estimate for each work hours group represents the average difference in outcome (i.e., incidence rate ratio (IRR) for frequency of out-of-home food purchasing, and number of servings for fruit and vegetables intake) compared with the reference group, that is, those not working.
*Models adjusted for age, sex, education, household composition, remoteness, neighbourhood socioeconomic status and work schedule.
Coef., coefficient; IRR, incidence rate ratio.

week) and those working overtime (>38 hours/week) (table 2). Similar patterns were observed for out-of-home food behaviours as for analysis modelling continuous work hours. Those working up to full-time and those working overtime consistently had a higher IRR for the frequency of out-of-home food purchasing for each eating occasion, although when comparing out-of-home food purchasing for breakfast among those not working to those working up to full-time the CI contained the null. Estimated effects also suggested fewer daily servings of vegetables among those working up to full-time and those working overtime compared with those not working, although the CI included the null. No differences were observed for fruit intake.

Figure 3 shows the predicted weekly frequency of out-of-home food purchasing for different eating occasions and the predicted number of daily servings of fruit and vegetables by work and commute hours. For example, while those working 15 hours per week were predicted to, on average, eat out about two times per week, those working 40 hours per week were predicted to, on average, eat out more than three times each week.

Associations between changes in work and commute hours with changes in food practices

Table 3 presents the results of the Poisson and linear fixed effects models. As weekly work hours increased by 1 hour within individuals over time, the IRR for the frequency of total out-of-home food purchasing changed by a factor of 1.006 (95% CI 1.005 to 1.007). As weekly commute hours increased by 1 hour within individuals over time, the IRR for the frequency of total out-of-home food purchasing changed by a factor of 1.014 (95% CI 1.011 to 1.017). When combined work and commute hours increased by 1 hour within individuals over time, the IRR for the frequency of total out-of-home food purchasing changed by a factor of 1.006 (95% CI 1.005 to 1.007). When exploring out-of-home food purchasing for eating occasions separately, similar results were observed, although IRRs were larger for out-of-home food purchasing for breakfast than for lunch and dinner. No associations were found between changes in work and commute hours over time and changes in fruit and vegetables consumption. Online supplemental file 5 presents the results for all analyses including estimates for covariates included in the adjusted models.

DISCUSSION

This study investigated longitudinal associations between both work hours and commute time with food practices. Results indicated that the longer individuals spent working and commuting, the more likely they were to purchase out-of-home foods and the less they consumed fruit and vegetables, although reductions in servings of fruit and vegetables were minimal. Overall, effect estimates for each outcome were small. However, figure 3 demonstrated what they meant in real terms (i.e., equated to weekly purchasing frequency and daily servings for given work hours and commute time), suggesting behaviours accumulate as work and commute hours increase, particularly for out-of-home food purchasing. Similar results

