Socioeconomic inequalities in mental health in Australia: Explaining life shock exposure

Rubayyat Hashmi[1]
School of Commerce, Faculty of Business, Education, Law & Arts
and Centre for Health, Informatics and Economic Research
University of Southern Queensland, Toowoomba, Queensland 4350 Australia
Ph: (+617) 4631 1085, Email: Rubayyat.Hashmi@usq.edu.au
http://orcid.org/0000-0002-5953-0650

Khorshed Alam, PhD
Professor (Economics)
School of Commerce, Faculty of Business, Education, Law & Arts
and Centre for Health, Informatics and Economic Research
University of Southern Queensland, Toowoomba, Queensland 4350 Australia
Ph: (+617) 4631 1291, Fax: (+617) 4631 5594 Email: Khorshed.Alam@usq.edu.au
http://orcid.org/0000-0003-2232-0745

Jeff Gow, PhD
Professor (Economics)
School of Commerce, Faculty of Business, Education, Law & Arts
and Centre for Health, Informatics and Economic Research
University of Southern Queensland, Toowoomba, Queensland 4350 Australia
Ph: (+617) 4631 2617, Fax: (+617) 4631 5594 Email: Jeffrey.Gow@usq.edu.au
and
School of Accounting, Economics and Finance, University of KwaZulu-Natal, Durban 4000, South Africa
http://orcid.org/0000-0002-5726-298X

Declaration of conflict of interest

Rubayyat Hashmi, Khorshed Alam and Jeff Gow declare no conflict of interest.

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[1] Corresponding author

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Highlights

- 24.7% to 40.5% of the mental health inequality are due to life-shocks.
- Mental health inequality due to life shocks is large in Australia.
- Lower SES groups experience more life shocks than higher SES groups.
- Financial hardship shocks contributes up to 35% of inequality in socioeconomic inequality.

Abstract

Background

Recent research suggests that there exists a strong link between life shocks and mental health. However, research on the distributional aspects of these shocks on mental health status is limited. In the health inequality literature no Australian studies have examined this relationship.

Objective

This study examines the distributional impact of life shocks (negative life events and financial hardships) on mental health inequality among different socioeconomic groups in a longitudinal setting in Australia.

Methods

This study analysed the data of 13,496 individuals from the Household, Income and Labour Dynamics in Australia (HILDA) survey, waves 12-17 (2012-2017). Using concentration index and Blinder-Oaxaca approaches, the study decomposed socioeconomic inequalities in mental health and changes in inequalities in mental health over the study period. The study used frailty indices to capture the severity of life shocks experienced by an individual.

Results

The results suggest that exposure to just one life shock will result in a greater risk of mental disorder in the most disadvantaged socioeconomic groups. The results also indicate that 24.7% to 40.5% of pro-rich socioeconomic mental health inequality are due to life shocks. Financial hardship shocks contributes to 21.6% to 35.4% of inequality compared with 2.3% to 5.4% inequality generated by negative life event shocks across waves.

Conclusions

Lower SES groups experience more life shocks than higher SES groups and in turn generate higher socioeconomic mental health inequality. Policies aimed at reducing socioeconomic inequality in mental health should account for these shocks when designing interventions.

1 Introduction

Unequal distribution of mental health status among different socioeconomic groups constitutes a serious challenge in achieving equitable mental health care [1, 2]. The challenge arises not only because the justification for unfair distribution is debatable but also the identification of the root causes of the unfair distribution is difficult to ascertain [3]. Indeed, the Grand Challenges in Global Mental Health initiative (a consortium of researchers, advocates and clinicians) has set the identification of root causes, risk and protective factors as a top priority for research in the area over the coming decade [4]. Some recent advances include identification of socioeconomic mental health inequalities in adults [5] and in children and adolescents [6]. This research is ongoing and since socioeconomic differences in mental health status evolve over a life course, a multidimensional perspective is needed to understand the causal pathway(s) [7].

One particular dimension that needs attention in mental health inequalities from a life course perspective is life shocks. Life shocks are adverse events that people experience during their life [8, 9]. Depending on the circumstances, some of these events may have severe psychological impacts on the individuals involved. This study investigates two kinds of life shocks: negative life events and financial hardship. Previous studies have shown a strong association between financial hardship and adverse mental health [10-12] and negative life events and adverse mental health [13-15]. Even though these studies have found an association between life shocks and mental health, the distributional impact of exposure to life shocks on socioeconomic mental health inequality is poorly understood. Little attention has been paid to the impact of life shocks (negative life events and/or financial hardship) on the socioeconomic gradient of mental health. Understanding these short-run shocks is crucial to designing efficient policies for social support, such as cash transfers and developing effective social programs including psychological support.

A concentration index measures the degree of socioeconomic inequality in a health variable. Figure 1 shows the time trend of a concentration index constructed from both mental health inventory 5 (MHI-5) and mental component score (MCS) in Australia between 2012 and 2017. It shows that socioeconomic mental health inequality is increasing overtime. This socioeconomic disparity on mental health, raises questions on the factors that contribute to this inequality. In addition, life shock exposure by socioeconomic status also shows that lower socio economic groups have significantly higher exposure to life shocks than higher socioeconomic groups. (see Figure A1 and A2 of Appendix A in online supplemental data). Thus, the objective of this study is to assess the impact of life shocks on socioeconomic inequality in the mental health status of Australian adults in a longitudinal

framework. To this end, the study seeks to address three specific research questions. i) Is the impact of life shocks on mental health status significant for Australian adults? ii) If so, to what extent do these life shocks contribute to the inequality in mental health status between rich and poor individuals?; and iii) What are the temporal impacts of the effects of life shocks on income related mental health inequality? In Australia, one in five people experience some form of mental illness annually. Given such circumstances, the motivation for this study is to explain such research questions in an Australian setting to assist those experiencing mental health issues. Understanding the contribution of life shock exposure to mental health inequality will help develop mitigating strategies for individuals who are vulnerable to such exposure and hopefully lead to more equitable health policies and practices.

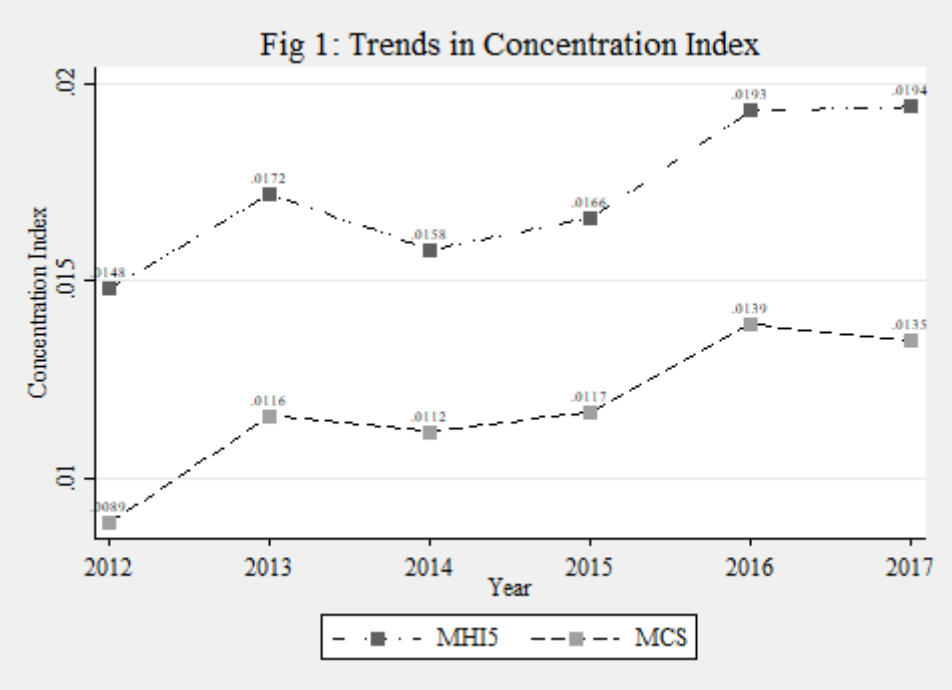

Figure 1: Trends in concentration indices using MHI5 and MCS as health variable and equivalent household income as ranking variable by wave

2 Methods

2.1 Data and study variables

2.1.1 The HILDA Dataset

The Household, Income and Labour Dynamics of Australia (HILDA) dataset is a nationally representative household-based longitudinal survey in Australia. The survey which commenced in 2001 is conducted annually. All members of the household are enumerated in the data collection procedure. However, individual and household level data are collected using both face-to-face interviews and self-completion questionnaires for those aged 15 years or older. HILDA data from wave 12 to wave 17 (2012-2017) were analysed in this study. The study

included the new top-up samples that were introduced in wave 11. To compare waves, the study constructed a balanced panel of 13,496 individuals. A missing observation analysis was conducted for item non-response and the analysis found that on average 9% of responses were missing for the life shocks and mental health score variables (see Table 10 of Appendix A in online supplemental data for missing analysis). The missing responses were imputed though the last observation carry forward method to produce conservative estimates. The socio-demographic and SES variables did not have a nonresponse problem. To account for sample attrition and panel characteristics, the longitudinal weights for wave 12 to wave 17 in HILDA data were used to adjust all calculations. The estimated population size after longitudinal weight adjustment was 16,699,284. Detailed information on survey design and sample weights can be found elsewhere [16].

