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## Does maternal background matter? A multilevel approach to modelling mental health status of Australian youth using longitudinal data

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<b>Keywords:</b>	Equity, Parental Characteristics, Socioeconomic Status, Family Background, Mental Health
<b>Abstract:</b>	<p><b>Purpose</b> Most previous research place great store on the influence of maternal background on child and adolescents mental health. However, age of onset studies indicates that the majority of the mental health disease prevalence occurs during the youth years. This study investigates the relationship of maternal background and individual circumstance on youth mental health status.</p> <p><b>Method</b> Data from 975 participants and 4632 observations of aged cohort 15 to 19 years in the Household, Income and Labour Dynamics in Australia (HILDA) longitudinal study were followed for 10 years (2007-2017).</p> <p><b>Results</b> The findings suggests that not all dimensions of maternal background (especially education) have impacts on youth mental health. We found household income (AOR: 1.572, 95% CI: 1.017-2.43) and living arrangement (AOR: 1.586, 95% CI: 1.097-2.294) significantly increases mental disorder odds whereas maternal education or occupation fixed effects were not significant. Individual level circumstances have much stronger impact on youth mental health. We found financial shock (AOR: 1.412, 95% CI: 1.277-1.561), life event shock (AOR: 1.157, 95% CI: 1.01-1.326), long term health conditions (AOR: 2.855, 95% CI: 2.042-3.99), smoking (AOR: 1.676, 95% CI: 1.162-2.416), drinking (AOR: 1.649, 95% CI: 1.286-2.114) and being female (AOR: 2.021, 95% CI: 1.431-2.851) have significant deteriorating effects on youth mental health.</p> <p><b>Conclusions</b> Our finding is in contrast to the majority of studies in the literature which give a preeminent role to maternal characteristics in child and youth mental health status. Mental health interventions should consider heterogeneity of adverse youth circumstances and health-related behaviours.</p>
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Additional data availability information:



1 Does maternal background matter? A multilevel approach to modelling mental  
2 health status of Australian youth using longitudinal data

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1 **Abstract**

2 Purpose

3 Most previous research place great store on the influence of maternal background on child and  
4 adolescents mental health. However, age of onset studies indicates that the majority of the mental health  
5 disease prevalence occurs during the youth years. This study investigates the relationship of maternal  
6 background and individual circumstance on youth mental health status.

7 Method

8 Data from 975 participants and 4632 observations of aged cohort 15 to 19 years in the Household,  
9 Income and Labour Dynamics in Australia (HILDA) longitudinal study were followed for 10 years  
10 (2007-2017).

11 Results

12 The findings suggests that not all dimensions of maternal background (especially education) have  
13 impacts on youth mental health. We found household income (AOR: 1.572, 95% CI: 1.017-2.43) and  
14 living arrangement (AOR: 1.586, 95% CI: 1.097-2.294) significantly increases mental disorder odds  
15 whereas maternal education or occupation fixed effects were not significant. Individual level  
16 circumstances have much stronger impact on youth mental health. We found financial shock (AOR:  
17 1.412, 95% CI: 1.277-1.561), life event shock (AOR: 1.157, 95% CI: 1.01-1.326), long term health  
18 conditions (AOR: 2.855, 95% CI: 2.042-3.99), smoking (AOR: 1.676, 95% CI: 1.162-2.416), drinking  
19 (AOR: 1.649, 95% CI: 1.286-2.114) and being female (AOR: 2.021, 95% CI: 1.431-2.851) have  
20 significant deteriorating effects on youth mental health.

21 Conclusions

22 Our finding is in contrast to the majority of studies in the literature which give a preeminent role to  
23 maternal characteristics in child and youth mental health status. Mental health interventions should  
24 consider heterogeneity of adverse youth circumstances and health-related behaviours.

25

26 **Keywords:** Equity, Parental Characteristics, Socioeconomic Status, Family Background, Mental  
27 Health



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## 1 1. Introduction

2 Social gradients in physical and mental health status exist and good mental health is not equally  
3 distributed [1-3]. Understanding the determinants of socioeconomic inequality is important for policy  
4 makers and researchers alike. While socioeconomic inequalities in adult mental health dominates  
5 current research, a growing body of literature currently points to the importance of maternal background  
6 on children and adolescents' mental health [4-6]. Accumulating evidence also suggests that lower  
7 socioeconomic status (SES) is an important marker of mental health problems in children and  
8 adolescents [7-9].

9 Although child and adolescent periods appear to be emerging points for mental disorders, age of onset  
10 (AOO) studies have identified that the majority of mental disorder incidence occurs at the early stages  
11 of youth, particularly when young people transition to adulthood [10, 11]. The problem in the literature  
12 relating to the influences of maternal background and childhood circumstances on mental health status  
13 is that the age bands in these studies are broad, obscuring the stages of youth by either younger youths  
14 being included with 'children and adolescents' (e.g. age 1-18 years) or older youths being included with  
15 'adults' (e.g. 15-64 years) [8, 12, 13]. The circumstances experienced by individuals in their childhood  
16 and adolescent period are certainly much different than the period when they are transitioning to youth  
17 and adulthood. Thus, the impact of maternal background on this transitioning phase on an individual's  
18 mental health outcome is not clear and may very well be different.

