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Employment-related time poverty, time stress and food away from home behaviour: Panel evidence from Australia

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ABSTRACT

This study examines the link between employment-related time poverty and food away from home (FAFH) behaviour. We use a large representative sample of Australians drawn from five waves of panel data from the Household, Income and Labour Dynamics in Australia (HILDA) survey. Endogeneity biases stemming from reverse causality and omitted variable issues are resolved using fixed effect-instrumental variable approach while other quasi-experimental methods are applied to check for consistency in findings. Overall, we find that employment-related time poverty is associated with an increase in the likelihood of engaging in FAFH behaviour. In specific terms, it is associated with an increase in the likelihood of consuming breakfast, dinner, and supper away from home. Employment-related time poverty is associated with an increase in FAFH tendencies more among females and those located in rural/remote communities. Regarding mealtimes, employment-related time poverty is associated with an increase in the drive towards FAFH behaviour more for lunch, followed by breakfast and dinner respectively. Psychological feeling of time stress is discovered as an important pathway via which time poverty is associated with an increase in FAFH tendencies.

1. Introduction

Consuming foods that provide sufficient energy, nutrients, and other essential components can improve health and well-being (Australian Institute of Health and Welfare [AIHW], 2019). Consumer demand, food availability and affordability as well as individual preferences and culture, all have a significant impact on dietary patterns and trends (Global Panel on Agriculture and Food Systems for Nutrition [GPAFSN], 2020; Herrero et al., 2023). Consumption of food away from home (FAFH) is a recent global trend that has been influenced by some of the factors identified above (Kalenkoski & Hamrick, 2013; Damari & Kissinger, 2018; Saksena et al., 2018; Hogan, 2018; Balagtas et al., 2023).

FAFH refers to the consumption of food prepared outside the home, typically obtained from restaurants, cafeterias, food trucks, street vendors, or vending machines (Landais et al., 2023). FAFH has increased in recent years, particularly in developed economies. For example, it accounted for 37.2% of Australia's total food budget in 2019, ranking among the highest globally. This figure dropped to 17.7% in 2021 but increased to 30.3% by 2023 (Australian Foodservice Advocacy Body, 2023), signalling the significant share of household consumption expenditure allocated to FAFH. Venn et al. (2018) reported that in Australia, socioeconomic status (income, education, and occupation) significantly influences food purchasing behaviour, diet quality, and nutrient intake. Those living in low socioeconomic neighbourhoods tend to consume more fast foods and fewer fruits and vegetables compared to those in high socioeconomic areas. Moreover, the rising cost of living has led to an increase in the consumption of fast food and ultra-processed foods, particularly among households in low socioeconomic neighbourhoods, as these options are often cheaper and more convenient than home-cooked meals.[1] Like the Australian case, it has been observed in the US that the importance of FAFH in diets increased from 41% in 1984 to 50% in 2010 (Saksena et al., 2018), with recent

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[1] Australian Broadcasting Corporation (ABC, 2023). Australians are eating more ultra-processed foods amid the rising cost of living. How can we turn that around? https://www.abc.net.au/news/2023-12-16/dependency-ultra-processed-foods-history-health-concerns-experts/103196858.

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data showing an upward accelerating trend (Balagtas et al., 2023). Similar trends have been observed in several developed countries such as Israel (Damari & Kissinger, 2018), Spain (Díaz-Méndez & García-Espejo, 2017) and Japan (Fujioka & Fukushige, 2019).

However, global trends in FAFH, particularly from fast-food establishments, are a health and public policy concern due to their links to poor nutrition and health outcomes like cardiovascular disease, insulin resistance, type 2 diabetes, and obesity (Ayala et al., 2008; GPAFSN, 2020; Jaworowska et al., 2013). A study by Du et al. (2021), using data from over 35,000 US adults between 1999 and 2014, found that frequent consumption of meals prepared away from home is significantly associated with an increased risk of all-cause mortality. In Australia, poor diet accounts for 5.4% of the country's disease burden (AIHW, 2019), leading to at least 25,000 deaths annually (Howes et al., 2020). Food eaten away from home is generally of lower nutritional quality than food cooked at home. For example, unlike home-cooked meals, where one has more control over the ingredients, cooking methods, and portion control, FAFH has higher energy density, higher levels of fat and sodium, and lower nutritional value, resulting in poor health outcomes (Du et al., 2021; Jaworowska et al., 2013).

Evidence shows that FAFH behaviour is influenced by many factors, including convenience, busy lifestyles, socialisation and entertainment, taste and variety, cultural norms and traditions, advertising and marketing, cost, food trends, and experiences (Mackay et al., 2017; United States Department of Agriculture [USDA], 2023). According to a US-based study, the increase in FAFH in the US can be attributed to factors such as increased female labour force participation rate, more accessible and affordable fast-food restaurants, and increased advertising and promotion by major food service chains (USDA, 2023). These notwithstanding, time constraints or employment-related time poverty can also influence dietary habits (Mackay et al., 2017). Time poverty or the lack of discretionary time for leisure and personal activities due to over-commitment to work (Kalenkoski & Hamrick, 2013; Martey, Etwire, Adusah-Poku, & Akoto, 2022), is influenced by various factors. These include busy lifestyles, demanding work schedules, household duties, caregiving responsibilities, and long commutes (Giurge et al., 2020). Managers or employees with supervisory roles tend to work longer hours and have poor work-life balance (Feldman, 2002; Gerstel & Clawson, 2018). Time poverty impairs people's ability to prioritise various activities, including food-cooking behaviours. It can lead to a shift towards FAFH, a decrease in the consumption of family meals and less physical activity, which can be detrimental to one's health (Jabs & Devine, 2006; Kalenkoski & Hamrick, 2013; Saksena et al., 2018).