2.1.2 Measures

In the health inequality literature, models are constructed according to their research objectives and use policy-relevant social determinants of health measures along with the SES and demographic variables [5, 17]. For this study's purpose, the following measures were used:

Mental health

This study used the Mental Health Inventory (MHI-5) of the Short Form 36 instrument (SF-36), a widely validated and reliable mental health measure [18, 19]. This instrument has been used in a large body of medical literature [20-22] and health economics literature [23, 24]. The scale is constructed from five items (nervous, down in dumps, peaceful, sad and happy) and its value ranges from 0-100. Higher scores imply higher levels of mental health. The MHI-5 measure also has clinical significance. A cut-off point of 76 MHI-5 score can be used to define a case of common mental disorder [25]. The study also constructed the Mental Component Score (MCS) using HILDA SF-36 questionnaire responses for sensitivity analyses (see Appendix A in online supplemental data for the sensitivity results).

Life shocks (Negative life event and financial hardship)

A negative life event is defined as direct exposure to a traumatic event as experienced by an individual, for example, separation from spouse, serious personal injury or being detained in jail [26]. Financial hardship occurs when individuals experience adverse economic shocks or circumstances. For example, went without meals or being unable to heat home [27]. This study uses nineteen life shocks (seven financial hardship and twelve negative life event items) to account for the effect of life shocks on socio-economic inequalities in mental health. The list of life shock items and their descriptive statistics are provided in Table 1. A frailty index (FI) is used to measure the intensity of negative life events and financial hardship. FI is widely used in the health and aging literature to

measure accumulation of deficits in health from aging [28]. It is expected that individuals with lower SES will accumulate considerable more adverse outcomes over their life time and the FI is thus a simple measure that can capture these adverse effects. The formula for measuring the frailty index is [29]:

$$\text{frailty index (FI)} = \frac{\text{Number of adverse outcome presents}}{\text{Number of adverse outcome measured}} \quad (1)$$

The range of this index is between 0 and 1. Higher values indicate that the respondent has accumulated a greater number of life shocks.

Income

Equivalised household disposable income was used to measure SES and construct the income component of the CI (Concentration Index). The study used a 'modified OECD' equivalence scale to measure disposable household income. The formula for equivalised household income is given by [30]:

$$\text{Equivalised income} = \frac{\text{Household Disposable income}}{(1 \text{ x first adult} + .5 \text{ x additional adult} + .3 \text{ x additional child})} \quad (2)$$

Other control variables

Education and labour force status along with equivalised income quartiles were used to control for other characteristics of SES in the analysis. Demographic characteristics like age and gender were also controlled for in the analysis. Since previous studies have found a link between mental health and club/sporting activities, the study also controlled for that factor [31]. Respondents in the HILDA survey were asked as to whether they were: "currently an active member of a sporting/hobby/community based club or association?" and the study used it as a dummy variable to indicate club participation. The study also controlled for long term health conditions. Previous studies have found strong relationships between mental health and long term health conditions [32].

2.2 Statistical analysis

The study first analysed the relationship of life shock exposure (mean scores of financial hardship index and negative life events) and income. The analyses found that the lower quartile income group has significantly higher life shock exposure than the higher quartile income groups (see Figures A1 and A2 of Appendix A in online supplemental data). Using the concentration index to measure socioeconomic health inequality, the study also found that socioeconomic mental health inequality was increasing in the study period as portrayed in Figure 1 and thereby the study research questions were formulated. Descriptive statistics in Table 1 show the population characteristics of the variables. To account for survey design and survey weights, the SVY command of STATA 15.0 software is used for all calculations [33]. The CONINDEX command is used to calculate concentration indices [34].

2.2.1 Concentration index and cross-sectional decomposition

The concentration index (CI) is a rank dependent inequality index that measures socioeconomic inequality in health [35].The value of the CI is bounded by -1 and 1, and is defined as follows [36, 37]:

$$CI = \frac{2}{\bar{h}} cov(h_i, R_i) \quad (3)$$

$$=> CI = \frac{2}{n\bar{h}} \sum_{i=1}^{n} h_i R_i - 1 \quad (4)$$

Where, a population of n individuals with health levels h_i is ranked by income or by some other SES, ordered from poorest to richest given fractional rank $R_i = \frac{2i-1}{2n}$, $\bar{h} = \frac{\sum_{i=1}^{n} h_i}{n}$ and $i = 1, 2, \ldots, n$. A positive (negative) value of the CI indicates that the health variable is concentrated among the rich (poor) and the health variable has a pro-rich (pro-poor) distribution.

Wagstaff et al.[38] in their seminal paper showed that if health is a linear function of k factors (e.g., demographic, lifestyle and SES) then the CI is a weighted sum of the socio-economic inequalities in these factors . Thus, the CI can be decomposed given the following regression model:

$$h_i = \alpha + \sum_{j=1}^{k} \beta_j x_{ij} + u_i \quad (5)$$

Where, α and $\beta_j, j = 1 \ldots k$ are coefficients to be estimated, and u_i is the error term with $E[u_i] = 0$. Substituting (5) into (4) and with some algebra, Wagstaff et al. [38] showed the following:

$$CI = \sum_k \eta_k CI_k + GC_u/\bar{h} \quad (6)$$

Where, $\eta_k = \beta_k \frac{\bar{x}_k}{\bar{h}}$ measures the average elasticities or the magnitude of the effect of k factors and CI_k is the concentration index of factor x_k. The first term $\eta_k CI_k$ of each factor x_k indicates the contribution to socioeconomic inequality by x_k. Thus, $\sum_k \eta_k CI_k$ is the total contribution of socio-economic inequality explained by the model. The residual term, CI_u, is the error term measuring unexplained socioeconomic inequality.

The following steps are taken to decompose the concentration index:

Step 1: An OLS regression of mental health score (MHI-5) on life shocks (financial hardship and negative life events), age categories and gender dummies, income quartiles, education, labour force status, club/sporting activities and long term health conditions for each wave was first run (using the svy command). The regression results are shown in Table 2.

Step 2: Using the svy and mean command the study also calculated mean values of all variables.

Step 3: Using the mean values and beta coefficients from the OLS regression, elasticities were calculated for all independent variables.

Step 4: Concentration indices of all independent variables were calculated using the conindex and svy command.

Step 5: Following equation 4, elasticities and concentration indices of each independent variables were then multiplied to get the relevant contribution of the variable.

Step 6: All previous steps were repeated to get a pooled estimates using the panel data. Pooled estimate reflects the average contribution of factors for all waves.

Step 7: All previous steps were repeated to conduct sensitivity analysis using mental component score (MCS) as the dependent variable instead of MHI-5 (see Appendix A in online supplemental data for the sensitivity results).

2.2.2 Decomposing changes in CI

From Figure 1 it is clear that socioeconomic mental health inequality is rising in Australia over the study period. Thus the third objective of this study was formulated where the research objective is to investigate the temporal impacts of life shocks on mental health inequality using the Oaxaca [39] and Blinder [40] type decomposition approach. Wagstaff et al.[38] first used the Oaxaca-Blinder type decomposition in the health economics literature to analyse the factors that change health inequality. Using equation (6) and applying the Oaxaca-Blinder method, the following equation for time period t and $t-1$ results:

$$\Delta CI = \sum_k \eta_{kt}(CI_{kt} - CI_{kt-1}) + \sum_k CI_{kt-1}(\eta_{kt} - \eta_{kt-1}) + \Delta \mathrm{G}CI_u/\bar{h} \quad (7)$$

The first and second terms in equation [7] show that the extent of changes in the CI are due to changes in inequality in the determinants of health and changes in their elasticities, respectively. The third term is the residual or unexplained component.

The following steps were taken to analyse the decomposition in the changes in the concentration index of mental health.

Step 1: Using the methods described in the previous section, estimate all elasticities and concentration indices of all factors.

Step 2: Subtract previous period elasticities from current elasticities for all factors. Similarly subtract previous period concentration indices from current period concentration indices for all factors.

Step 3: For each factor multiply wave wise change in concentration indices with current period elasticities ($\Delta C\eta$) and multiply wave wise change in elasticities with current period concentration indices ($\Delta \eta C$) as in equation 7.

Step 4: Adding $\Delta C\eta$ and $\Delta \eta C$ for each factor will result in the total contribution to changes in that factor. The compiled results of all these factors are provided in Table 4 (see Appendix A in online supplemental data).

Step 5: Similar analyses were done using MCS score as a dependent variable for sensitivity analysis (see Appendix A in online supplemental data for the sensitivity results).

3. Results

3.1 Descriptive statistics

Table 1 shows the longitudinal survey weight adjusted summary statistics of wave 12 and wave 17 of HILDA data for all key variables. The weight adjusted HILDA sample statistics are nationally representative and it infers results for 16.7 million in-scope individuals in the target population. The key objective variables in this study are mental health (MHI-5 score), and life shocks (financial hardship and negative life events). The mean mental health score is 74.5 and 73.35 for wave 12 and wave 17 respectively indicating average mental health population score has worsened. Since the threshold mental health score is 76, the risk of suffering mental illness for an average Australian is now greater. The mean value of financial hardship index and negative life event index are 0.063 and 0.053 respectively for wave 12. These values were reduced to 0.059 and 0.046 respectively in wave 17. This implies the Australian population as a whole experienced a lower number of life shocks in wave 17 than wave 12.

3.2 Regression results

Table 2 reports the individual and pooled OLS estimates. All variables, except education, are significant and have the expected signs. The results suggest that on average, ceteris paribus, women in general had about one point lower mental health score than men, across waves. The difference in mental health score is also much higher between the younger and older populations. Older age (65-84) and (85+) groups had on average about eight and nine points higher mental health scores respectively than the reference group (15-24 years) implying a protective effect of retirement on mental health. Unsurprisingly, the results also show that higher income groups have higher mental health scores. The highest quartile income group had a 2.5 points higher mental health score than the lowest quartile income group, on average, across waves. The labour force status results report a negative relationship to mental health. An unemployed individual had lower mental health scores compared to an employed individual ranging from one to six points across waves. Individuals who are active members of sporting/community clubs received a positive effect on mental health ranging from three to four points across waves. Having long term health conditions also reduce mental health by approximately seven points, on average, across waves.