19 In this paper, we tried to address this issue by selecting a 15-19 years age cohort and following the  
20 cohort for ten years (up to six measurement points) to investigate the impact of youth circumstances on  
21 mental health outcomes. Although significant advances have been made in our understanding of the  
22 impact of maternal background on childhood mental health status, considerable knowledge gaps still  
23 exist. For instance, we do not understand how different attributes that constitutes maternal social class  
24 variations (such as mothers education, income or occupational status) contributes to the variation in  
25 youth mental status or how such inequalities evolve over time. Little is known about the variability of  
26 individual level and social class level characteristics on mental health outcome inequalities for youth  
27 and young people.



1 Thus, the primary goal of this paper is to fill this knowledge gap and attempt to provide a link between  
2 prior studies on childhood and adult mental health inequalities. In addition, the focus on Australian  
3 youth complements existing US, UK or European studies on youth mental health inequalities. Our study  
4 extends the literature to another developed country with different social welfare system and norms that  
5 provide different perspectives on mental health equity issues. We also extend the scope of our research  
6 by using improved modelling techniques, for example, utilising multi-level modelling to assess mental  
7 health outcomes, which is another major contribution of this study.



## 8 **2. Methods**


### 9 2.1 Data source

10 All our analyses are based on sample data from the Household, Income and Labour Dynamics in  
11 Australia (HILDA) panel survey[14]. This nationally representative household survey has been carried  
12 out annually from 2001 through 2018 (waves 1-18). It interviews and subsequently reinterviews all  
13 members aged 15 years and over of the same selected household every year. More than 30,000  
14 individuals (40,000+ enumerated) have participated in the survey over the years and on average 15,000  
15 individuals have been interviewed every year. A 90% wave on wave response rates of HILDA survey  
16 are comparable with other large longitudinal surveys like the British Household Panel Study (BHPS)  
17 or Panel Study of Income Dynamics (PSID). Details of HILDA sample design, survey response rates  
18 and attrition rates can be found elsewhere [15].

19 <Insert Figure 1 here>

### 20 2.2 Inclusion criteria of the samples

21 For the purpose of this study, we limit the sample to young Australians aged 15-19 years (late adolescent  
22 period) at the baseline wave (wave 7) and then followed the participants for 10 years (up to six  
23 measurement points) which covers youth (20-24 years) and transition to adulthood phase (25-29 years)  
24 in the follow up. We chose to start from wave 7, because HILDA survey did not start to collect Kessler  
25 Psychological Distress Scale (K10) scores (our main outcome of interest) in earlier waves and it  
26 provides the score subsequently in every odd wave (every two years) thereafter. Thus we constructed


1 an unbalanced panel data using wave 7, 9, 11, 13, 15 and 17. To be included in the analyses, the  
2 participants had to be interviewed in the baseline wave 7 and has to appear in at least one of the follow-  
3 up waves. Our final sample contains 975 participants across the six waves with a total of 4,632  
4 observations. The 15-19 age cohort was thus followed up to 25-29 years with an average of 5.18  
5 observations per person. The participant flow into the sample is shown in Figure 1. 

### 6 2.3 Outcome variable, exposure variables and other co-variates

7 This study uses the Kessler Psychological Distress Scale (K10) as the measure of mental health  
8 outcomes and is the main dependent variable for analyses[16]. In clinical practice, the scale is used to  
9 assess the likelihood of having a mental disorder; for example, a person with a score of 10-15 has a low  
10 risk of having a mental disorder whereas a person with a score of 20-24 is likely to have a mild mental  
11 disorder, a score of 25-30 would indicate a likely moderate mental disorder and a person with a score  
12 of 30-50 is likely to have a severe mental disorder[17]. In the analyses, we use a dichotomous K10  
13 variable (where a score of greater than 20 depict the likelihood of a mental disorder) as measures of our  
14 dependent variable for mental health performance [18].

15 Following Roemer's equality of opportunity theory [19, 20] we classify all our exposure variables into  
16 two types: i) circumstances category and ii) effort category. The theory of equality of opportunity  
17 revolves around the goal of compensating for 'negative' circumstances (such as parental background)  
18 on health outcomes while disregarding the health inequalities generated by effort category variables  
19 (such as lifestyle or health habits) that can be attributed to the behaviour of an individual. We use the  
20 biological mothers' education level and occupational status, household income and family living  
21 arrangements (whether the participant lived with both parents at the age of 14 years old) to determine  
22 the maternal background status as a group level characteristic of the circumstances category. We define  
23 maternal education level as low if the highest qualification level obtained by the mother is secondary  
24 level or lower. We use the Australian Socioeconomic Index 2006 (AUSEI06) occupational status scale  
25 as the measure of the occupational status of mother [21]. We assign occupational status as low if the  
26 value range falls in the lowest quintile. Similarly, we assign household income as low if the equivalised  
27 household income range falls in the lowest quintile. Using household income, family living

1 arrangement, maternal education and occupational status we have constructed 16 (2x2x2x2) different  
2 types of maternal background history groups for the multilevel analyses.