Despite the potential link between employment-related time poverty and FAFH, empirical evidence on this topic is limited (Jabs & Devine, 2006; Kalenkoski & Hamrick, 2013). This includes a study by Kalenkoski and Hamrick (2013) which examined the impact of time poverty on Americans' eating habits and physical activity, discovering that time-poor individuals tend to purchase pre-prepared meals from grocery shops instead of fast food. The study suggested there was a need for more research to understand the nuances. On the contrary, research on employment-related time poverty has focused more on its impact on health outcomes such as overweight, obesity, and cardiovascular disease (Ayala et al., 2008; Hogan., 2018; Balagtas et al., 2023; Landais et al., 2023); food insecurity (Adeosun et al., 2022; Farfán et al., 2017); energy choices (Martey, Etwire, Adusah-Poku, & Akoto, 2022) and child schoolwork and attendance (Martey, Etwire, & Koomson, 2022). Other studies often focus on identifying barriers and facilitators of different eating practices, with time frequently cited as a barrier (Venn et al., 2018; Jabs & Devine, 2006), without quantifying the direct impact of employment-related time poverty.

In Australia, studies on time use have mainly focused on time stress/pressure, which occurs when individuals feel rushed, pressured, or constantly running out of time (see e.g., Craig & Brown, 2017; Ruppanner et al., 2019; Strazdins et al., 2016). However, time stress and time poverty differ in nature, causes, and impact. Time poverty is a structural issue relating to the actual availability of time, often caused by external factors such as economic conditions and job requirements (Jabs & Devine, 2006). In contrast, time stress is a psychological problem related to the perception of time pressure or inadequacy, typically caused by internal factors like personal time management and workload perception, affecting mental health and productivity (Kleiner, 2014). In essence, time stress is an outcome of time poverty. Time poverty primarily affects one's ability to perform essential activities and can perpetuate economic disadvantage. Both time stress and time poverty vary by socioeconomic factors such as gender and location. For example, women and working individuals are more likely to report experiencing time stress and time poverty (Chatzitheochari & Arber, 2012; Jabs & Devine, 2006). In Australia, women working full-time are 12% more likely to be time-poor compared to men (Nadalin, 2024). Location-wise, the Household Income Labour Dynamics in Australia (HILDA) data shows that employment-related time poverty is 2% higher among rural residents. This confirms the assertion that employment-related time poverty is often higher among those experiencing material deprivation (Whillans & West, 2022).

A closer look at the empirical study by Kalenkoski and Hamrick (2013), along with the broader literature (Jabs & Devine, 2006), points to several motivations that warrant this study. First, more empirical studies on this topic are required from both developed and developing countries. Second, the study did not investigate how the relationship between employment-related time poverty and FAFH varies by gender, location (urban versus rural/remote), and mealtimes (breakfast, lunch, and dinner). Third, potential pathways in the link between employment-related time poverty and FAFH are yet to be empirically analysed.

Thus, we contribute to the literature by investigating the effect of employment-related time poverty on FAFH behaviour using five waves of panel data extracted from the HILDA survey.[2] HILDA is a comprehensive survey that tracks over 17,000 Australians annually, providing insights into economic well-being, personal health, labour market dynamics, and family life. We examine the results of meals consumed at different times of the day to identify the most impacted ones. We conduct gender- and location-specific subsampled analyses to assess potential heterogeneities in our findings. Finally, we consider the potential role of time stress in mediating the relationship between employment-related time poverty and FAFH. The current study's findings on the associations between employment-related time poverty and FAFH behaviour can provide valuable insights, including understanding the complexities of eating and activity patterns in Australia, which is critical in addressing the country's high rates of obesity and cardiovascular disease (AIHW, 2019; AIHW, 2023; Howes et al., 2020).

2. Methods

This study employs a quantitative research design and draws statistical inferences to establish the associations between employment-related time poverty, FAFH behaviour and time stress using panel data obtained from the HILDA survey. More information on the data can be found in Section 2.1.

2.1. Data

This study uses secondary data sourced from release/version 22 of the HILDA survey, which is a nationally representative panel data in Australia that began in 2001 and gathers information on households and individuals aged 15 years and older using a multi-stage sampling procedure (Watson & Wooden, 2012). Specifically, sampling is done in three stages—starting from the selection of primary sampling units (PSUs), followed by enumerated households and finally, individuals

[2] HILDA Survey https://melbourneinstitute.unimelb.edu.au/hilda.

within households. The collection of data for each wave often starts from July to March of the following year. To reduce follow-up loss or attrition, the HILDA team and office staff track participants who change locations within and across states by conducting telephone and assisted interviews. They also contact participants yearly by providing multiple contacting options and retain cross-sectional representativeness by adding top-up samples. Although HILDA 22 contains data from waves 1 to 22, we only utilised data from waves 7, 9, 13, 17, and 21 since the module on eating behaviours was only included in the five waves listed. In addition to demographic data, HILDA also includes information on topics such as time use and employment, eating habits, health, household and personal finances, energy use, and many others (Watson & Wooden, 2012).