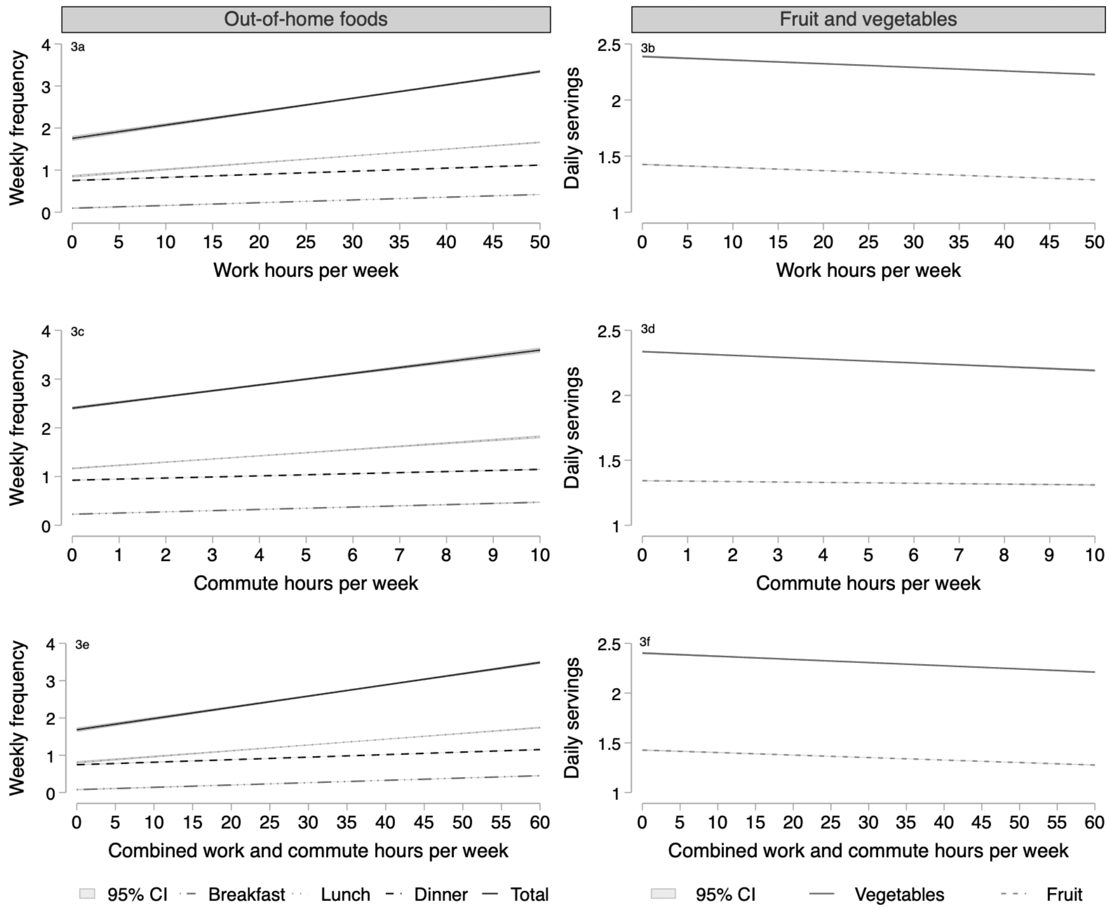

Figure 3 Predicted weekly frequency of out-of-home food purchasing (breakfast, lunch, dinner, total) and predicted number of daily servings of fruit and vegetables by weekly work and commute hours from adjusted mixed models.

regarding associations between work hours and commute time with out-of-home food purchasing were observed when looking at changes within individuals over time. For example, individuals whose weekly work hours increased by 10 hours over time were estimated to have an increased IRR for the frequency of total out-of-home food purchasing of 1.06, that is, a 6% increase compared with individuals whose work hours did not change. However, no associations were observed between changes in work hours and commute time and changes in fruit and vegetables consumption.

Results of this study support previous cross-sectional findings suggesting links between longer work hours and a higher frequency of restaurant and fast food visits,[27] more takeaway meals[40] and eating out at least once per week.[24] Previous studies have identified quickness, busyness[41] and the need to minimise time and efforts for meals[42] as common reasons for buying takeaway and fast-food meals. Long work hours and commute times may therefore lead to potentially less healthy food practices through mechanisms including scarcity of time available for preparation of and access to healthy foods.[13 14] In addition to work-related time demands, additional household-related time demands (e.g., housekeeping, caring for children) may further exacerbate negative impacts on food practices.[42]

Additional mechanisms of the influence of longer work hours on increased out-of-home food purchasing may relate to more income owing to longer work hours increasing affordability of out-of-home foods. This may not always be the case. Long work hours may not necessarily mean high income. One could argue household income may influence individual work hours. For example, in a multi-person household, if one person earns enough to provide for the whole household, other people in the household may not need to work at all or only work short hours. However, additional analyses included models also adjusting for household income as a confounder, and no differences in magnitude or direction of effects were observed (results not shown).