3 We use the number of financial shocks, number of life event shocks and long term health conditions in  
4 the individual level circumstances category[12]. The number of financial shock variable shows the  
5 number of adverse financial events the study participant has experienced (for example: went without  
6 meals or asked for financial help from friends or family). Similarly, life event shock variable shows the  
7 number of life events related to grief, loss or injury the study participant has suffered (for example:  
8 death of a family member or serious personal injury). The list of events that constitutes financial and  
9 life event shocks are given in the appendix.  use negative health habits such as being obese (as a  
10 proxy of unhealthy eating and lack of exercising ), being a daily smoker and regular drinker (drinks  
11 more than four standard drink/day), and positive health habits such as being an active member of a  
12 sporting/hobby/community based club or association as an effort type of variables. This study also  
13 included gender and rural residency as demographic covariates in the analyses on the basis of past  
14 literature [22]. In addition, we construct our time variable by setting zero at the baseline wave 7 and  
15 subsequently adding two for each additional measurement point (since between wave time period is  
16 two years and there are up to six measurement points) to get a ten year follow-up at wave 17 (t=  
17 0,2,4,6,8, and 10).

## 18 2.4 Statistical Analyses

19 The authors constructed an unbalanced longitudinal data set of the youth cohort by linking an  
20 individual's record who participated in the baseline (wave 7) at age 15-19 years and in one of the follow-  
21 up waves (9, 11, 13, 15 and 17). Descriptive statistics and mental health opportunity profile were  
22 summarized to understand the impact of maternal background characteristics on youth mental health.  
23 Visual trends of psychological distress scale were analysed for group level characteristics. Traditional  
24 single level regression analysis such as logistic regression model only assumes fixed-effect impacts of  
25 dependent variables and does not allow for random effects of intercepts and slopes for individual and  
26 group level characteristics. However, data structure can be nested or clustered by some observable  
27 characteristics that creates similarity between individuals and ignoring this phenomena can violate the

1 independence assumption of regression analysis. Multi-level models allow for a nested data structure  
2 and make it possible to study sources of variance at different levels of an outcome variable [23]. In our  
3 analyses, we used both single level logistic regression and multilevel logistic regression models. we  
4 have nested our data structure into three levels: i) time, ii) individual, and iii) maternal background  
5 history (a total of 16 different background history types; for example a background history type could  
6 be: household income: high, mothers education: low, mothers occupation: low and family living  
7 arrangement - whether not lived with both biological parents: yes.) We assigned unique identifiers for  
8 each group for the analysis. We control for individual fixed effects characteristics like circumstances  
9 and effort covariates in level 2 and group level fixed effects characteristics like various maternal  
10 background characteristics in level 3. All statistical analyses were conducted using Stata 15.

### 11 **3. Results**

#### 12 3.1 Describing the sample

13 <Insert Table 1 here>

14 Table 1 displays the socio-demographic characteristics of the study population by mental health status.  
15 It can be seen that age groups do not vary significantly in mean K10 score both in the baseline wave  
16 and in all waves average. However, in our sample, males have lower average K10 score than females  
17 in both baseline wave and all waves average. Richer household income group has on average two-point  
18 lower K10 scores at baseline and approximately three points in all waves average. Those youth, who  
19 did not live with both biological parents at age 14, have two-point higher average K10 scores both in  
20 baseline and all waves average. Maternal education level does not indicate any significant difference in  
21 average scores between education groups. However, mothers with lower occupational status have  
22 approximately one point higher average scores. All groups have approximately six to seven points of  
23 standard deviation which indicates considerable variability at the individual level.

24 <Insert Table 2 here>

25 For a deeper understanding of maternal background groups, the mental health opportunity profile of the  
26 study participants are provided in Table 2. Depending upon household income, maternal education,

1 maternal occupation and living history arrangement of the participant, 16 types of background groups  
2 are identified. The groups are ranked in ascending order according to the average K10 score (lower  
3 score implies better mental health). Out of 16 groups, there are three groups with high risk level of  
4 developing a mental disorder. Three more groups also show a K10 average of more than 19 and slightly  
5 avoid entering into the high risk group. In addition, the high household income attribute has been  
6 clustered into lower rankings and vice versa. To further investigate, we plot the temporal evolution by  
7 the 16 maternal background types in Figure 2. The thick line (trend values varies between 15 and 25)  
8 shows that there also exist a lot of group level variability overtime in the average K10 scores. The trend  
9 analysis thus indicates both individual and group level variability and justifies analysing the data  
10 through a multi-level modelling approach.