Our initial unbalanced panel data includes 104,097 observations for 33,968 respondents aged 15 years and over across the five selected waves (see Fig. A1 in the Supplementary Materials). This included 17,280 respondents in Wave 7, 17,632 (Wave 9), 23,299 (Wave 13), 23,442 (Wave 17), and 22,444 (Wave 21). Apart from Waves 7 and 9 which had no top-up samples, the remaining waves respectively included top-up samples of 5178 (Wave 13), 5042 (Wave 17), and 4698 (Wave 21). From the initial sample, we excluded 55,754 observations for respondents who are currently unemployed or have never been employed, leaving us with 48,343 observations for 18,650 employed respondents in all five waves. We excluded the unemployed from our data because the time poverty construct in this study is employment-related, and hours of work cannot be obtained for the unemployed. We further excluded 1394 observations for respondents with no data on weekly hours of paid work. The remaining sample included 46,949 observations for 18,384 employed respondents aged 15 years and over, with data on weekly hours of paid work. Due to 31 missing data points in some demographic variables, our main regression analyses included 46,918 observations for 18,372 individuals.

2.2. Variables

2.2.1. Food away from home behaviour (FAFH)

In line with the conceptualisation of FAFH as the consumption of food prepared outside the house, usually from restaurants, cafeterias, etc, we measure respondents' FAFH behaviour using the three separate questions for breakfast, lunch, and supper in the HILDA survey. Respondents were asked on a scale of 0–7 how frequently in a week they buy breakfast, lunch, and supper from a restaurant, café, fast food outlet, or any other establishment that prepares and sells meals. In the questionnaire, a meal is defined as being more than a beverage or a snack food (like a chocolate bar). Among the responses to all three questions, respondents had the option to 'refuse' to answer or simply select "don't know". We respectively captured breakfast, lunch, or supper away from home as binary variables, where responses 1–7 were coded as 1 ('Yes') while a 0 response was coded as a 'No'. From the three variables, we obtained our overall FAFH behaviour variable, which is coded as 1 to reflect a "Yes" response to either of the breakfast, lunch, or supper away from home indicators, while a consistent "No" response to all three questions was coded as 0. The overall FAFH behaviour variable is used in the main analysis, while the breakfast, lunch, or supper away from home variables are used in the heterogeneous analyses. We use the binary version of the FAFH variable because it helps in the easy identification of those who exhibit such behaviours, while the statistical results obtained are simple to interpret. In the robustness check, we also used an overall continuous variable to capture the average number of times one eats away from home, irrespective of mealtime. Similar continuous versions are used for the frequency of eating breakfast, lunch and supper away from home to test for consistency in findings.

2.2.2. Time poverty (employment-related)

Our measure of employment-related time poverty aligns with the standard measure of absolute poverty, which is pegged along a poverty line. Since our construct is employment-specific, we follow previous studies (Goodin, 2011, pp. 9–12) to identify the time-poor as anyone who works more than 38 h per week in paid labour. Our 38-h threshold for employment-related time poverty is informed by Australian law, which stipulates regular working hours to be 38 h per week or 7.6 h per day (7 h, 36 min) for those on permanent or fixed-term contracts (Fair Work Ombudsman, 2023). Our binary construct of employment-related time poverty takes on a value of 1 to denote those who are time-poor, and 0 if otherwise. To compare our results to studies from other countries or to accommodate instances where people work 8 h a day, we also use a 40-h threshold to measure employment-related time poverty, which is employed as a robustness check on the main construct.

2.2.3. Mediator

To investigate the possible pathway through which employment-related time poverty influences FAFH behaviour, we explore the relevance of time stress.

We measure time stress using the HILDA question, which asks respondents on a five-point scale (1 "Almost always" to 5 "Never"), "How often do you feel rushed or pressed for time?". Responses 1 to 3 (almost always, always, and sometimes) were coded as 1 to identify those experiencing time stress, while responses 4 and 5 (rarely and never) were coded as 0 to denote 'no time stress'. In Table A1 in the Supplementary Materials, we see that individuals who are time-poor are more likely to experience time stress.

3. Estimation strategy

To analyse the association between employment-related time poverty and FAFH behaviour, we estimate our preliminary model using ordinary least squares (i.e., Pooled OLS) and Fixed Effects (FE) models. Unlike the Pooled OLS, the FE model includes individual fixed effects. These are done using the following preliminary model:

$$FAFH_{it} = \beta_1 TPOV_{it} + \sum_n \beta_n X_{n,it} + \varphi_i + \tau_t + \eta_s + e_{it} \quad (1)$$

where $FAFH_{it}$ denotes whether individual i at time t eats food away from home or not. It also represents the breakfast, lunch, and dinner FAFH behaviours in the heterogeneous analyses. $TPOV_{it}$ represents an individual's employment-related time poverty status (1 = Yes; 0 = No). In the heterogeneous models, we estimate separate regressions for breakfast, lunch, and supper away from home, which are captured as binary variables. This is done to explore the relative effect of employment-related time poverty on FAFH behaviour at different mealtimes. The control variables $(X_{n,it})$ include gender, age, household size, rural residency, log of disposable income, and education and marital statuses. The estimated association between employment-related time poverty and FAFH behaviour is based on contemporaneous relationships, but the model accounts for time, state and individual fixed effects. φ_i, τ_t and η_s respectively represent individual, wave, and state fixed effects. e_{it} is a random error term. Apart from the main and different mealtime models, we also estimate separate models for male-female and rural-urban subsamples. To do this, we first engage in interaction analysis for gender and location, which are detailed and interpreted in Section 4.4.