Table 1: Longitudinal survey weight adjusted sample characteristics (wave 12 and 17) of variables of interest in the HILDA database (observations: 13,496, population size: 16,699,284)

Variables	Wave 12		Wave 17	
	Mean	SD	Mean	SD
SF-36 mental health score(MHI5)	74.503	16.851	73.353	17.579
SF-36 mental health score(MCS)	49.117	10.081	48.265	10.570
Financial hardship score	0.063	0.147	0.059	0.147
Variables used to construct financial hardship score:				
Could not pay electricity, gas or telephone bills on time	0.126	0.330	0.112	0.314
Could not pay the mortgage or rent on time	0.059	0.234	0.055	0.226
Pawned or sold something	0.046	0.208	0.042	0.200
Went without meals	0.030	0.169	0.035	0.181
Was unable to heat home	0.030	0.169	0.030	0.169
Asked for financial help from friends or family	0.116	0.318	0.105	0.305
Asked for help from welfare/community organisations	0.033	0.177	0.032	0.175
Negative life events score	0.053	0.074	0.0455	0.068
Variables used to construct negative life events score:				
Separated from spouse	0.034	0.181	0.027	0.162
Serious personal injury/illness	0.081	0.270	0.079	0.268
Serious injury/illness to family member	0.156	0.361	0.122	0.325
Death of spouse or child	0.009	0.093	0.008	0.089
Death of close relative/family member	0.127	0.330	0.108	0.308
Death of a close friend	0.117	0.319	0.107	0.307
Victim of physical violence	0.015	0.121	0.011	0.102
Victim of a property crime	0.036	0.185	0.026	0.159
Detained in jail	0.002	0.040	0.002	0.046
Close family member detained in jail	0.013	0.114	0.013	0.114
Fired or made redundant	0.029	0.167	0.028	0.165
A weather related disaster (flood, cyclone)	0.015	0.120	0.014	0.116
Male	0.490	0.496	0.490	0.496
Female	0.510	0.496	0.510	0.496
Age - 15-24 years	0.174	0.376	0.091	0.286
Age - 25-44 years	0.353	0.474	0.342	0.471
Age - 45-64 years	0.324	0.464	0.348	0.473
Age- 65-84 years	0.141	0.346	0.190	0.389
Age- 85+ years	0.009	0.094	0.030	0.168
HH income -Q1 0-25%	0.252	0.431	0.229	0.417
HH income-Q2 25-50%	0.279	0.445	0.235	0.421
HH income-Q3 50-75%	0.261	0.436	0.257	0.434
HH income-Q4 75-100%	0.208	0.403	0.279	0.445
Education-Year 12 or below	0.452	0.494	0.368	0.479
Education- Certificates & diploma	0.298	0.454	0.337	0.469
Education-Bachelor or honours degree	0.195	0.393	0.222	0.412
Education- Postgraduate degree	0.055	0.227	0.074	0.259
Labour force status- Employed	0.644	0.475	0.639	0.477
Labour force status -Unemployed	0.036	0.184	0.031	0.172
Labour force status -Not in the labour force	0.320	0.463	0.330	0.467
Club/community activities	0.352	0.474	0.355	0.475
Long term health condition	0.255	0.433	0.312	0.460

An increase in one additional life shock increases the financial hardship index by approximately 0.14 (there are seven financial hardship items) and one additional life shock increases the negative life events index by approximately 0.083 (there are twelve negative life events items). The main implications of the results are that an increase in one life shock will reduce an individuals' mental health score by approximately three points and two points for financial hardship and negative life events, respectively on average, across waves [0.14*(-20)= -2.8 ≈ -3] points and [0.083*(-18)= -1.5 ≈ 2 points). This is significant because these events have differential impacts on different socio-economic groups. For example, in wave 17, a young unemployed woman who is in the lowest quartile income group with long term health conditions and undertaking no sporting activities will have a 28 points (-0.88-4.76-3.34-6.66-4.68-7.3= 27.62 ≈ 28) lower mean mental health score compared with a physically engaging middle aged working man in the richest income quartile with no long term health conditions. Thus, exposure to just one life shock will result in a greater risk of lowering an individuals' mental health score below the cut-off score of 76, which in turn increases the risk of developing a common mental disorder. In summary, life shocks significantly affect mental health and the impact differs by socio-economic status.

3.3 Factor decomposition of mental health inequality

Table 3 presents the estimates of the factor decomposition of socio-economic mental health inequality. The first row of each variable measures the average elasticity indicating the impact of that determinant on mental health outcomes. The second row measures the CI or income related factor's inequality. The third row is a multiplicative term of the first and second rows which measures the factor 'contribution' to mental health. The sum of all factor contributions in a wave constitutes the explained part of the total contribution of CI in mental health of that wave. For a health variable that represents better health with higher values (mental health score variable in this case), a positive (negative) contribution of a factor suggests that good mental health is concentrated among the rich (poor) by that factor and inequality is increasing leading to a pro-rich (pro-poor) distribution by that factor [41].

Table 2: Regression results

Variables	wave 12	wave 13	wave 14	wave 15	wave 16	wave 17	Pooled
SF-36 Mental Health Score: MHI-5 (Dep. variable)	n=13496 (unweighted) n=13262 (weighted) Population size: 16,699,284						
Key objective variables							
Financial hardship score	-20.276*** (1.587)	-20.010*** (1.817)	-20.228*** (1.692)	-20.178*** (1.856)	-20.067*** (1.912)	-17.402*** (1.730)	-19.759*** (1.344)
Negative life event score	-18.766*** (2.900)	-17.080*** (3.126)	-20.979*** (3.243)	-22.079*** (3.187)	-16.242*** (3.499)	-16.045*** (3.510)	-18.259*** (2.217)
Demographic variables							
-Male (ref.)							
-Female	-1.182*** (0.360)	-0.770** (0.334)	-1.203*** (0.359)	-1.225*** (0.341)	-0.935*** (0.364)	-0.879** (0.368)	-1.029*** (0.262)
Age							
-15-24 years (ref.)							
- 25-44 years	2.096*** (0.679)	0.904 (0.689)	0.967 (0.708)	1.080 (0.775)	1.479* (0.866)	1.200 (0.747)	1.148** (0.550)
- 45-64 years	3.306*** (0.639)	2.863*** (0.650)	2.787*** (0.691)	4.063*** (0.756)	3.732*** (0.904)	4.762*** (0.718)	3.447*** (0.567)
- 65-84 years	8.192*** (0.779)	8.175*** (0.818)	8.109*** (0.926)	9.164*** (0.937)	8.786*** (1.268)	9.923*** (1.177)	8.520*** (0.779)
- 85+ years	9.546*** (2.013)	12.330*** (1.665)	10.438*** (1.558)	8.0379*** (1.840)	9.426*** (1.779)	11.592*** (1.331)	9.547*** (1.216)
SES variables							
Household income quartile							
-Q1 0-25% (ref.)							
-Q2 25-50%	1.498* (0.791)	2.670*** (0.9681)	1.443* (0.871)	1.522* (0.885)	2.951*** (0.955)	1.888* (1.096)	2.004*** (0.675)
-Q3 50-75%	1.5166** (0.725)	2.0803** (1.015)	0.8303 (0.753)	1.4863* (0.849)	3.2247*** (1.024)	3.2386*** (1.214)	2.027*** (0.724)
-Q4 75-100%	2.0121** (0.826)	2.9874*** (0.985)	1.9101** (0.792)	2.0144** (0.841)	3.4633*** (1.004)	3.3444*** (1.224)	2.552*** (0.751)
Education							
-Year 12 or below (ref.)							
- Certificates & diploma	0.230 (0.487)	1.126** (0.464)	0.128 (0.482)	-0.428 (0.507)	0.262 (0.567)	0.250 (0.567)	0.189 (0.398)
-Bachelor or honours degree	-0.817 (0.791)	-0.604 (0.723)	-0.783 (0.815)	-1.674** (0.816)	-0.976 (0.866)	-1.617 (1.026)	-1.132 (0.757)
- Postgraduate degree	-0.070 (1.783)	0.466 (1.356)	-0.364 (0.790)	-0.478 (1.283)	-0.692 (0.854)	-0.819 (0.814)	-0.408 (0.894)
Labour force status							
-Employed (ref.)							
-Unemployed	-2.434** (1.095)	-1.071 (1.528)	-1.227 (1.559)	-4.435*** (1.073)	-6.155*** (2.352)	-6.663** (2.785)	-3.575*** (0.978)
-Not in the labour force	-1.743*** (0.686)	-2.343*** (0.680)	-2.115*** (0.593)	-2.062*** (0.622)	-1.083* (0.593)	-2.842*** (0.636)	-2.019*** (0.440)
Other variables							
Club/community activities	3.236*** (0.418)	3.302*** (0.488)	3.221*** (0.487)	4.082*** (0.468)	3.532*** (0.443)	4.681*** (0.534)	3.675*** (0.375)
Long term health conditions	-5.705*** (0.582)	-6.972*** (0.478)	-7.256*** (0.578)	-8.103*** (0.559)	-8.617*** (0.606)	-7.296*** (0.687)	-7.380*** (0.338)
Constant	74.142*** (0.858)	73.556*** (1.083)	74.756*** (0.803)	74.064*** (0.972)	72.067*** (1.190)	71.148*** (1.132)	73.496*** (0.750)

Notes: *** p < 0.01, ** p < 0.05, and * p < 0.1. Standard errors are in the parentheses.