11 <Insert Figure 2 here>

### 12 3.2 Regression analysis

13 The results of the regression models are in Table 3. Since, a single point change in the average K10  
14 score might not mean anything unless it drives up into other risk categories Table 3 considers a  
15 dichotomous dependent variable ( $K10 \geq 20$  implies a higher risk of mental disorder) which measures  
16 risks through nonlinear estimation of odds ratios. The ‘null’ model results are shown in the first column.  
17 The ‘null’ model considers no explanatory variable and focuses just between and within individual  
18 variability. The random effect variances estimates for both maternal background level (level 3  $\sigma^2_{v0}$  is  
19 0.423 and SE is lower at 0.202) and individual level (level 2  $\sigma^2_{u0}$  is 4.101 and SE is also much lower at  
20 0.422) of the null model justifies the use of the multi-level approach. The second model in Table 3  
21 shows the fixed effect logit estimates for comparison purpose. Unlike multilevel (ML) models, the logit  
22 does not have a random component and only shows fixed effects of the variables. To understand the  
23 maternal background variability, we do not consider the fixed effect of maternal background in the third  
24 model (Mixed 1 multilevel model). However, the final multilevel model (mixed 2) considers maternal  
25 background fixed effects. Individual fixed effects are considered in all models.

26 <Insert Table 3 here>

1 The individual level circumstances category variables are highly significant in all models. For example,  
2 exposure to an additional financial shock has a 1.4 times higher risk of having a mental illness than  
3 individuals who do not experience a shock (logit Adjusted Odds Ratio [AOR]: 1.321, 95% CI: 1.243-  
4 1.404; Mixed 1 AOR: 1.436, 95% CI: 1.298-1.589 and Mixed 2 AOR: 1.412, 95% CI: 1.277-1.561).  
5 Similarly, a single life event shock increases the risk of having mental disorder by 1.15 times higher  
6 (logit AOR: 1.156, 95% CI: 1.059-1.262; Mixed 1 AOR: 1.161, 95% CI: 1.013-1.331 and Mixed 2  
7 AOR: 1.157, 95% CI: 1.01-1.326). This is considerable if you consider the possibility of experiencing  
8 multiple life events and financial shocks in a period. In addition, the study result also found that  
9 individuals who have long term health conditions are approximately 2.9 times highly likely to have a  
10 mental condition (logit AOR: 2.232, 95% CI: 1.853-2.688; Mixed 1 AOR: 2.934, 95% CI: 2.098-4.103  
11 and Mixed 2 AOR: 2.855, 95% CI: 2.042-3.99).

12 The individual effort or lifestyle category variables such as ‘daily smoker’, ‘heavy drinker’ and ‘active  
13 membership of club or sporting activities’ are also significant in all models. Club activities have a  
14 positive effect on mental health (logit AOR: 0.651, 95% CI: 0.559-0.758; Mixed 1 AOR: 0.623, 95%  
15 CI: 0.487-0.797 and Mixed 2 AOR: 0.635, 95% CI: 0.496-0.812). On the contrary, negative habits such  
16 as smoking (logit AOR: 1.241, 95% CI: 1.018-1.512; Mixed 1 AOR: 1.801, 95% CI: 1.246-2.604 and  
17 Mixed 2 AOR: 1.676, 95% CI: 1.162-2.416) and drinking (logit AOR: 1.344, 95% CI: 1.163-1.554;  
18 Mixed 1 AOR: 1.651, 95% CI: 1.288-2.117 and Mixed 2 AOR: 1.649, 95% CI: 1.286-2.114) have  
19 deteriorating effects on mental health. This study, however, did not find any significant association of  
20 being obese and mental health for the study cohort in all our models. In the case of demographic  
21 variables, the study found that women are twice as likely as men to have a mental disorder (logit AOR:  
22 1.484, 95% CI: 1.286-1.712; Mixed 1 AOR: 2.063, 95% CI: 1.461-2.913 and Mixed 2 AOR: 2.021,  
23 95% CI: 1.431-2.851). However, the ‘rural resident’ variable was found to be significant in only the  
24 logit estimate (AOR: 0.759, 95% CI: 0.593-0.97). In addition, the study found not significant  
25 association between the sample period (time variable) and mental disorder of the study cohort.

26 In our findings, individual-level fixed effects have much stronger impacts on mental health than  
27 maternal background characteristics. We found that only household income and parental living

1 arrangement (whether participants did not have the opportunity to live with both biological parents)  
2 were significant. Individuals who grew up in a poor household have approximately 1.6 times more  
3 likely to have mental disorder compared to youth who grew up in an affluent family (logit AOR: 1.258,  
4 95% CI: 1.05-1.506; Mixed 2 AOR: 1.572, 95% CI: 1.017-2.43). Similarly, individuals who did not  
5 grow up with both biological parents in their childhood have approximately 1.6 times more likely to  
6 have mental disorder compared to the youths who grew up with both parents (logit AOR: 1.183, 95%  
7 CI: 1.017-1.376; Mixed 2 AOR: 1.586, 95% CI: 1.097-2.294). However, in our study, both mother's  
8 education and occupational status were not significant in any model. In addition, the random variances  
9 of maternal background in multilevel models were much lower compared to the null model (Null  $\sigma^2_{v0}$ :  
10 0.423, 95% CI: 0.166-1.08 and Mixed 1  $\sigma^2_{v0}$  : 0.078, 95% CI: 0.01-0.608). Indeed, the background  
11 variance disappears if fixed effect background characteristics are considered. Contrary to background  
12 random effects, individual level intercept variances are much larger (Null  $\sigma^2_{u0}$ : 4.101, 95% CI: 3.353-  
13 5.017, Mixed 1  $\sigma^2_{u0}$  : 4.068 95% CI: 2.878-5.749 and Mixed 2  $\sigma^2_{u0}$  : 4.116, 95% CI: 2.921-5.8). In  
14 summary, rather than the group level maternal backgrounds, the driving forces in mental health  
15 outcomes of the youths are the individual-level characteristics.