The estimated effect of $TPOV_{it}$ can be biased due to endogeneity, which may be caused by omitted variable bias or bidirectional causality (Do et al., 2015; Nguyen & Connelly, 2014; Urwin et al., 2019). The omitted variable problem, which results in the correlation between $TPOV_{it}$ and the unobserved individual-specific characteristics (φ_i), can be resolved by the FE model since HILDA surveys the same individuals over time. Conversely, the FE model is unable to address the bidirectional causality problem emanating from the link between $TPOV_{it}$ and e_{it} (Jacobs et al., 2014; Zhu & Onur, 2023). Considering the bidirectional causality, we argue that individuals who spend extra hours at work will have less time to either prepare meals at home or eat meals prepared for

them at home. On the other hand, an individual can opt to consume FAFH because they intend to extend their working hours into the night or start earlier than usual. To address both omitted variable bias and reverse casualty problems, we employ the fixed effects instrumental variable (FE-IV) model. The FE-IV is implemented by using an employee's supervisory responsibility as an instrument. We argue that one's supervisory responsibility over other workers is expected to increase the amount of committed time at work because such individuals are expected to complete their own tasks while spending extra time to provide oversight responsibilities for members of staff (Brett & Stroh, 2003; Feldman, 2002). On the contrary, having a supervisory responsibility is not expected to directly influence one's FAFH behaviour unless such responsibilities cause one to work extended hours, thereby leaving limited time available for shopping for groceries and cooking at home or going home on time to eat meals prepared for them.

The instrument's validity can potentially be compromised if the need to provide oversight responsibilities is associated with extra financial incentives. The financial incentive can increase purchasing power, making FAFH more likely. To circumvent this potential problem, we include disposable income as a control variable in our model to capture purchasing power.

Apart from the FE-IV estimator, we also employ different quasi-experimental methods as robustness checks on our main results. These include the Lewbel (2012) and control function IV approaches and propensity score matching (PSM) method. We also employ the 40-h threshold version of employment-related time poverty to test the sensitivity of our main measure. These methods are fully explained in subsection 4.5. From this point forward, our reference to time poverty is employment related.

3.1. Descriptive statistics

Table A2 in the Supplementary Materials presents the summary statistics for the outcome and explanatory variables. Depending on the threshold used to define time poverty (more than 38 and 40 h), approximately 48% and 31% of respondents are classified as time-poor, respectively. About 83% of respondents regularly purchase breakfast, lunch, and dinner from restaurants, cafés, fast food outlets, or other establishments that prepare and sell meals. Specifically, 25% buy breakfast, 63% buy lunch, and 70% buy supper away from home. Regarding demographics, 49% of the respondents are female, with an average age of 39 years and an average household size of three. About 32% reside in rural areas, and the average log annual disposable income is 11.40 Australian dollars. Additionally, 81% have been educated beyond year 12, and the marital status breakdown is as follows: 47% married, 20% in a de facto relationship, 3% separated, 5% divorced, and 1% widowed. Furthermore, 84% of respondents reported feeling time-stressed, and 45% reported having supervisory responsibilities toward other employees.

Comparatively, respondents in the excluded sample are slightly older, with an average age of 40 years and a 14% higher female composition. The excluded sample had 6% higher rural-located respondents, but the average household sizes and incomes in both samples are similar. Other comparable summary statistics for education and marital statuses for the excluded sample can be found in Table A3 in the Supplementary Materials.

4. Results

4.1. Preliminary results

In this section, we report preliminary results for the link between time poverty and FAFH in Table 1. In Columns 1 and 2, we respectively report the pooled OLS and FE estimates of the effect of time poverty on FAFH. Overall, our findings show that time poverty is associated with an increase in individuals' FAFH tendencies. Specifically, we observe in columns 1 and 2 that time poverty is associated with increases individuals' likelihood of consuming FAFH by 2.9 and 2.2 percentage points, respectively. It is worth noting that the estimated effect of time poverty in the FE model that accounts for individual heterogeneities in resolving omitted variable bias is smaller than that of the OLS model.

Table 1
Time poverty and FAFH (Pooled OLS and FE results).

Variables	(1)	(2)
	Pooled OLS	Fixed effects
Time poverty	0.029***	0.022***
	(0.004)	(0.005)
Female	−0.026***	−0.024***
	(0.005)	(0.009)
Age	−0.006***	−0.006***
	(0.000)	(0.001)
Household size	−0.014***	−0.006***
	(0.002)	(0.002)
Rural	−0.083***	−0.050***
	(0.005)	(0.010)
log(disposable income)	0.026***	0.012***
	(0.003)	(0.003)
Educated above year 12	0.030***	0.077***
	(0.006)	(0.012)
Married	0.004	−0.001
	(0.006)	(0.009)
Defacto	0.035***	0.001
	(0.005)	(0.007)
Separated	0.022	0.021
	(0.014)	(0.017)
Divorced	0.021*	0.028
	(0.013)	(0.019)
Widowed	−0.003	−0.038
	(0.031)	(0.047)
Individual fixed effects	No	Yes
Time fixed effects	Yes	Yes
State fixed effects	Yes	Yes
Observations	46,918	46,918
Number of individuals	18372	18,372

Robust standard errors in parentheses ***p < 0.01, **p < 0.05, *p < 0.1.