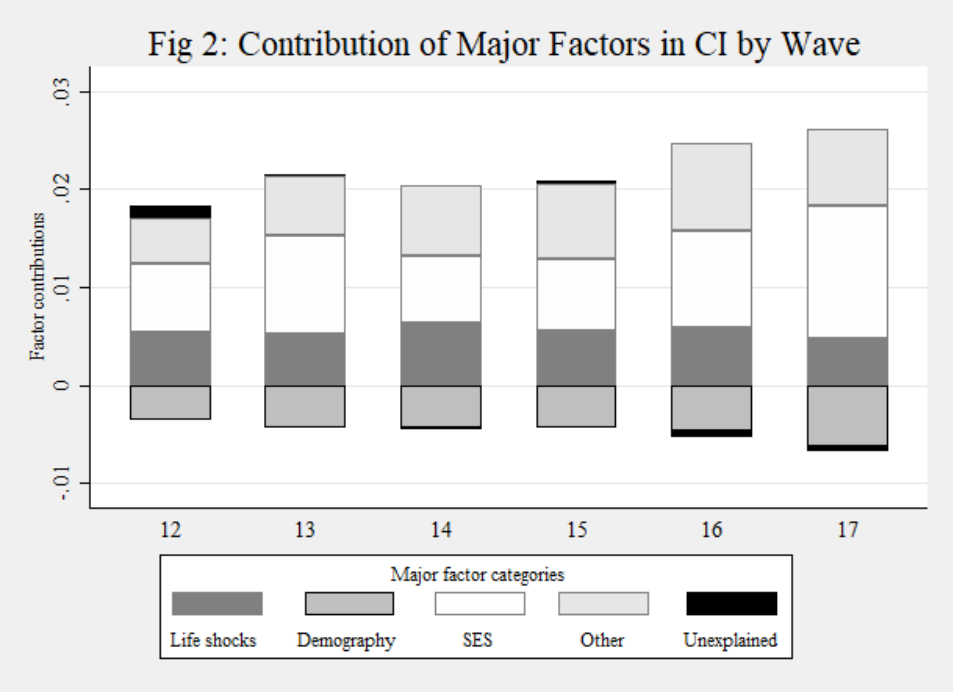

Figure 2: Contribution of major factors to socioeconomic mental health inequality by wave

Over the study period, the socio-economic inequality of mental health ranged from 0.015 to 0.019 (last row in Table 3). Figure 2 shows the major factors' contribution by wave. Figure 2 reveals that life shocks contributes significantly to socioeconomic mental health inequality. The life shock contribution to mental health inequality ranges from 0.005 to 0.006 across waves. The contributions can be expressed as a percentage term by taking the percentage of a contribution to the actual concentration index. Life shock contributes to a pro-rich distribution and contribution to mental health inequality ranges from as low as 24.7% in wave 17 to as high as 40.5% in wave 14. From Table 3 it can be seen that financial hardship is the major driver of life shocks. It contributes to mental health inequality by 21% to 35% across waves. Negative life events contribute 2% to 5% of mental health inequality across waves. The demographic variables (age and gender) contribute to a pro-poor distribution because of the aging or retirement effect. Age reduces inequality by 23.6% to 32.5% across waves. However, SES variables (e.g. income, education and labour force status) explain approximately 69.6% of the pro-rich contribution to mental health inequality in wave 17. The lowest SES contribution is 43% in wave 14. Figure 2 shows broad category factors' contribution (see Appendix A in online supplemental data for broad category factors' percentage contribution).

The study also found that inequality is generated from both negative values of elasticities and concentration indices of factors from life shocks, being female, long term health conditions and labour force status for all waves. On the contrary, inequality is generated from both positive values of elasticities and concentration indices of

factors from higher quartile income (Q3 and Q4), working aged population (aged 25-44 and 45-64 years) and club/community activities in all waves.

This study conducted sensitivity analyses using the mental component score (MCS) as the dependent variable. The clinical threshold score for MCS is lower than MHI-5. Thus, socioeconomic inequality is lower when the MCS is used. However, the trends and pattern of inequality are similar as can be seen in Figure 1 (see Appendix A in online supplemental data for the sensitivity results). The results of the sensitivity analyses are provided in the online appendix Table 6. The results are similar and the basic conclusion remains the same. Thus, mental health inequality arising from shocks are a major driver of socioeconomic mental health inequality in the Australian context.

3.4 Factor trajectories of changes in mental health inequalities

This study also investigated the factor trajectories of changes in mental health inequalities using the Oaxaca-Blinder decomposition approach (see Table 4 of Appendix A in online supplemental data for the study results). This table explains how the inequality of mental health has changed overtime. The first and second row of each variable explains the contribution to changes in mental health inequality due to changes in factor inequality and changes in factor elasticity, respectively.

The results suggest that, in the study period, the highest quartile income group is still the major driver of socioeconomic mental health inequality. This group increased mental health inequality 0.003 and 0.004 in wave 12-13 and wave 15-16 respectively. "Not in the labour force" variable is another major driver that increased inequality by 0.003 in wave 16-17. Other variables that increased socioeconomic mental health inequality by at least 0.001 in at least one wave are: Q2 and Q3 income quartiles, bachelor or honours degree holders, long term health condition, financial hardship index, being unemployed and being 45-64 years of age. All these variables also had at least one wave where inequality reduced by at least 0.001 (except for the unemployed group). The older age group (65-84 and 85+ years) showed reductions in mental health inequality in most waves. The results were also very similar when the MCS score was compared instead of MHI-5 in the sensitivity analysis (see Table 7 of Appendix A in online supplemental data for the sensitivity results).

Table 3: Wagstaff - Doorslaer – Watanabe Decomposition results

Variables		wave 12	wave 13	wave 14	wave 15	wave 16	wave 17	Pooled
	η[a]	-0.017	-0.017	-0.017	-0.017	-0.017	-0.014	-0.016
Financial hardship score	CI[b]	-0.267	-0.292	-0.319	-0.291	-0.301	-0.300	-0.295
	Co[c]	**0.005**	**0.005**	**0.006**	**0.005**	**0.005**	**0.004**	**0.005**
	η	-0.013	-0.012	-0.015	-0.015	-0.011	-0.01	-0.012
Negative life event score	CI	-0.064	-0.039	-0.054	-0.045	-0.067	-0.059	-0.056
	Co	**0.001**	**0.000**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**
	η	-0.008	-0.005	-0.008	-0.009	-0.007	-0.006	-0.007
Female	CI	-0.030	-0.029	-0.029	-0.022	-0.026	-0.030	-0.027
	Co	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Age	η	0.010	0.004	0.005	0.005	0.007	0.006	0.005
- 25-44 years	CI	0.067	0.074	0.070	0.089	0.091	0.099	0.081
	Co	**0.001**	**0.000**	**0.000**	**0.001**	**0.001**	**0.001**	**0.000**
	η	0.014	0.013	0.013	0.019	0.017	0.023	0.016
- 45-64 years	CI	0.103	0.112	0.112	0.103	0.107	0.111	0.109
	Co	**0.002**	**0.001**	**0.001**	**0.002**	**0.002**	**0.003**	**0.002**
	η	0.016	0.017	0.018	0.022	0.022	0.026	0.019
- 65-84 years	CI	-0.349	-0.312	-0.288	-0.271	-0.268	-0.278	-0.289
	Co	**-0.005**	**-0.005**	**-0.005**	**-0.006**	**-0.006**	**-0.007**	**-0.006**
	η	0.001	0.002	0.002	0.002	0.003	0.005	0.002
- 85+ years	CI	-0.437	-0.472	-0.480	-0.531	-0.492	-0.531	-0.493
	Co	**-0.001**	**-0.001**	**-0.001**	**-0.001**	**-0.002**	**-0.003**	**-0.001**
Household income quartile	η	0.006	0.009	0.005	0.005	0.010	0.006	0.007
-Q2 25-50%	CI	-0.216	-0.232	-0.250	-0.282	-0.291	-0.307	-0.263
	Co	**-0.001**	**-0.002**	**-0.001**	**-0.001**	**-0.003**	**-0.002**	**-0.002**
	η	0.005	0.007	0.003	0.005	0.011	0.011	0.007
-Q3 50-75%	CI	0.324	0.276	0.247	0.221	0.209	0.185	0.244
	Co	**0.002**	**0.002**	**0.001**	**0.001**	**0.002**	**0.002**	**0.002**
	η	0.006	0.010	0.007	0.007	0.013	0.013	0.009
-Q4 75-100%	CI	0.792	0.765	0.746	0.739	0.732	0.721	0.749
	Co	**0.004**	**0.007**	**0.005**	**0.005**	**0.009**	**0.009**	**0.007**
Education	η	0.001	0.005	0.001	-0.002	0.001	0.001	0.001
- Certificates & diploma	CI	0.024	0.015	0.009	-0.001	-0.010	-0.013	0.005
	Co	**0.000**	**0.0001**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
	η	-0.002	-0.002	-0.002	-0.005	-0.003	-0.005	-0.003
- Bachelor or honours degree	CI	0.2307	0.2238	0.2228	0.234	0.234	0.2233	0.2292
	Co	**-0.001**	**-0.000**	**-0.001**	**-0.001**	**-0.001**	**-0.001**	**-0.001**
	η	-0.000	0.000	-0.000	-0.000	-0.001	-0.001	-0.001
- Postgraduate degree	CI	0.326	0.334	0.295	0.332	0.324	0.309	0.322
	Co	**0.000**	**0.000**	**-0.000**	**-0.000**	**-0.000**	**-0.000**	**-0.000**
Labour force status	η	-0.001	-0.001	-0.001	-0.002	-0.003	-0.003	-0.002
-Unemployed	CI	-0.169	-0.210	-0.321	-0.341	-0.252	-0.380	-0.281
	Co	**0.000**	**0.000**	**0.000**	**0.001**	**0.001**	**0.001**	**0.001**
	η	-0.008	-0.010	-0.009	-0.009	-0.005	-0.013	-0.009
-Not in the labour force	CI	-0.322	-0.313	-0.309	-0.318	-0.328	-0.341	-0.322
	Co	**0.002**	**0.003**	**0.003**	**0.003**	**0.002**	**0.005**	**0.003**
	η	0.015	0.017	0.016	0.020	0.016	0.023	0.018
Club/community activities	CI	0.050	0.047	0.066	0.046	0.054	0.049	0.052
	Co	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**
	η	-0.020	-0.027	-0.028	-0.033	-0.034	-0.031	-0.029
Long term health condition	CI	-0.202	-0.192	-0.216	-0.208	-0.236	-0.216	-0.210
	Co	**0.004**	**0.005**	**0.006**	**0.007**	**0.008**	**0.007**	**0.006**
Total estimated Contribution		**0.014**	**0.017**	**0.016**	**0.016**	**0.020**	**0.020**	**0.017**
CI of Mental health		**0.015**	**0.017**	**0.016**	**0.017**	**0.019**	**0.019**	**0.017**