Changes in out-of-home food purchasing did not translate into changes in fruit and vegetables consumption. This may be because food habits relating to fruit and vegetables are formed early in life[43] and maintained regardless of changes in work hours or commute time. In other words, individuals' changes in employment-related time demands may not be associated with fruit and vegetables intake changes because people adapt to maintain the same behaviours around their time demands.

With increasing work-related time demands and the health implications of food practices, policy efforts

Table 3 Poisson and linear fixed effects models* of weekly out-of-home food purchasing and daily fruit and vegetables consumption

	Work hours			Commute hours			Combined work and commute hours		
	IRR	**95% CI**	**P value**	**IRR**	**95% CI**	**P value**	**IRR**	**95% CI**	**P value**
Breakfast	1.010	(1.007 to 1.013)	<0.001	1.026	(1.017 to 1.036)	<0.001	1.010	(1.007 to 1.013)	<0.001
Lunch	1.005	(1.004 to 1.007)	<0.001	1.014	(1.010 to 1.018)	<0.001	1.006	(1.004 to 1.007)	<0.001
Dinner	1.006	(1.005 to 1.007)	<0.001	1.009	(1.005 to 1.013)	<0.001	1.006	(1.004 to 1.007)	<0.001
Total food out	1.006	(1.005 to 1.007)	<0.001	1.014	(1.011 to 1.017)	<0.001	1.006	(1.005 to 1.007)	<0.001
	Coef.	**95% CI**	**P value**	**Coef.**	**95% CI**	**P value**	**Coef.**	**95% CI**	**P value**
Fruit	1×10^{-5}	(−0.001 to 0.001)	0.977	−0.001	(−0.004 to 0.003)	0.784	-7×10^{-5}	(−0.001 to 0.001)	0.899
Vegetables	-3×10^{-4}	(−0.002 to 0.001)	0.675	−0.003	(−0.008 to 0.002)	0.186	-1×10^{-4}	(−0.002 to 0.001)	0.802

Sample size for each analysis is presented in online supplemental file 2. The estimate of each exposure represents the average change in outcome (i.e., IRR for frequency of out-of-home food purchasing, and number of servings for fruit and vegetables intake) for a one-unit (i.e., 1 hour) within-individual change in exposure.
*Models adjusted for age, education, household composition, remoteness, neighbourhood socioeconomic status and work schedule.
Coef., coefficient; IRR, incidence rate ratio.

to promote healthy eating and healthy living among working individuals are timely and warranted. Potential strategies to deter negative impacts of work-related time demands on food practices may include changes in work arrangements such as employers offering flexible work hours and the opportunity to work from home to take the pressure of the roads and transport networks.[44] However, governments may find it hard to encourage employers to be more flexible with work hours, and have long struggled with shortening commute times.[45] Another possible response from governments may be to ensure environments do not facilitate unhealthy food choices in the first place, and encourage healthy eating among those looking for quick and convenient food options. Research suggests that access to healthy food options at the worksite is often limited compared with the myriad of unhealthy food options available in cafeterias, onsite shops and vending machines.[46] Given the length of time workers spent at their workplace and the health implications of healthy eating, employers should consider improving the healthfulness of the worksite food environment by ensuring healthy foods are available to employees onsite as well as limiting the availability of unhealthy food options in the workplace.[47 48]

As a result of the COVID-19 pandemic, many workers around the world were forced to work from home for the greater part of 2020 and some of 2021, temporarily reducing, if not eliminating commute times.[49] The consequences of this change on food practices remain largely unknown, however, the impact of COVID-19 and working from home can be examined in future releases of the HILDA data.[50]

A strength of this study is its use of data from a nationally representative sample with a high participation rate.[34] The study is also strengthened by its strong methodological approach, using two complementary sets of regression analyses. Within-person differences (fixed effects regression) and between-person differences (mixed effects regression) were examined, providing a more comprehensive investigation of the associations between work hours and commute time with food practices. Further, most studies have focused on work hours, with little research exploring links between food practices and commute time or have focused exclusively on work hours or commute time separately. This study examined work hours and commute time separately as well as combined, providing a more accurate assessment of work-related time demands.