#### 16 **4. Discussion**

17 The present study aimed to investigate the influence of group level maternal background characteristics  
18 and individual level circumstances-effort characteristics on the performance of youth mental health over  
19 time in Australia. For this purpose, the study sampled the 15-19 years cohort data from the long-running  
20 HILDA survey and followed 10 years for up to six measured points. Past research amassed substantial  
21 evidence in linking maternal education and occupation, with child's health outcomes [4, 6, 9]. However,  
22 contrary to this, we did not find any evidence linking youths' mental health with mother's education in  
23 any of our regression results. Perhaps, the thesis examined by Patrick West in earlier research plays a  
24 role in this context. West argued that youth, in contrast to childhood, possess a process of equalisation  
25 which removes the influences of certain dimensions of family background differences (such as maternal  
26 education in our case) in youth mental health [24]. Few studies have explored this area, and further  
27 work is needed for the youth age groups. It is possible that as youth become more independent that the



1 influence of mothers' education becomes less important. We did, however, find significant impact of  
2 household income and family living arrangement on mental health performance of the youth. This  
3 impact is supported by other empirical literature [4, 6, 9, 25].

4 In order to investigate the underlying value judgement of individual effects, we followed equality of  
5 opportunity theory and categorised our variables into circumstances and effort groups [19, 20]. Our  
6 estimated results are consistent with the theory. We found that financial shocks, life event shocks and  
7 long term health conditions significantly deteriorate youth mental health condition. These findings are  
8 consistent with the adverse event literature [12, 26, 27]. In addition, we found that negative health habits  
9 such as smoking and drinking worsen mental health where as positive social habits such a club or  
10 sporting activities favours mental health, which is also in line with existing research [28]. Certainly, as  
11 youth become independent, the role of social relationships with those outside of families become  
12 particularly important in bolstering mental health.

13 One of the major contribution of this study is that we considered individual and group level variability  
14 through a multilevel modelling technique that other studies in the literature ignore. We found that there  
15 exists significant variability in individual level characteristics. In addition, individual level slope and  
16 intercepts also varied across time. However, compared with individual effects, the group level impact  
17 of maternal background characteristics did not vary. The implication of our finding is that, even though,  
18 some dimensions of maternal background have significant influences, the impact of maternal  
19 background is much smaller than the individual effects such as financial and adverse life events, long-  
20 term health conditions, and health behaviour related activities (smoking and drinking habits).

21 Our results and findings have some interesting implications. Our findings stimulate discussion about  
22 the mechanism of maternal background linking the mental health childhood and adult cohorts. The  
23 findings suggest, more research is needed both in childhood and adult cohorts to further our  
24 understanding as to the impact of maternal background. Whilst maternal background may shape health  
25 in early childhood, its role in shaping youth health and mental health may not be so clear. On the other  
26 hand, there are number of factors that are clearly linked to youth mental health trajectories, including  
27 their physical health during ages 15-19. Policy makers might therefore be interested in implementing



1 health related behavioural interventions to promote both physical and mental health. Another  
2 observation of this study also suggests the importance of providing ongoing support to youth who have  
3 experienced financial and adverse life events in order to prevent long-term mental illness. This may  
4 include financial, care coordination and emotional support to manage the consequences of the adverse  
5 events in the short-term and trauma-informed psychological care in the long-term. Detailed research in  
6 the methodology and design of such interventions as well as estimation of the associated delivery costs  
7 of such program are needed.



## 8 **Conclusions**

9 In summary, our findings contribute to current knowledge by drawing attention to the lack of impact of  
10 maternal background on youth mental health. It is imperative that future research examines further the  
11 link of maternal background between younger and older age cohorts. The main strength of our study is  
12 the use of an equality of opportunity framework and multilevel modelling techniques to address critical  
13 questions on youth mental health in Australia. Policy-wise, mental health interventions should consider  
14 heterogeneity of adverse youth circumstances and health-related behaviours. This research will provide  
15 essential insights into how to improve such interventions.



## 16 **Authors' contributions**

17 RH conceptualised the study, conducted the data analysis and drafted the manuscript. KA, JG and SM  
18 offered advice, critical comments and edited the draft manuscript. All authors contributed to revisions  
19 of the manuscript and approved the final version of the manuscript prior to its submission.

20

## 21 **Conflict of interest**

22 The authors declare that they have no potential conflicts of interest with respect to the research,  
23 authorship, and/or publication of this article.