Results for the covariates further show that females and rural residents are less likely to consume FAFH, while those educated above year 12, those in de facto relationships and divorced are more likely to exhibit FAFH behaviours. An increase in age and household size is associated with an increase in the probability of consuming FAFH, while disposable income is associated with an increase in FAFH tendencies. The results on family size, education, and income are consistent with the findings of Saksena et al. (2018).

4.2. Endogeneity-resolved results

In Table 2, we report the 2SLS (Column 1) and FE-IV (Column 2) results for models in which supervision of other employees is used as an instrument to address the endogeneity problem associated with time poverty. For all two models, the F-statistics of the first stage estimates are all greater than 10, so we infer that our instrument is not weakly associated with time poverty (Stock & Yogo, 2002). We observe from the first stage results that those who have supervisory roles over other employees are more likely to be time-poor. This indicates that supervising other employees is associated with an increase in one's workload and committed time in the labour market thus increasing time poverty. The main results confirm that time poverty is associated with increases in individuals' FAFH consumption. In particular, we find in Columns 1 and 2 that time poverty is associated with an increase in the likelihood of consuming FAFH by 24.0 and 22.8 percentage points, respectively. The 2SLS and FE-IV estimates are bigger than the preliminary estimates (OLS and FE), implying that the endogeneity associated with time poverty causes a downward bias in the OLS and FE estimates. Also, the FE-IV

Table 2
Time poverty and FAFH (FE-IV results).

Variables	(1)	(2)
	2SLS	FE-IV
Time poverty	0.240***	0.228***
	(0.022)	(0.044)
Individual fixed effects	No	Yes
Time fixed effects	Yes	Yes
State fixed effects	Yes	Yes
First stage		
Supervise other employees	0.182***	0.106***
	(0.005)	(0.006)
F-Statistic	356.29	297.22
Observations	41,065	41,065
Number of individuals	12,524	12,524

Robust standard errors in parentheses ***p < 0.01, **p < 0.05, *p < 0.1.

model, which resolves both omitted variable bias and bidirectional causality, again has produced an estimate smaller than that from the 2SLS model, so we stick the FE-IV model in our subsequent analysis.

4.3. Time of meal results

In Table 3, we conducted heterogenous analyses of the link between time poverty and FAFH by decomposing FAFH behaviour to reflect different mealtimes—breakfast, lunch, and supper. We find that time poverty is significantly associated with an increase in people's likelihood of consuming lunch away from home (28.5%), followed by breakfast (19.5%) and dinner (17.4%).

4.4. Gender and location analyses

To explore the gender and location dynamics in the time poverty-FAFH nexus, we analyse and report results separately for male-female and rural-urban subsamples in this section. Empirical justification for engaging in subsampled models for gender and location is provided by the interaction analyses, where the female and rural variables were separately interacted with time poverty to assess their statistical significance. As reported in Table A4 in the Supplementary Materials, we observe that the interaction coefficients for gender and location with time poverty are both significant, implying that male-female respondents and rural-urban residents have statistically different outcomes for the effects of time poverty on FAFH behaviour. In Table 4, results for the male and female samples are reported in columns 1 and 2, while those of the rural-urban samples are reported in columns 3 and 4, respectively. We find that time poverty is associated with 19.3 and 28.1 percentage points increases in the likelihood of consuming FAFH among males and females, respectively.

In Columns 3 and 4 of Table 4, we see that time poverty is associated with 26.7 and 21.8 percentage points increases in the likelihood of consuming FAFH among rural and urban residents, respectively. The results suggest that time-poor rural residents are more likely to consume FAFH than urban households.

Table 3
Time poverty and FAFH (FE-IV results): Different mealtimes.

Variables	(1)	(3)	(3)
	Time of meal		
	Breakfast	Lunch	Dinner
Time poverty	0.195***	0.285***	0.174***
	(0.052)	(0.057)	(0.053)
Individual fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes
First stage			
Supervise other employees	0.106***	0.106***	0.106***
	(0.006)	(0.006)	(0.006)
F-Statistic	297.25	297.17	296.42
Observations	41,060	41,061	41,056
Number of individuals	12,523	12,523	12,522

Robust standard errors in parentheses ***p < 0.01, **p < 0.05, *p < 0.1.

Table 4
Time poverty and FAFH (gender & location—FE-IV results).

Variables	(1)	(3)	(3)	(4)
	Gender		Location	
	Male	Female	Rural	urban
Time poverty	0.193***	0.281***	0.267***	0.218***
	(0.058)	(0.070)	(0.103)	(0.052)
Individual fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
State fixed effects	Yes	Yes	Yes	Yes
First stage				
Supervise other employees	0.107***	0.101***	0.098***	0.103***
	(0.008)	(0.009)	(0.011)	(0.008)
F-Statistic	162.63	127.62	76.56	183.56
Observations	21,162	19,901	12,283	27,392
Number of individuals	6374	6150	3947	8580

Robust standard errors in parentheses ***p < 0.01, **p < 0.05, *p < 0.1.

4.5. Robustness and sensitivity checks

In this section, we run various tests to ensure that our results are robust. In Table 5, we employed the Lewbel IV method (Kofinti et al., 2024; Koomson, 2024; Opoku et al., 2024), which uses internal and external instruments (i.e., supervision of other employees) and report the results in Columns 1 and 2, respectively. Consistent with the IV results, we find that time poverty is associated with increases in the likelihood of consuming FAFH between 8.9 and 16.3 percentage points. The IV estimates are both larger than the preliminary results and consistent with the IV results, implying that the time poverty's increasing effect on FAFH consumption is consistently established irrespective of the method used to address endogeneity.