As frequency of out-of-home food purchasing and fruit and vegetables intake were self-reported, social desirability biases cannot be excluded. Further, while we were able to assess out-of-home food purchasing for key eating occasions including breakfast, lunch and dinner, other smaller meals such as snacks were not captured. Further, we were unable to adjust for household food role. It remains unknown whether respondents were the main person responsible for food purchasing and preparation within their household. For example, those working longer hours may still be able to eat healthy home-prepared meals if another household member is responsible for food preparation and cooking. The HILDA Survey also lacks an indicator for the days of the week out-of-home purchasing occurs. Therefore, it is impossible to differentiate between those buying out-of-home foods at weekends (or non-working days) as a potential treat or way to socialise from those purchasing out-of-home foods to save time due to long work hours and commute times on working days. We were also unable to determine if respondents worked at a single location or at multiple locations. Food intake such as fruit and vegetables consumption in our sample is slightly lower than national trends, with for example respondents in the sample consuming on average 1.3 serves of fruit and 2.3 serves of vegetables each day in 2017, compared with an average of 1.7 and 2.4, respectively, at the national level in 2017–2018.[51] However, our findings are only representative of the sample at hand. No inferences are made at the population-level.

This study enhances our understanding of food practices among working individuals, with results suggesting that work-related time demands push individuals towards purchasing out-of-home foods more often. In the long term, this may have negative health consequences as out-of-home foods tend to be generally less healthy than foods prepared at home. Potential solutions to reduce work-related time demands may lay in work arrangements such as flexible work hours and telecommuting.

Acknowledgements The authors thank Professor Kylie Ball for her contributions to the initial conceptualisation of the study and early drafts of the manuscript.

Contributors LHO and LT conceptualised the study with input from all authors. LHO led the analysis with input from KEL and LT. LHO drafted the initial manuscript. KEL, DC and LT provided critical feedback on drafts of the manuscript. All authors read and approved the final manuscript. LHO acts as guarantor for the final manuscript.

Funding This work was supported by a Deakin University Postgraduate Research Scholarship to LHO. Award/grant number not applicable.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval The HILDA Survey was approved by the Human Research Ethics Committee of the University of Melbourne. An ethics exemption for secondary data analysis was approved by the Deakin University Human Research Ethics Committee.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available for approved users from the Australian Data Archive Dataverse system. This paper uses unit record data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey. The HILDA Project was initiated and is funded by the Australian Government Department of Social Services (DSS) and is managed by the Melbourne Institute of Applied Economic and Social Research (Melbourne Institute). The findings and views reported in this paper, however, are those of the author and should not be attributed to either DSS or the Melbourne Institute. The authors requested access to the data through the Australian Data Archive Dataverse system.

ORCID iDs

Laura Helena Oostenbach http://orcid.org/0000-0002-1514-6390
Karen Elaine Lamb http://orcid.org/0000-0001-9782-8450
Lukar Thornton http://orcid.org/0000-0001-8759-8671