Notes: a. η represents elasticity. By definition $\eta_k = \beta_k \frac{\bar{x}_k}{\bar{h}}$, b. CI is concentration index of the row variable ranked by equivalised household income, c. Co is the contribution to mental health concentration index. Sum of all Co constitute the explained part of CI of mental health in a wave.

4. Discussion

In this study, the shocks of negative life events and financial hardship on mental health disparities among different socio-economic groups in Australia were examined. The study used the HILDA longitudinal survey which is comparable to the British Household Panel Survey (BHPS), the German Socio-Economic Panel (SOEP) and the Panel Study of Income Dynamics (PSID) of the USA. This contributes to the body of knowledge in the socio-

economic health inequality literature by addressing the effect of short term shocks in a longitudinal setting. Although past studies have tackled socio-economic health inequality in a cross-sectional setting [5, 42] or in a longitudinal setting [43] no previous studies have quantitatively measured such shocks in the health inequality field.

The impact of SES and demographic variables in Australia are similar to what other country studies have found [5, 44, 45]. This study supports the argument of Kolodziej and García-Gómez [46] that retirement has a protective effect on mental health. This study also showed that 65+ year groups have lower socioeconomic mental health inequality. The findings also showed the expected result that higher income groups have higher mental health status [47]. The results also found a negative relationship between unemployment and mental health status which is well documented in the literature [44, 48, 49].

The major contribution of this study is to assess mental health inequality using a life course perspective where both life shocks and SES are considered. The results indicate that life shocks contribute significantly to socioeconomic mental health inequality. The negative concentration indices of life shock variables in Table 3 (i.e. the CI values in the second row of the life shock variables) indicate that the poor are exposed to more life shocks than the rich. In addition, the negative elasticity of the life shock variables (the first row in the life shock variables in Table 3) show that increasing life shock exposure will reduce mental health and will contribute to mental health inequality. The above mentioned effects are also similar to the effect of labour force status, being female and long term health conditions variables. On the contrary, higher income quartile group, club/community activities and working age population variables are different in nature when generating inequalities. Both concentration indices and elasticities are positive for these variables, implying richer people have better resources, do more club/community activities and working aged people have higher incomes and having more of these characteristics implies better mental health (which also reflected by the positive elasticity value). Because the effects of all these variables on mental health is different for lower and higher socioeconomic groups, socioeconomic mental health inequality is increasing overtime in Australia.

Overall, the findings suggest that lower SES groups, particularly young individuals who are not employed or in the labour force and are not active in club/community activities or are disadvantaged with disabilities/long term health conditions are at risk of much lower mental health from life shocks. In particular, the effects of financial hardship shocks are found to be more pronounced in this study. Government welfare support, for example, through cash transfers, can be provided for such individuals. A regression analysis of individual shocks (see Table 8 of

Appendix A in online supplemental data for the regression results) found that individuals who went without meals or were unable to heat homes or asked for financial help from family and community organisations had significantly lower mental health scores. The study also found that serious personal injury, being separated from a spouse or the death of a spouse or child results in significantly lower mental health scores. Government policy could be designed such that these individuals can get adequate psychological supports especially focusing on lower SES groups.

One of the limitations of this study is that approximately nine percent of the life shock variables were missing and were imputed using the last observation carry forward method. Since, life shocks have a low probability of occurrence, this method might underestimate the true impact of life shocks in the mental health distribution. In addition, because of the group based analysis and methodological constraints, individual heterogeneity is not accounted for in the analysis. The study also did not investigate health selection reverse causality, i.e. the impact of mental health leading to lower socioeconomic status. These issues are precisely the future research avenues this study suggest are worthy of consideration.

5. Conclusions

The present study adds life shocks into the analysis of the socioeconomic inequality of mental health. The study has demonstrated that the impact of life shocks on mental health status is significant for Australian adults. This study also has demonstrated that the impact of life shocks on lower SES groups creates disadvantageous mental health outcomes when compared to higher SES groups. This generates significant mental health disparities at a population level. In Australia, for example, during the study period, the study found that life shocks (financial hardship and negative life events) contributes to 24.7% to 40.5% of pro-rich socioeconomic mental health inequality. Individuals in lower socioeconomic groups are more vulnerable to life shocks than the higher socioeconomic groups and this itself is generating mental health inequality.

The study also investigated the temporal impacts of the effects of life shocks. The study found that life shocks periodically increase socioeconomic mental health inequality, although the distributional effect of these shocks is reduced in other periods. Income and employment status were still the major driver for the change in socioeconomic health inequality. The socioeconomic inequality due to the contribution of life shocks can be addressed through targeted welfare programs such as financial assistance, employment generation schemes and psychological support programs. Short term welfare targeting for groups of poor individuals who encounter such life shocks will have their mental health status improved and will reduce the burden on existing healthcare delivery system in welfare states like Australia. The current contribution explains these phenomena. To measure the

progress of such programs, mental health inequality can be monitored and compared with other similar countries. Thus, lessons learned from this study can contribute to the understanding of the impact of shocks in socioeconomic inequality in mental health in other developed countries. Further research is needed to design specific interventions to address shock related mental health disparities. In conclusion, life shocks significantly contribute to mental health disparities and should be accounted for in designing policies and intervention strategies.

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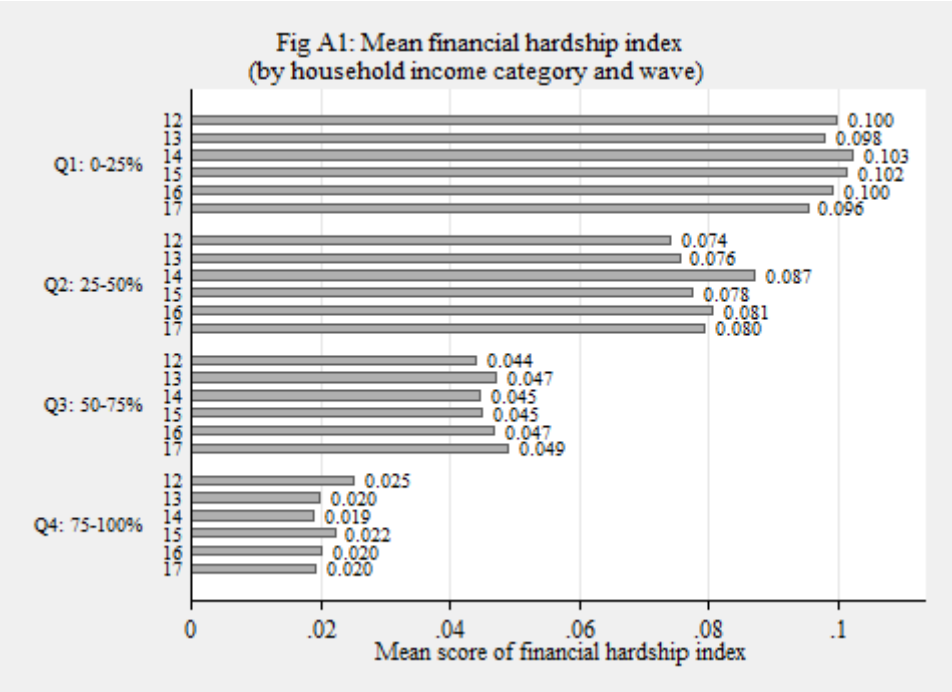

Figure A1: Bar graph for mean score of financial hardship index by income quartile category

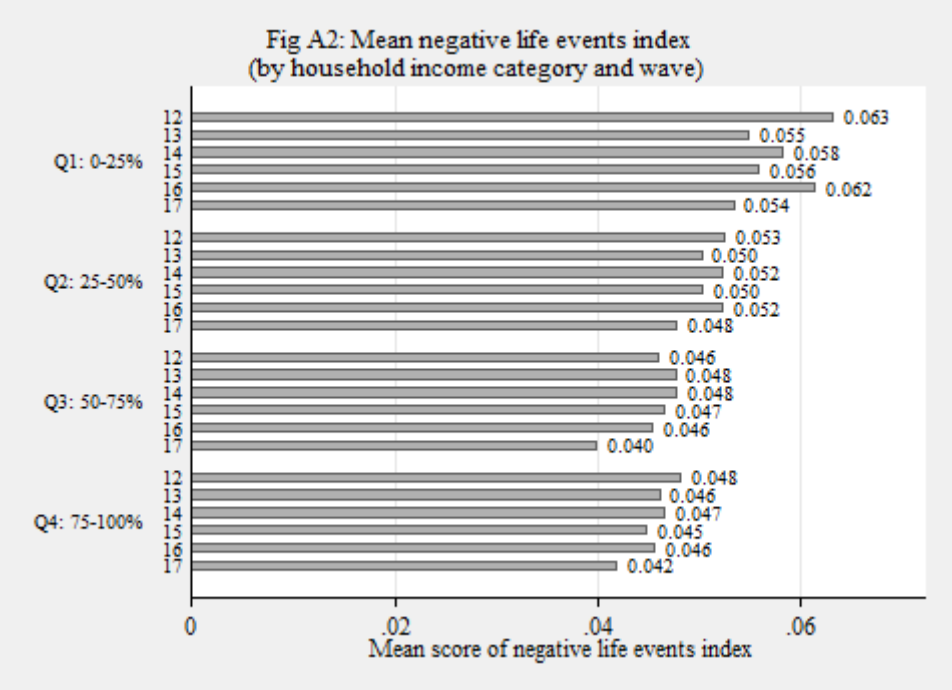

Figure A2: Bar graph for mean score of negative life events index by income quartile category