24

## 25 **Ethics statement**

26 This study did not require any ethics approval since it draws upon a secondary dataset. In addition, the  
27 Australian Government Department of Social Services (DSS) and Melbourne Institute of Applied

1 Economic and Social Research at the University of Melbourne disseminate information in full  
2 compliance with the regulation pertaining to the privacy of the participants.

3

4 **Data availability**

5 The data is available from the National Centre for Longitudinal Data (NCLD) of DSS for researchers  
6 of approved organisations who meet the criteria for access to confidential data.

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8 **Code availability**

9 The programming code for analyses in the study can be made available upon request as determined by  
10 the authors.

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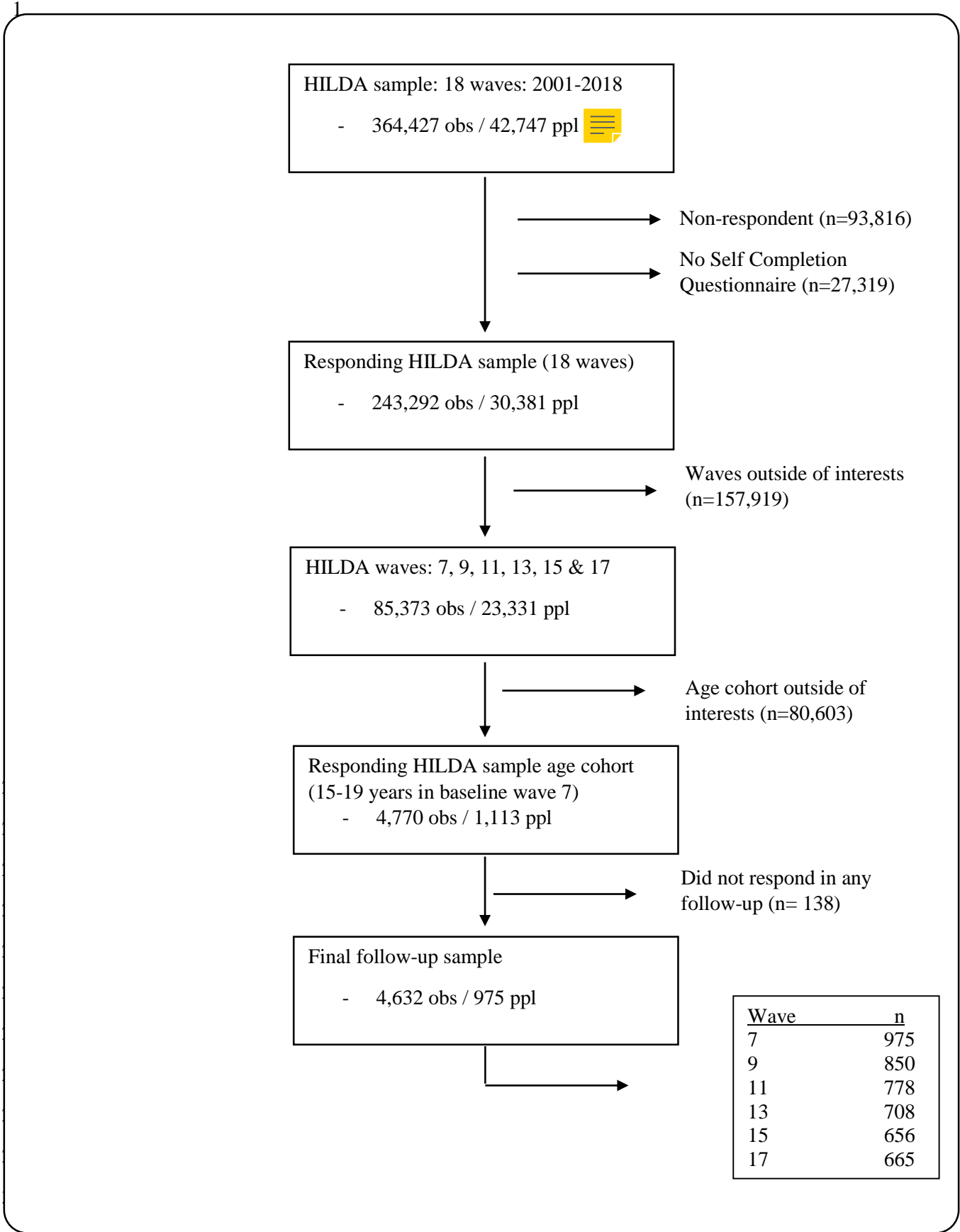
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Appendix A

Variable description in HILDA for financial shock and life event shock

Variables used to construct financial shock		
S1	Variable name	Variable description
1.	_fiprbeg	Could not pay electricity, gas or telephone bills on time
2.	_fiprbmr	Could not pay the mortgage or rent on time
3.	_fiprbps	Pawned or sold something
4.	_fiprbwm	Went without meals
5.	_fiprbuh	Was unable to heat home
6.	_fiprbfh	Asked for financial help from friends or family
7.	_fiprbwo	Asked for help from welfare/community organisations
Variables used to construct life event shock		
1.	_leins	Serious personal injury/illness
2.	_leinf	Serious injury/illness to family member
3.	_ledsc	Death of spouse or child
4.	_ledrl	Death of close relative/family member
5.	_ledfr	Death of a close friend
6.	_levio	Victim of physical violence
7.	_lepcm	Victim of a property crime
8.	_lejls	Detained in jail
9.	_lejlf	Close family member detained in jail
10.	_lefrd	Fired or made redundant
11.	_ledhm	A weather related disaster (flood, bushfire, cyclone) damaged or destroyed your home