Table 6 shows the results of the control function method (Column 1), which uses the predicted residual of the first-stage regression (Awaworyi

Table 5
Time poverty and FAFH (Lewbel IV results).

Variables	(1)	(2)
	Lewbel IV	
	Internal-Only	Internal & External
Time poverty	0.087***	0.163***
	(0.031)	(0.017)
All controls	Yes	Yes
First stage		
Supervise other employees	–	0.176***
	–	(0.004)
F-Statistic	26.73	101.69
JP-value	0.082	–
Observations	46,918	46,911
Number of individuals	18370	18370

Standard errors in parentheses ***p < 0.01, **p < 0.05, *p < 0.1.

Table 6
Time poverty and FAFH (Alternative method & measures).

Variables	(3)	(4)
	Alternative method	Alternative measure
	Control Function Approach	Time poverty (>40 h)
Time poverty	0.203***	0.257***
	(0.022)	(0.050)
Residuals	−0.180***	
	(0.022)	
All controls	Yes	Yes
First stage		
Supervise other employees	0.179***	0.094***
	(0.004)	(0.006)
F-Statistic	335.88	258.88
Observations	41,065	41,065
Number of individuals	12,524	12,524

Standard errors in parentheses ***p < 0.01, **p < 0.05, *p < 0.1.

Churchill et al., 2023; Koomson, Zhang, & Prakash, 2024) and the estimates from the sensitivity analysis based on an alternative measure of time poverty (i.e., a cut-off of 40 h a week—Column 2). Results from the control function method and alternative time poverty conceptualisation methods are both consistent with the IV results. They show that time poverty is associated with increases in the probability of consuming FAFH between 20.3 and 26 percentage points. We can infer that the positive effect of time poverty on FAFH is again robust to an alternative approach to addressing endogeneity and a different conceptualisation of time poverty.

Again, we apply the PSM method to address the coefficient bias that arises from self-selection issues (see Ansong et al., 2023; Koomson, Afoakwah, & Twumasi, 2024). We used a battery of matching methods such as nearest neighbour, radius, kernel, and local linear regression. We complement the matching techniques with an Inverse Probability Weighted Regression Adjustment (IPWRA), which is considered doubly robust. The results are presented in Table 7, and they demonstrate a consistent positive association between time poverty and FAFH across various matching methods and the IPWRA. In Columns 1 to 5, we observed that the average treatment effect on the treated (ATT) for the effect of time poverty on FAFH ranges from 0.026 to 0.039. This implies that the increasing effect of time poverty on FAFH ranges from 2.6 to 3.9 percentage points. The PSM results further highlight the important link between time poverty and FAFH.

Finally, we use continuous versions of the FAFH variables as sensitivity checks and report the results in Table A5 in the Supplementary Materials. For the overall FAFH behaviour, we used the average number of times one eats away from home, irrespective of mealtime. For breakfast, lunch, and supper, their respective 0–7 frequencies are used as continuous variables. Upon using the continuous variables, we consistently find that time poverty is associated with increases in individuals' frequency of engaging in FAFH behaviours, with consistent findings established for the breakfast, lunch, or supper models.

Table 7
Propensity score matching of the effect of time poverty on FAFH.

Variables	(1)	(2)	(3)	(4)	(5)
	Nearest Neighbour (1–5)	Radius	Kernel	Local linear matching	IPWRA
Time poverty	0.028***	0.039***	0.031***	0.026***	0.039***
	(0.004)	(0.002)	(0.004)	(0.005)	(0.003)
All control variables	Yes	Yes	Yes	Yes	Yes
Observations	46,918	46,918	46,918	46,918	46,918

Standard errors in parentheses ***p < 0.01, **p < 0.05, *p < 0.1.
Number of Bootstrap replications (50).

4.6. Mediation analysis

We conduct a mediation analysis to establish the mechanism through which time poverty influences the consumption of FAFH. To do this, we assess the role of time stress (i.e., an individual feeling rushed or pressed for time) as a potential pathway by applying Dippel et al.'s (2020) instrumental variable approach, which has been deployed in recent studies (Funke et al., 2023; Koomson et al., 2023; Rezki, 2023). This method is capable of solving the endogeneity problem for both time poverty and the mediator to estimate the direct, indirect, and total effects. It eliminates the need for an additional instrument for the mediator (Dippel et al., 2020).

In the first of two steps, we demonstrate in Table 8 that being time-poor is significantly associated with a 22.3 percentage point increase in the likelihood of feeling time-stressed. Individuals who are time-poor in work-related activities spend more time at work, which leaves them with little or no room for leisure and home activities, thus increasing their time stress.

Step two involves the inclusion of time stress in the FAFH model to analyse its mediation effect based on the estimated direct, indirect, and total effects, as shown in Table 9. We observe that time stress is associated with a 70.7 percentage point increase in the likelihood of consuming FAFH. We also see that the total effect of time poverty on FAFH is 16.2 percentage points. Of the total effect, the mediating/indirect effect of time pressure is 15.8 percentage points and is statistically significant, implying that time stress serves as an important channel via which time poverty influences FAFH behaviour.