Table 4: Oaxaca-Blinder decomposition results[a]

Variables		wave 12-13	wave 13-14	wave 14-15	wave 15-16	wave 16-17
Financial hardship score	ΔCη[b]	0.0004	0.0005	-0.0005	0.0002	0
	ΔηC[c]	-0.0002	0.0003	-0.0002	0	-0.0008
	T[d]	**0.0002**	**0.0007**	**-0.0007**	**0.0001**	**-0.0008**
Negative life event score	ΔCη	-0.0003	0.0002	-0.0001	0.0003	-0.0001
	ΔηC	-0.0001	0.0001	0	-0.0002	-0.0001
	T	**-0.0004**	**0.0003**	**-0.0001**	**0.0001**	**-0.0002**
Female	ΔCη	0	0	-0.0001	0	0
	ΔηC	-0.0001	0.0001	0	0	0
	T	**-0.0001**	**0.0001**	**-0.0001**	**0**	**0**
Age	ΔCη	0	0	0.0001	0	0
- 25-44 years	ΔηC	-0.0004	0	0	0.0002	-0.0001
	T	**-0.0004**	**0**	**0.0001**	**0.0002**	**-0.0001**
- 45-64 years	ΔCη	0.0001	0	-0.0002	0.0001	0.0001
	ΔηC	-0.0002	0	0.0007	-0.0001	0.0005
	T	**-0.0001**	**0**	**0.0005**	**0**	**0.0006**
- 65-84 years	ΔCη	0.0006	0.0004	0.0004	0.0001	-0.0003
	ΔηC	-0.0005	-0.0003	-0.001	0	-0.0011
	T	**0.0001**	**0.0001**	**-0.0006**	**0**	**-0.0013**
- 85+ years	ΔCη	-0.0001	0	-0.0001	0.0001	-0.0002
	ΔηC	-0.0003	-0.0001	0	-0.0005	-0.0008
	T	**-0.0004**	**-0.0001**	**-0.0001**	**-0.0004**	**-0.0009**
Household income quartile	ΔCη	-0.0001	-0.0001	-0.0002	-0.0001	-0.0001
-Q2 25-50%	ΔηC	-0.0008	0.001	0	-0.0013	0.0011
	T	**-0.0009**	**0.0009**	**-0.0002**	**-0.0014**	**0.001**
-Q3 50-75%	ΔCη	-0.0003	-0.0001	-0.0001	-0.0001	-0.0003
	ΔηC	0.0006	-0.0012	0.0006	0.0013	0
	T	**0.0002**	**-0.0013**	**0.0005**	**0.0012**	**-0.0002**
-Q4 75-100%	ΔCη	-0.0003	-0.0001	-0.0001	-0.0001	-0.0001
	ΔηC	0.0031	-0.0022	0.0004	0.0041	0.0001
	T	**0.0028**	**-0.0023**	**0.0004**	**0.004**	**-0.0001**
Education	ΔCη	0	0	0	0	0
- Certificates & diploma	ΔηC	0.0001	-0.0001	0	0	0
	T	**0**	**-0.0001**	**0**	**0**	**0**
-Bachelor or honours degree	ΔCη	0	0	-0.0001	0	0.0001
	ΔηC	0.0001	-0.0001	-0.0006	0.0005	-0.0005
	T	**0.0001**	**-0.0001**	**-0.0006**	**0.0005**	**-0.0004**
- Postgraduate degree	ΔCη	0	0	0	0	0
	ΔηC	0.0001	-0.0002	0	-0.0001	-0.0001
	T	**0.0001**	**-0.0002**	**-0.0001**	**-0.0001**	**0**
Labour force status	ΔCη	0	0.0001	0	-0.0003	0.0004
-Unemployed	ΔηC	-0.0001	0	0.0005	0.0002	0
	T	**-0.0001**	**0.0001**	**0.0006**	**-0.0001**	**0.0003**
-Not in the labour force	ΔCη	-0.0001	0	0.0001	0	0.0002
	ΔηC	0.0008	-0.0003	-0.0001	-0.0013	0.0026
	T	**0.0007**	**-0.0003**	**0**	**-0.0013**	**0.0028**
Club/community activities	ΔCη	0	0.0003	-0.0004	0.0001	-0.0001
	ΔηC	0.0001	0	0.0003	-0.0002	0.0004
	T	**0**	**0.0003**	**-0.0001**	**-0.0001**	**0.0002**
Long term health condition	ΔCη	-0.0003	0.0007	-0.0002	0.001	-0.0006
	ΔηC	0.0015	0.0002	0.0009	0.0003	-0.0007
	T	**0.0013**	**0.0009**	**0.0007**	**0.0013**	**-0.0013**
Explained changes		0.0031	-0.001	0.0002	0.004	-0.0004
Unexplained changes		-0.0007	-0.0004	0.0006	-0.0013	0.0005
Total actual changes		**0.0024**	**-0.0014**	**0.0008**	**0.0027**	**0.0001**

Notes: a. The 0 values don't indicate actual zeros. These values are approximately zero, b. ΔCη represents health changes due to changes in inequality, c. ΔηC represents health changes due to changes in elasticity d. T represents the total changes explained by variable. Large contributions were colored.

Sensitivity analysis (MCS)

Table 5: Regression results

Variables	wave 12	wave 13	wave 14	wave 15	wave 16	wave 17	Pooled
SF-36 Mental Health Score: MCS (Dep. variable)	n=13496 (unweighted) n=13262 (weighted) Population size: 16,699,284						
			Key objective variables				
Financial hardship score	-13.479*** (0.9564)	-13.7818*** (1.0086)	-13.9779*** (0.9297)	-13.3859*** (0.9605)	-14.0612*** (0.994)	-12.1382*** (0.8831)	-13.5229*** (0.6574)
Negative life event score	-14.9535*** (1.6723)	-13.2141*** (1.7784)	-15.6536*** (2.0132)	-15.7048*** (1.7183)	-12.9396*** (1.7391)	-12.8184*** (1.9077)	-14.0078*** (1.0279)
			Demographic variables				
-Male (ref.)							
-Female	-0.8275*** (0.2034)	-0.6318*** (0.1956)	-0.88*** (0.2253)	-0.6493*** (0.1966)	-0.7727*** (0.2085)	-0.6042*** (0.2392)	-0.7278*** (0.1541)
Age							
-15-24 years (ref.)							
- 25-44 years	1.0975*** (0.3884)	0.9194** (0.3815)	0.9832** (0.4355)	0.7531 (0.5267)	1.2719** (0.5171)	1.0166** (0.4219)	0.9014*** (0.3322)
- 45-64 years	2.4904*** (0.3876)	2.4351*** (0.3952)	2.7924*** (0.4129)	2.9551*** (0.4773)	3.0607*** (0.5394)	3.5005*** (0.4581)	2.7617*** (0.3444)
- 65-84 years	5.686*** (0.4821)	5.7715*** (0.499)	6.3745*** (0.5189)	6.4928*** (0.5783)	6.3197*** (0.6892)	7.1848*** (0.5989)	6.125*** (0.4402)
- 85+ years	5.6364*** (1.2365)	7.699*** (0.9121)	7.6755*** (0.8463)	4.9875*** (1.0933)	6.4102*** (1.0634)	7.3513*** (0.837)	6.1096*** (0.6758)
			SES variables				
Household income quartile							
-Q1 0-25% (ref.)							
-Q2 25-50%	0.5873 (0.4232)	1.1769** (0.4909)	0.592 (0.4787)	0.4274 (0.4335)	1.2209*** (0.4177)	0.5633 (0.4817)	0.7658*** (0.2478)
-Q3 50-75%	0.3549 (0.3705)	0.8358* (0.4805)	0.0853 (0.4407)	0.1478*** (0.409)	1.0304** (0.4466)	1.2105** (0.5284)	0.5834** (0.2925)
-Q4 75-100%	0.3182 (0.4144)	0.918* (0.4909)	0.3719 (0.4698)	0.4367 (0.4107)	1.0568** (0.4508)	1.0194* (0.5382)	0.6413** (0.3091)
Education							
-Year 12 or below (ref.)							
- Certificates & diploma	-0.0842 (0.2798)	0.6034** (0.2603)	-0.1028 (0.2659)	-0.2217 (0.2627)	0.3159 (0.2676)	0.03 (0.2761)	0.0341 (0.2028)
-Bachelor or honours degree	-0.6222* (0.3691)	-0.6305 (0.3845)	-0.7333* (0.3729)	-1.1776*** (0.3682)	-0.732* (0.4051)	-1.0142** (0.4193)	-0.8627*** (0.3129)
- Postgraduate degree	-0.174 (1.1244)	0.3971 (0.83)	-0.1754 (0.639)	0.0994 (0.7823)	-0.2053 (0.5822)	-0.5916 (0.4264)	-0.1769 (0.6166)
Labour force status							
-Employed (ref.)							
-Unemployed	-1.0401 (0.7326)	-0.0833 (0.797)	-0.155 (0.8697)	-2.4289*** (0.7176)	-2.5774*** (0.7093)	-2.5655*** (0.9816)	-1.448*** (0.3586)
-Not in the labour force	-0.9457*** (0.3703)	-0.8999*** (0.3376)	-1.3327*** (0.3467)	-1.3628*** (0.3444)	-0.7397** (0.3295)	-1.7395*** (0.3995)	-1.1414*** (0.2326)
			Other variables				
Club/community activities	1.9007*** (0.2305)	1.9234*** (0.2455)	1.7675*** (0.2623)	2.2716*** (0.2564)	2.1764*** (0.2378)	2.6344*** (0.2527)	2.1222*** (0.1824)
Long term health conditions	-3.0361*** (0.3358)	-4.0276*** (0.2936)	-4.2113*** (0.3243)	-4.6889*** (0.3283)	-4.9609*** (0.334)	-4.45*** (0.3154)	-4.2778*** (0.2029)
Constant	49.4069*** (0.4699)	48.7632*** (0.5307)	49.2675*** (0.5071)	49.006*** (0.5989)	47.8212*** (0.668)	47.3618*** (0.5832)	48.7625*** (0.3895)