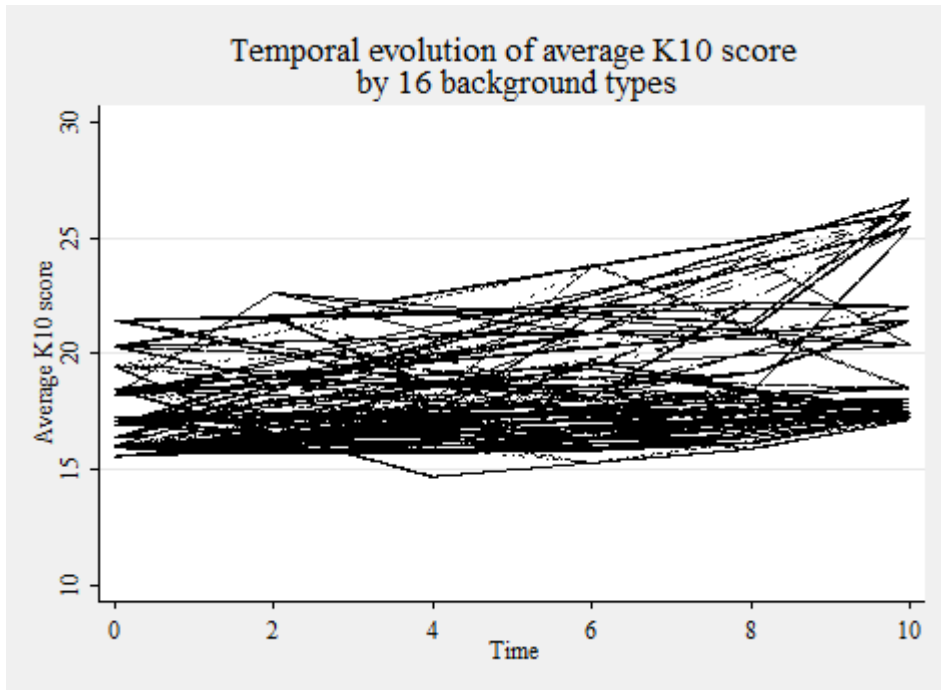
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32 Figure 1: Participants flow into the sample

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Figure 2: Temporal evolution of mental health Status (K10 score)  
by background

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1 Table 1 Socio-demographic characteristics of the study population by mental health status

	<b>Baseline (wave 7)</b>		<b>All waves</b>	
	<b>N (%)</b>	<b>K10 score Mean (std)</b>	<b>N (%)</b>	<b>K10 score Mean (std)</b>
<b>Gender</b>				
Male	465 (47.69)	15.76 (5.87)	2,109 (45.53)	16.39 (6.51)
Female	510 (52.31)	17.78 (6.92)	2,523 (54.47)	17.77 (7.25)
<b>Age</b>				
15 years	197 (20.21)	16.62 (6.84)	197 (4.25)	16.62 (6.84)
16 years	240 (24.62)	16.60 (6.29)	240 (5.18)	16.60 (6.29)
17 years	184 (18.87)	17.38 (6.43)	363 (7.84)	17.22 (6.74)
18 years	195 (20)	16.8 (6.26)	399 (8.61)	16.84 (6.43)
19 years	159 (16.31)	16.77 (6.89)	466 (10.06)	16.85 (6.79)
<b>HH Income group (Lowest quintile)</b>				
Low	222 (22.77)	18.37 (7.65)	931 (19.78)	19.34 (8.32)
High	753 (77.23)	16.36 (6.07)	3716 (80.22)	16.59 (6.46)
<b>Mother's Education (Low= secondary or lower)</b>				
Low	204 (20.92)	16.80 (6.67)	1759 (37.97)	17.71 (7.27)
High	771 (79.08)	16.80 (6.48)	2873 (62.03)	17.00 (6.87)
<b>Mother's occupational status (Lowest quintile)</b>				
Low	216 (22.15)	17.43 (7.12)	943 (20.36)	18.46 (7.88)
High	759 (77.85)	16.64 (6.33)	3689 (79.64)	16.80 (6.66)
<b>Did not live with both parents</b>				
No	652 (66.87)	16.03 (5.69)	3169 (68.42)	16.56 (6.46)
Yes	323 (33.13)	18.41 (7.7)	1463 (31.58)	18.40 (7.79)

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1 Table 2: Mental health opportunity profile