5. Discussion

Food consumption and its impact on health are influenced by various factors, including socioeconomic characteristics, external shocks, the food environment, and employment-related time poverty. This paper focuses on the latter, specifically examining the effect of employment-induced time poverty on the consumption of FAFH. Time poverty can be measured using either relative or absolute metrics and either considering paid or unpaid activities or both. In this study, we adopt an absolute measure based solely on paid activities, as paid and unpaid work may differentially impact FAFH consumption. Since paid work is linked to income, its influence on FAFH consumption is expected to be more pronounced. This is supported by findings from Jones et al. (2018), which show that increased workforce participation correlates with higher fast-food consumption and greater expenditure on FAFH. The findings of our study carry important implications for household welfare.

First, we find that time-poor individuals are more likely to consume FAFH. The findings show that individuals who work longer hours than

Table 8
Effect of Time poverty on time stress (IV results).

Variables	Time stress
Time poverty [EM]	0.223***
	(0.015)
All controls	Yes
F-Statistic	2802.262
Observations	41,065
Number of individuals	12,524

Robust standard errors in parentheses ***p < 0.01, **p < 0.05, *p < 0.1.
EM: Effect on mediator.

Table 9
Linear IV Mediation analysis with direct, indirect, and total effects.

Variables	(1)
	Mediator: Time stress
Time poverty [DE]	0.002
	(0.007)
Time stress [ME]	0.707***
	(0.106)
All controls	Yes
Mediation indicators	
Total effect [TE]	0.162***
	(0.016)
Direct effect [DE]	0.002
	(0.007)
Indirect effect [IE = EM*ME]	0.158***
	(0.026)
Observations	41,065
Number of individuals	12,524
First stage 2 (F-statistic)	138.08

Standard errors in parentheses ***p < 0.01.
TE: Total effect ME: Mediator effect EM: Effect on Mediator.

anticipated in the labour market tend to have less time to prepare meals at home. As a result, these individuals are more likely to rely on FAFH options, such as dining out, takeout, or pre-prepared meals, to meet their dietary needs. This dependency on FAFH could be attributed to the time constraints imposed by their extended work hours, which limit their ability to cook meals from scratch or engage in other time-intensive food preparation activities at home. Consequently, their dietary habits may shift towards more convenient food options that require minimal preparation time. Our finding implies that reducing time poverty can lead to a reduction in FAFH, which may, in turn, improve individual health outcomes (Ayala et al., 2008). Our finding differs from that of Kalenkoski and Hamrick (2013), given that our measure of FAFH is overarching and encompasses all meals for breakfast, lunch or supper purchased from restaurants, café, fast food outlets, or any other place (including grocery shops) that prepares and sells meals. Astbury et al. (2020) show that the type of work and the level of engagement is highly correlated with eating behaviour. Women who spend more time on food-related activities or foodwork such as shopping for food, food preparation and management, or washing dishes spend less time eating. However, other studies have shown that it is difficult to increase home food production (healthy diets) due to the interactive effect of income and time poverty. In such situations, FAFH is more accessible to home managers who are responsible for home food preparation (Jones et al., 2018; Tiwari et al., 2017). Astbury et al. (2022) observed a decline in participation in foodwork in the UK between 1983 and 2014, resulting in increased time allocation to productive work, which has implications for other time use.

Second, we find evidence of heterogeneity in the association between time poverty and consumption of FAFH at different times of the day. The findings show that time poverty is associated with an increase in the consumption FAFH for all mealtimes, but the effect is greatest during lunchtime. Put differently, the time constraint experienced by individuals in the labour market is most likely to either limit their ability to cook and pack lunch for consumption during a break or to cook in the afternoon when at home.

Third, the effect of time poverty on FAFH is more evident among women due to the double burden of workload (committed time in paid and unpaid work) on women, which is more likely to increase their time poverty (Orkoh et al., 2020) and increase their dependence on FAFH. Reducing women's workload is expected to make a more significant difference in reducing the consumption of FAFH for women than for men.

Fourth, the effect of time poverty on FAFH is more noticeable among rural households. Eating behaviour is significantly impacted by social, physical, and macro-environmental factors (LaCaille, 2020). The availability and type of restaurants in an area have a direct impact on FAFH consumption. The setting in which FAFH is consumed has been shown to influence not just the caloric content of foods but also the amount of nutrients consumed (Godbharle et al., 2022). Rural communities in Australia frequently have longer commute times due to their remote location from workplaces, schools, and vital utilities, which may contribute considerably to the prevalence of FAFH consumption. Furthermore, unlike their urban counterparts, rural dwellers experience a paucity of food options, particularly those that serve healthy meals. These areas' limited FAFH alternatives frequently include foods high in saturated fat, added sugars, salt, and kilojoules. Fast-food restaurants, in particular, are frequently blamed for creating an environment conducive to obesity, more so than traditional indoor diners (Tian et al., 2018).

Finally, we find that time stress is an important pathway through which time poverty influences FAFH. In essence, individuals who feel time-stressed as a result of time poverty are unlikely to make time to shop for groceries to cook at home but would instead go for FAFH to make time to engage more in productive activities. Time poverty and time stress may seem similar but are conceptually different. Time poverty is a structural problem related to actual availability and is often caused by external factors such as economic conditions and job requirements, which make an individual work longer hours than is expected on average in paid work, extensive unpaid labour, or a combination of both. Time poverty primarily affects the ability to perform essential activities and can perpetuate economic disadvantage. On the other hand, time stress is the feeling of being overwhelmed or pressured due to a perceived lack of time. It is a psychological state where individuals feel they do not have enough time to complete their tasks or meet their obligations (Pritchard, 2015; Sussman & Sekuler, 2022). This is caused by a high workload, tight deadlines, poor time management skills, or a tendency to overcommit to tasks and responsibilities. It is often related to an individual's perception of time and their ability to manage it effectively. From the information above, it can be deduced that time stress is caused by time poverty. This implies that designing labour market and socioeconomic interventions to reduce time poverty will likely reduce time stress and hence reduce the FAFH tendencies.