Notes: *** p < 0.01, ** p < 0.05, and * p < 0.1. Standard errors are in the parentheses.

Table 6: Wagstaff - Doorslaer –Watanabe Decomposition results (MCS)

Variables		wave 12	wave 13	wave 14	wave 15	wave 16	wave 17	Pooled
	η[a]	-0.0173	-0.0172	-0.0183	-0.0168	-0.0175	-0.0148	-0.017
Financial hardship score	CI[b]	-0.2671	-0.2916	-0.3191	-0.2914	-0.3011	-0.2996	-0.2951
	Co[c]	**0.0046**	**0.005**	**0.0058**	**0.0049**	**0.0053**	**0.0044**	**0.005**
	η	-0.0161	-0.0135	-0.0165	-0.016	-0.0136	-0.0121	-0.0144
Negative life event score	CI	-0.0637	-0.0389	-0.0539	-0.0446	-0.0674	-0.0594	-0.0556
	Co	**0.001**	**0.0005**	**0.0009**	**0.0007**	**0.0009**	**0.0007**	**0.0008**
	η	-0.0086	-0.0066	-0.0092	-0.0068	-0.0081	-0.0064	-0.0076
Female	CI	-0.0295	-0.0288	-0.0294	-0.022	-0.0255	-0.0296	-0.0273
	Co	**0.0003**	**0.0002**	**0.0003**	**0.0002**	**0.0002**	**0.0002**	**0.0002**
Age	η	0.0079	0.0066	0.0071	0.0054	0.009	0.0072	0.0064
- 25-44 years	CI	0.0674	0.0744	0.069	0.0892	0.0911	0.0989	0.0814
	Co	**0.0005**	**0.0005**	**0.0005**	**0.0005**	**0.0008**	**0.0007**	**0.0005**
	η	0.0164	0.0161	0.019	0.0205	0.0217	0.0252	0.019
- 45-64 years	CI	0.1031	0.1117	0.1117	0.1032	0.107	0.1111	0.1088
	Co	**0.0017**	**0.0018**	**0.0021**	**0.0021**	**0.0023**	**0.0028**	**0.0021**
	η	0.0163	0.0182	0.0214	0.0232	0.0236	0.0282	0.021
- 65-84 years	CI	-0.3491	-0.3115	-0.2884	-0.2711	-0.2681	-0.2784	-0.289
	Co	**-0.0057**	**-0.0057**	**-0.0062**	**-0.0063**	**-0.0063**	**-0.0079**	**-0.0061**
	η	0.001	0.0018	0.0024	0.002	0.0033	0.0045	0.0023
- 85+ years	CI	-0.4373	-0.4722	-0.4796	-0.5307	-0.4916	-0.5313	-0.4927
	Co	**-0.0005**	**-0.0008**	**-0.0011**	**-0.0011**	**-0.0016**	**-0.0024**	**-0.0011**
Household income quartile	η	0.0033	0.0061	0.0031	0.0022	0.0062	0.0027	0.004
-Q2 25-50%	CI	-0.2164	-0.2319	-0.2504	-0.2817	-0.2908	-0.3066	-0.263
	Co	**-0.0007**	**-0.0014**	**-0.0008**	**-0.0006**	**-0.0018**	**-0.0008**	**-0.001**
	η	0.0019	0.0043	0.0004	0.0008	0.0054	0.0064	0.0031
-Q3 50-75%	CI	0.3238	0.2755	0.2469	0.2207	0.209	0.1852	0.2435
	Co	**0.0006**	**0.0012**	**0.0001**	**0.0002**	**0.0011**	**0.0012**	**0.0007**
	η	0.0013	0.0044	0.0019	0.0024	0.0058	0.0059	0.0033
-Q4 75-100%	CI	0.7923	0.7645	0.7464	0.7392	0.7318	0.721	0.7492
	Co	**0.0011**	**0.0034**	**0.0014**	**0.0017**	**0.0043**	**0.0042**	**0.0025**
Education	η	-0.0005	0.0038	-0.0007	-0.0015	0.0022	0.0002	0.0002
- Certificates & diploma	CI	0.0237	0.0145	0.0088	-0.0007	-0.0095	-0.0132	0.0046
	Co	**0**	**0.0001**	**0**	**0**	**0**	**0**	**0**
	η	-0.0025	-0.0026	-0.0031	-0.0051	-0.0032	-0.0047	-0.0037
-Bachelor or honours degree	CI	0.2307	0.2238	0.2228	0.234	0.234	0.2233	0.2292
	Co	**-0.0006**	**-0.0006**	**-0.0007**	**-0.0012**	**-0.0008**	**-0.001**	**-0.0008**
	η	-0.0002	0.0005	-0.0002	0.0001	-0.0003	-0.0009	-0.0002
- Postgraduate degree	CI	0.326	0.3342	0.2952	0.3324	0.3242	0.3094	0.3224
	Co	**-0.0001**	**0.0002**	**-0.0001**	**0**	**-0.0001**	**-0.0003**	**-0.0001**
Labour force status	η	-0.0008	-0.0001	-0.0001	-0.002	-0.0018	-0.0016	-0.0011
-Unemployed	CI	-0.1688	-0.2102	-0.3206	-0.3407	-0.2516	-0.3802	-0.2807
	Co	**0.0001**	**0**	**0**	**0.0007**	**0.0005**	**0.0006**	**0.0003**
	η	-0.0062	-0.0058	-0.0087	-0.0089	-0.005	-0.0119	-0.0076
-Not in the labour force	CI	-0.3223	-0.3129	-0.3088	-0.3183	-0.3279	-0.3408	-0.3215
	Co	**0.002**	**0.0018**	**0.0027**	**0.0028**	**0.0016**	**0.0041**	**0.0024**
	η	0.0136	0.0145	0.013	0.0171	0.015	0.0194	0.0155
Club/community activities	CI	0.05	0.047	0.0661	0.0458	0.0541	0.049	0.0515
	Co	**0.0007**	**0.0007**	**0.0009**	**0.0008**	**0.0008**	**0.001**	**0.0008**
	η	-0.0157	-0.0237	-0.0248	-0.0286	-0.0297	-0.0288	-0.0253
Long term health condition	CI	-0.2023	-0.1918	-0.2157	-0.2081	-0.2361	-0.2159	-0.2104
	Co	**0.0032**	**0.0046**	**0.0054**	**0.006**	**0.007**	**0.0062**	**0.0053**
Total Contribution		**0.0082**	**0.0113**	**0.0112**	**0.0114**	**0.0143**	**0.0137**	**0.0115**
CI of Mental health		**0.0089**	**0.0116**	**0.0112**	**0.0117**	**0.0139**	**0.0135**	**0.0116**

Notes: a. η represents elasticity. By definition $\eta_k = \beta_k \frac{\bar{x}_k}{\bar{h}}$, b. CI is concentration index of the row variable ranked by equivalised household income, c. Co is the contribution to mental health concentration index. Sum of all Co constitute the explained part of CI of mental health in a wave.