<b>Rank</b>	<b>HH income</b>	<b>Mother's education</b>	<b>Mother's occupational status</b>	<b>Did not live with both parents</b>	<b>Group sample size (n)</b>	<b>Average k10 score of the participant</b>	<b>Risk level</b>
1	High	Low	High	No	328	16.1	Low
2	High	High	High	No	2032	16.25	Low
3	High	Low	Low	Yes	68	16.53	Low
4	High	High	Low	No	208	16.62	Low
5	High	High	High	Yes	731	17.12	Low
6	Low	High	High	No	231	17.17	Low
7	Low	High	Low	No	100	17.48	Low
8	High	Low	High	Yes	97	17.52	Low
9	High	Low	Low	No	150	17.69	Low
10	High	High	Low	Yes	87	18.72	Low
11	Low	Low	Low	No	81	19.26	Low
12	Low	Low	High	Yes	46	19.28	Low
13	Low	Low	High	No	39	19.97	Low
14	Low	High	High	Yes	185	20.7	High
15	Low	Low	Low	Yes	107	20.89	High
16	Low	High	Low	Yes	142	21.15	High

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Table 3: Parameter estimates of different logit regression models  
(Dependent variable: Whether likely to have mental disorder- i.e. K10  $\geq$  20)

Fixed effects	Null			Logit			Mixed 1			Mixed 2		
	Estimate (OR)	Std error	95% CI	Estimate (AOR)	Std error	95% CI	Estimate (AOR)	Std error	95% CI	Estimate (AOR)	Std error	95% CI
Intercept	0.296***	0.059	(0.2-0.437)	0.168***	0.017	(0.138-0.204)	0.075***	0.018	(0.047-0.12)	0.05***	0.011	(0.322-0.078)
Wave (time)				1.019	0.011	(0.998-1.04)	0.999	0.022	(0.957-1.042)	1.00	0.022	(0.961-1.047)
<b>Individual characteristics</b>												
Gender - Female (Ref.: Male)				1.484***	0.108	(1.286-1.712)	2.063***	0.363	(1.461-2.913)	2.021***	0.355	(1.431-2.851)
Rural resident - Yes (Ref.: No)				0.759*	0.095	(0.593-0.97)	0.89	0.195	(0.579-1.366)	0.899	0.197	(0.586-1.383)
Number of financial shock				1.321***	0.041	(1.243-1.404)	1.436***	0.074	(1.298-1.589)	1.412***	0.072	(1.277-1.561)
Number of life event shock				1.156***	0.052	(1.059-1.262)	1.161*	0.081	(1.013-1.331)	1.157*	0.08	(1.01-1.326)
Long term health condition - Yes (Ref.: No)				2.232***	0.212	(1.853-2.688)	2.934***	0.502	(2.098-4.103)	2.855***	0.488	(2.042-3.99)
Club activities - Yes (Ref.: No)				0.651***	0.05	(0.559-0.758)	0.623***	0.078	(0.487-0.797)	0.635***	0.08	(0.496-0.812)
Daily smoker - Yes (Ref.: No)				1.241*	0.125	(1.018-1.512)	1.801**	0.339	(1.246-2.604)	1.676**	0.313	(1.162-2.416)
Heavy drinker - Yes (Ref.: No)				1.344***	0.099	(1.163-1.554)	1.651***	0.209	(1.288-2.117)	1.649***	0.209	(1.286-2.114)
Obese - Yes (Ref.: No)				1.131	0.11	(0.935-1.367)	1.372	0.269	(0.935-2.014)	1.311	0.256	(0.895-1.921)
<b>Background characteristics</b>												
Household Income - Low (Ref.: High)				1.258*	0.116	(1.05-1.506)				1.572*	0.349	(1.017-2.43)
Mothers Education - Low (Ref.: High)				0.972	0.088	(0.814-1.162)				0.921	0.203	(0.597-1.421)
Mothers' occupation - Low (Ref.: High)				1.188	0.109	(0.992-1.423)				1.314	0.296	(0.845-2.043)
Did not live with both parents - Yes (Ref.: High)				1.183*	0.091	(1.017-1.376)				1.586*	0.298	(1.097-2.294)
<b>Random effects</b>												
Background (level 3)												
Intercept variance $\sigma^2_{v0}$	0.423	0.202	(0.166-1.08)				0.078	0.082	(0.01-0.608)	7.14e-32	3.89e-17	
Individual (level 2)												
Intercept variance $\sigma^2_{u0}$	4.101	0.422	(3.353-5.017)				4.068	0.718	(2.878-5.749)	4.116	0.720	(2.921-5.8)
Wave variance $\sigma^2_{u1}$							0.062	0.015	(0.039-0.098)	0.062	0.015	(0.039-0.099)
Covariance $\sigma^2_{v0v1}$							-0.091	0.071	(-0.231-0.048)	-0.098	0.071	(-0.238—0.041)
ICC												
$rho_{background}$	0.054	0.024	(0.022-0.127)				0.011	0.011	(0.001-0.076)	9.64e-33	5.26e-18	
$rho_{individual / background}$	0.579	0.026	(0.527-0.629)				0.558	0.043	(0.472-0.64)	0.556	0.043	(0.47-0.063)

Notes: \*\*\* p < 0.001, \*\* p < 0.01, and \* p < 0.05.