6. Conclusion and recommendation

This study used five waves of panel data extracted from the HILDA survey to test the effect of time poverty on FAFH in Australia, controlling for unobserved heterogeneity. We estimated a fixed effects model and employed several models that are widely used to address endogeneity (i.e., 2SLS, FE-IV, control function and Lewbel IV methods) to ensure greater consistency in our findings. In addition, we applied the PSM method to fix coefficient bias, which could result from self-selection. Finally, we employed time poverty measures that were captured based on both 38- and 40-h thresholds of weekly working hours in paid jobs, while FAFH was measured as a binary variable to encompass all meals for breakfast, lunch or supper purchased from restaurants, café, fast food outlet, or any other place (including grocery shops) that prepares and sells meals.

Our main finding shows that time poverty is associated with an increase in an individual's tendency to consume FAFH. The positive association between time poverty and FAFH is robust to different quasi-experimental methods and different conceptualisations of time poverty. We find evidence of heterogenous effects in the relationship between time poverty and FAFH based on sex, location, and age cohort. The results show that time poverty has a greater impact on FAFH among females and rural residents. Finally, we find that time stress is an important pathway through which time poverty influences FAFH.

The findings from this study lead to three main policy implications.

First, intervention strategies intended to address the time burden, such as labour-saving technologies at workplaces and improved transportation systems, must be vigorously pursued. Such strategies are needed to reduce individuals' time commitment and promote healthy eating and leisure habits. However, more attention must be paid to the rural areas, which lack most of the infrastructure required to improve productivity. The transportation systems in rural areas are not efficient and require long commuting hours even if they exist, especially when most high-paying jobs are located outside the rural areas. Second, work schedules that require more committed time for supervising other employees can be reduced through the introduction and scaling of existing monitoring systems with limited human interventions. Third, governments' labour policies must encourage firms or institutions to provide daycare services to employers and early childhood education, especially for women, to reduce women's time allocated to child work. Fourth, we urge governments to increase minimum wage and encourage employers to provide flexible working arrangements, which have the potential to reduce time poverty and FAFH tendencies in the process.

7. Limitation of the study

Despite the significant findings of our study regarding time poverty induced by paid work and its policy implications, we acknowledge that paid and unpaid work can interact in various ways to exacerbate time poverty. Additionally, unpaid work is often gendered, with significant implications for household time use and overall well-being. Future research could consider incorporating unpaid work and commuting time into the construct of time poverty, as commuting patterns differ between rural and urban residents.

Due to data constraints, we empirically analysed the role of one main potential pathway despite the possibility of others. These include insufficient time for home-prepared meals, physical exhaustion/fatigue, and the relative perceived cost of FAFH. Regarding time insufficiency, employment-related time poverty can result in individuals having inadequate time to plan, purchase, and prepare meals at home. Considering fatigue, working beyond expected hours can make people feel stressed, thereby reducing the motivation to cook and making eating out or ordering food more appealing. Again, people who are time-poor in employment are more inclined to view the perceived time investment in cooking as exceeding the cost of dining out, particularly if their jobs come with higher remuneration. We suggest that future studies be done in other jurisdictions to explore more pathways based on context and relevance to help in context-specific policy designs.

While the FE-IV estimation strategy is useful for addressing endogeneity, it has limitations. These include unmeasured or omitted time-varying confounding, sensitivity to model specification and non-random missing data in unbalanced panels. First, although the FE-IV model resolves endogeneity by controlling for individual heterogeneities or fixed effects, it only effectively eliminates biases associated with time-invariant variables (Wooldridge, 2010). The model is unable to adjust for the omission of time-varying confounders that could potentially be linked to both independent and outcome variables. This might bias estimates and make it difficult to assert causality (Wooldridge, 2010). Second, FE-IV models can be very sensitive to errors in model specification. When misspecified, the fixed effects could absorb a considerable portion of the heterogeneity in the data, which will conceal the actual effect of the endogenous variable (Greene, 2003). Finally, the FE-IV model is conditioned on a chosen instrument being valid and exogenous. This notwithstanding, an instrument's validity can be undermined in an unbalanced panel if the missing data is non-random and is correlated with the endogenous variable of interest (Joshi, 2019). Due to these limitations, care must be taken when asserting causality based on FE-IV estimates.

CRediT authorship contribution statement

Isaac Koomson: Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Formal analysis, Data curation, Conceptualization. **Edward Martey:** Writing – review & editing, Writing – original draft, Validation, Methodology, Conceptualization. **Omphile Temoso:** Writing – review & editing, Writing – original draft, Validation, Methodology, Conceptualization.

Ethical issues

Participants of the HILDA survey provided informed consent by affirmatively responding to the statement "I am aware that my responses are confidential, and I agree to participate in this survey". Participants had the option to leave the survey at any moment and without explanation. The HILDA Survey was approved by the University of Melbourne Human Research Ethics Committee.

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Declaration of competing interest

We certify that we have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2024.107734.

Data availability

The authors do not have permission to share data.

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