Table 7: Oaxaca-Blinder decomposition results[a] (MCS)

Variables		wave 12-13	wave 13-14	wave 14-15	wave 15-16	wave 16-17
	$\Delta C\eta$[b]	0.0004	0.0005	-0.0005	0.0002	0
Financial hardship score	$\Delta\eta C$[c]	0	0.0003	-0.0005	0.0002	-0.0008
	T[d]	**0.0004**	**0.0008**	**-0.0009**	**0.0004**	**-0.0009**
	$\Delta C\eta$	-0.0003	0.0002	-0.0001	0.0003	-0.0001
Negative life event score	$\Delta\eta C$	-0.0002	0.0001	0	-0.0001	-0.0001
	T	**-0.0005**	**0.0004**	**-0.0002**	**0.0002**	**-0.0002**
	$\Delta C\eta$	0	0	-0.0001	0	0
Female	$\Delta\eta C$	-0.0001	0.0001	-0.0001	0	0
	T	**-0.0001**	**0.0001**	**-0.0001**	**0.0001**	**0**
Age	$\Delta C\eta$	0	0	0.0001	0	0.0001
- 25-44 years	$\Delta\eta C$	-0.0001	0	-0.0001	0.0003	-0.0002
	T	**0**	**0**	**0**	**0.0003**	**-0.0001**
	$\Delta C\eta$	0.0001	0	-0.0002	0.0001	0.0001
- 45-64 years	$\Delta\eta C$	0	0.0003	0.0002	0.0001	0.0004
	T	**0.0001**	**0.0003**	**0**	**0.0002**	**0.0005**
	$\Delta C\eta$	0.0007	0.0005	0.0004	0.0001	-0.0003
- 65-84 years	$\Delta\eta C$	-0.0006	-0.001	-0.0005	-0.0001	-0.0012
	T	**0**	**-0.0005**	**-0.0001**	**0**	**-0.0015**
	$\Delta C\eta$	-0.0001	0	-0.0001	0.0001	-0.0002
- 85+ years	$\Delta\eta C$	-0.0003	-0.0003	0.0002	-0.0007	-0.0006
	T	**-0.0004**	**-0.0003**	**0.0001**	**-0.0005**	**-0.0008**
Household income quartile	$\Delta C\eta$	-0.0001	-0.0001	-0.0001	-0.0001	0
-Q2 25-50%	$\Delta\eta C$	-0.0006	0.0007	0.0002	-0.0011	0.001
	T	**-0.0007**	**0.0006**	**0.0002**	**-0.0012**	**0.001**
	$\Delta C\eta$	-0.0002	0	0	-0.0001	-0.0002
-Q3 50-75%	$\Delta\eta C$	0.0008	-0.0011	0.0001	0.001	0.0002
	T	**0.0006**	**-0.0011**	**0.0001**	**0.001**	**0.0001**
	$\Delta C\eta$	-0.0001	0	0	0	-0.0001
-Q4 75-100%	$\Delta\eta C$	0.0024	-0.0019	0.0003	0.0026	0
	T	**0.0023**	**-0.0019**	**0.0003**	**0.0025**	**0**
Education	$\Delta C\eta$	0	0	0	0	0
- Certificates & diploma	$\Delta\eta C$	0.0001	-0.0001	0	0	0
	T	**0.0001**	**-0.0001**	**0**	**0**	**0**
	$\Delta C\eta$	0	0	-0.0001	0	0.0001
-Bachelor or honours degree	$\Delta\eta C$	0	-0.0001	-0.0004	0.0004	-0.0003
	T	**0**	**-0.0001**	**-0.0005**	**0.0004**	**-0.0003**
	$\Delta C\eta$	0	0	0	0	0
- Postgraduate degree	$\Delta\eta C$	0.0002	-0.0002	0.0001	-0.0001	-0.0002
	T	**0.0002**	**-0.0002**	**0.0001**	**-0.0001**	**-0.0002**
Labour force status	$\Delta C\eta$	0	0	0	-0.0002	0.0002
-Unemployed	$\Delta\eta C$	-0.0001	0	0.0006	0	0
	T	**-0.0001**	**0**	**0.0006**	**-0.0002**	**0.0002**
	$\Delta C\eta$	-0.0001	0	0.0001	0	0.0002
-Not in the labour force	$\Delta\eta C$	-0.0001	0.0009	0.0001	-0.0013	0.0023
	T	**-0.0002**	**0.0009**	**0.0002**	**-0.0012**	**0.0024**
	$\Delta C\eta$	0	0.0002	-0.0003	0.0001	-0.0001
Club/community activities	$\Delta\eta C$	0	-0.0001	0.0003	-0.0001	0.0002
	T	**0**	**0.0002**	**-0.0001**	**0**	**0.0001**
	$\Delta C\eta$	-0.0002	0.0006	-0.0002	0.0008	-0.0006
Long term health condition	$\Delta\eta C$	0.0016	0.0002	0.0008	0.0002	-0.0002
	T	**0.0014**	**0.0008**	**0.0006**	**0.0011**	**-0.0008**

Notes: a. The 0 values don't indicate actual zeros. These values are approximately zero, b. $\Delta C\eta$ represents health changes due to changes in inequality, c. $\Delta\eta C$ represents health changes due to changes in elasticity d. T represents the total changes explained by variable.

Table 8: Complete and partial regression model (OLS) of disentangled life shock variables for wave 12 and wave 17

	Wave 12		Wave 17	
Variables	Complete model	Partial Model	Complete Model	Partial Model
Could not pay electricity, gas or telephone bills on time	-1.234	-1.728**	-1.233	-2.263***
Could not pay the mortgage or rent on time	0.111	0.32	0.478	1.39
Pawned or sold something	-2.758***	-3.654***	-1.519	-2.694***
Went without meals	-7.371***	-7.787***	-8.144***	-9.987***
Was unable to heat home	-5.876***	-7.109***	-3.658***	-4.772***
Asked for financial help from friends or family	-3.289***	-4.103***	-2.982***	-4.815***
Asked for help from welfare/community organisations	-3.581***	-4.919***	-2.603*	-5.341***
Separated from spouse	-3.588*	-4.64**	-5.87***	-5.823***
Serious personal injury/illness	-5.201***	-6.005***	-4.924***	-6.114***
Serious injury/illness to family member	-0.442	-0.562	-1.183**	-0.893
Death of spouse or child	-4.245**	-4.153*	-7.558***	-7.932***
Death of close relative/family member	-0.389	-0.69	0.494	0.348
Death of a close friend	1.018*	1.666***	1.15*	1.938***
Victim of physical violence	-2.832	-4.114	-0.165	-1.422
Victim of a property crime	-3.365***	-3.028***	-1.47	-1.633
Detained in jail	-8.39***	-8.247**	5.904*	4.904*
Close family member detained in jail	-2.021	-3.034*	-2.792**	-4.116***
Fired or made redundant	-2.429**	-2.691**	-0.457	-1.046
A weather related disaster (flood, cyclone)	-2.672**	-3.105**	-1.862	-1.425
Gender	-1.243***		-0.94***	
Age- 25-44 years	1.822***		0.855	
Age- 45-64 years	2.872***		4.341***	
Age- 65-84 years	7.556***		9.305***	
Age- 85+ years	8.76***		10.934***	
Household Income: Q2: 25-50%	1.25		1.746*	
Household Income: Q3: 50-75%	1.356**		3.134***	
Household Income: Q4: 75-100%	1.966**		3.285***	
Education: Certificates & diploma	0.41		0.287	
Education: Bachelor or honours degree	-0.545		-1.366	
Education: Postgraduate degree	0.225		-0.566	
Labour force status: Unemployed	-2.055**		-6.753**	
Labour force status: Not in the labour force	-1.643***		-2.586***	
Club/community activities	3.062***		4.551***	
Long term health condition	-5.325***		-6.939***	
constant	74.224***	76.963***	71.32***	75.536***

Table 9: Major factors contribution and by percentage by wave

	Wave 12	Wave 13	Wave 14	Wave 15	Wave 16	Wave 17
Financial hardship (fh)	0.0046	0.0048	0.0056	0.0048	0.005	0.0042
Negative life event (nl)	0.0008	0.0004	0.0008	0.0007	0.0008	0.0006
Life shocks (fh+nl)	0.0054	0.0052	0.0064	0.0055	0.0058	0.0048
Demography	-0.0035	-0.0043	-0.0043	-0.0043	-0.0047	-0.0063
SES	0.007	0.0101	0.0068	0.0074	0.01	0.0135
Other	0.0047	0.006	0.0071	0.0077	0.0089	0.0078
Unexplained	0.0012	0.0002	-0.0002	0.0003	-0.0007	-0.0004

	Wave 12	Wave 13	Wave 14	Wave 15	Wave 16	Wave 17
Financial hardship (fh)	31.1%	27.9%	35.4%	28.9%	25.9%	21.6%
Negative life event (nl)	5.4%	2.3%	5.1%	4.2%	4.1%	3.1%
Life shocks (fh+nl)	36.5%	30.2%	40.5%	33.1%	30.1%	24.7%
Demography	-23.6%	-25.0%	-27.2%	-25.9%	-24.4%	-32.5%
SES	47.3%	58.7%	43.0%	44.6%	51.8%	69.6%
Other	31.8%	34.9%	44.9%	46.4%	46.1%	40.2%
Unexplained	8.1%	1.2%	-1.3%	1.8%	-3.6%	-2.1%
Total %	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 10: Missing observation analysis

Variable	Variable Description	Missing	Available	Missing %
helth	Long term health condition	15	80961	0.02%
lsclub	Club/community activities	7241	73735	8.94%
fiprbeg	Could not pay electricity, gas or telephone bills on time	8839	72137	10.92%
fiprbmr	Could not pay the mortgage or rent on time	9105	71871	11.24%
fiprbps	Pawned or sold something	8985	71991	11.10%
fiprbwm	Went without meals	8958	72018	11.06%
fiprbuh	Was unable to heat home	8994	71982	11.11%
fiprbfh	Asked for financial help from friends or family	8866	72110	10.95%
fiprbwo	Asked for help from welfare/community organisations	8966	72010	11.07%
ghmh	SF-36 mental health score(MHI5)	6881	74095	8.50%
lesep	Separated from spouse	7196	73780	8.89%
leins	Serious personal injury/illness	7257	73719	8.96%
leinf	Serious injury/illness to family member	7290	73686	9.00%
ledsc	Death of spouse or child	7218	73758	8.91%
ledrl	Death of close relative/family member	7186	73790	8.87%
ledfr	Death of a close friend	7209	73767	8.90%
levio	Victim of physical violence	7266	73710	8.97%
lepcm	Victim of a property crime	7133	73843	8.81%
lejls	Detained in jail	7133	73843	8.81%
lejlf	Close family member detained in jail	7134	73842	8.81%
lefrd	Fired or made redundant	7201	73775	8.89%
ledhm	A weather related disaster (flood, cyclone)	7163	73813	8.85%
			Average	9.16%