REFERENCES

1 De Sousa M, Peterman AH, Reeve CL. An initial model of scarcity. *Qual Psychol* 2018;5:59–76.
2 Strazdins L, Griffin AL, Broom DH, *et al*. Time scarcity: another health inequality? *Environ Plan A* 2011;43:545–59.
3 Pega F, Náfrádi B, Momen NC, *et al*. Global, regional, and national burdens of ischemic heart disease and stroke attributable to exposure to long working hours for 194 countries, 2000-2016: a systematic analysis from the WHO/ILO joint estimates of the work-related burden of disease and injury. *Environ Int* 2021;154:106595.
4 ABS. *General social survey: summary results, Australia, 2014*. Canberra, 2015.
5 ABS. *Stressed for time*. Canberra, 2013.
6 Giattino C, Ortiz-Ospina E, Roser M. *Working hours*. Oxford: Our Wolrd in Data, 2020.
7 Giménez-Nadal JI, Molina JA, Velilla J. *Trends in Commuting time of European workers: a Cross-Country analysis*. Bonn: IZA Institute of Labor Economics, 2020.
8 Wilkins R, Laß I, Butterworth P. *The household, income and labour dynamics in Australia survey: selected findings from waves 1 to 17*. Melbourne: Melbourne Institute, Applied Economic & Social Research, University of Melbourne, 2019.
9 Office for National Statistics. *Travel to work methods and the time it takes to commute from home to work, labour force survey, 2007 to 2016*, 2018.
10 Angel S, Sheppard SC, Civco DL. *The dynamics of global urban expansion*. Washington DC: Department of Transport and Urban Development, The World Bank, 2005.
11 Infrastructure Australia. *An Assessment of Australia's Future Infrastructure Needs: The Australian Infrastructure Audit 2019*. Sydney, 2019.
12 Mullainathan S, Shafir E. *Scarcity: why having too little means so much: Allen Lane*, 2013.
13 Jabs J, Devine CM. Time scarcity and food choices: an overview. *Appetite* 2006;47:196–204.
14 Strazdins L, Broom DH, Banwell C, *et al*. Time limits? reflecting and responding to time barriers for healthy, active living in Australia. *Health Promot Int* 2011;26:46–54.
15 Djupegot IL, Nenseth CB, Bere E, *et al*. The association between time scarcity, sociodemographic correlates and consumption of ultra-processed foods among parents in Norway: a cross-sectional study. *BMC Public Health* 2017;17:447.
16 Olstad DL, Kirkpatrick SI. Planting seeds of change: reconceptualizing what people eat as eating practices and patterns. *Int J Behav Nutr Phys Act* 2021;18:32.
17 Venn D, Banwell C, Dixon J. Australia's evolving food practices: a risky mix of continuity and change. *Public Health Nutr* 2017;20:2549–58.
18 Hogan L. *Food demand in Australia trends and issues 2018 Canberra: Australian Bureau of agricultural and resource economics and sciences*, 2018.
19 Lachat C, Nago E, Verstraeten R, *et al*. Eating out of home and its association with dietary intake: a systematic review of the evidence. *Obes Rev* 2012;13:329–46.
20 Wellard-Cole L, Davies A, Allman-Farinelli M. Contribution of foods prepared away from home to intakes of energy and nutrients of public health concern in adults: a systematic review. *Crit Rev Food Sci Nutr* 2021;127:1–12.
21 Afshin A, Sur PJ, Fay KA, *et al*. Health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the global burden of disease study 2017. *The Lancet* 2019;393:1958–72.

22 Micha R, Shulkin ML, Peñalvo JL, *et al*. Etiologic effects and optimal intakes of foods and nutrients for risk of cardiovascular diseases and diabetes: systematic reviews and meta-analyses from the nutrition and chronic diseases expert group (NutriCoDE). *PLoS One* 2017;12:e0175149.
23 Sam L, Craig T, Horgan GW, *et al*. Association between hours worked in paid employment and diet quality, frequency of eating out and consuming takeaways in the UK. *Public Health Nutr* 2019;22:3368–76.
24 Mills S, Adams J, Wrieden W, *et al*. Sociodemographic characteristics and frequency of consuming home-cooked meals and meals from out-of-home sources: cross-sectional analysis of a population-based cohort study. *Public Health Nutr* 2018;21:2255–66.
25 Christian TJ. Trade-offs between commuting time and health-related activities. *J Urban Health* 2012;89:746–57.
26 Mazumder B, Seeskin Z. Breakfast skipping, extreme Commutes, and the sex composition at birth. *Biodemography Soc Biol* 2015;61:187–208.
27 Binkley JK. The effect of demographic, economic, and nutrition factors on the frequency of food away from home. *J Consum Aff* 2006;40:372–91.
28 Christian TJ. *Opportunity costs surrounding exercise and dietary behaviors: quantifying trade-offs between commuting time and health-related activities*. Working Paper Brown University, 2009.
29 Escoto KH, French SA, Harnack LJ, *et al*. Work hours, weight status, and weight-related behaviors: a study of Metro transit workers. *Int J Behav Nutr Phys Act* 2010;7:91.
30 Miller J, Chan L, Mehta K, *et al*. Dietary intake of working women with children does not appear to be influenced by hours of employment: a secondary analysis of the Australian health survey (2011-2013). *Appetite* 2016;105:106–13.
31 Brown H, Presseau J. Work me not into Temptation: exploring the relationship between work and healthy eating in Dieters using data from the HILDA survey. *Aust Econ Rev* 2018;51:368–81.
32 The University of Melbourne. *HILDA survey*. Melbourne: The University of Melbourne, 2020.
33 Watson N, Wooden M. The HILDA survey: a case study in the design and development of a successful household panel survey. In: *Longitudinal and life course studies*. , 2012: 3, 369–81.
34 Summerfield M, Bright S, Hahn M. *HILDA user manual – release 18*. Melbourne: Melbourne Institute Applied Economic and Social Research, University of Melbourne, 2019.
35 Strazdins L, Welsh J, Korda R, *et al*. Not all hours are equal: could time be a social determinant of health? *Sociol Health Illn* 2016;38:21–42.
36 Allison PD. Chapter 1. Introduction. In: Allison PD, ed. *Fixed effects regression models*. Thousand Oaks: SAGE Publications, 2009: 2–6.
37 Gunasekara FI, Richardson K, Carter K, *et al*. Fixed effects analysis of repeated measures data. *Int J Epidemiol* 2014;43:264–9.
38 Fair Work. *Types of employees*. Canberra: Fair Work, 2021.
39 Fair Work. *Maximum Weekly hours*. Canberra: Fair Work, 2021.
40 Devine CM, Farrell TJ, Blake CE, *et al*. Work conditions and the food choice coping strategies of employed parents. *J Nutr Educ Behav* 2009;41:365–70.
41 Rydell SA, Harnack LJ, Oakes JM, *et al*. Why eat at fast-food restaurants: reported reasons among frequent consumers. *J Am Diet Assoc* 2008;108:2066–70.
42 Devine CM, Jastran M, Jabs J, *et al*. "A lot of sacrifices:" work-family spillover and the food choice coping strategies of low-wage employed parents. *Soc Sci Med* 2006;63:2591–603.
43 Lacy KE, Spence AC, McNaughton SA, *et al*. Home environment predictors of vegetable and fruit intakes among Australian children aged 18 months. *Appetite* 2019;139:95–104.
44 Messenger J. *Working time and the future of work. ILO Future of work research paper series*. Geneva: International Labour Office, 2018.
45 Infrastructure Australia. *Urban transport crowding and congestion*. Sydney: Infrastructure Australia, 2019.
46 Clohessy S, Walasek L, Meyer C. Factors influencing employees' eating behaviours in the office-based workplace: a systematic review. *Obes Rev* 2019;20:1771–80.
47 Steyn N, Parker W, Lambert E, *et al*. Nutrition interventions in the workplace: evidence of best practice. *South Afr J Clin Nutr* 2009;22:111–7.
48 Schliemann D, Woodside JV. The effectiveness of dietary workplace interventions: a systematic review of systematic reviews. *Public Health Nutr* 2019;22:942–55.
49 Australia IP. *Australian travel time metric 2020 edition*. Sydney: Infrastructure Partnerships Australia, 2020.
50 Wooden M. *HILDA project discussion paper series responding to the COVID-19 pandemic in the HILDA survey. Australia, HILDA*. Melbourne: The University of Melbourne, 2020.
51 ABS. *Dietary behaviour*. Canberra, 2018.