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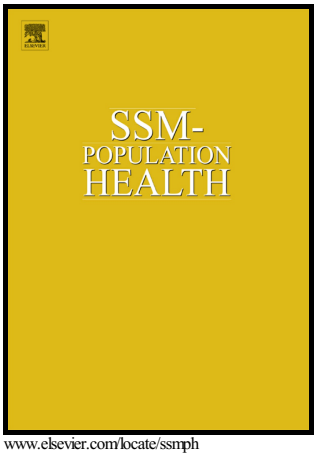

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Inequalities in mental health and well-being in a time of austerity: follow-up findings from the Stockton-on-Tees cohort study

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Abstract

In response to the 2007/8 financial crisis and the subsequent 'Great Recession', the UK government pursued a policy of austerity, characterised by public spending cuts and reductions in working-age welfare benefits. This paper reports on a case study of the effects of this policy on local inequalities in mental health and wellbeing in the local authority of Stockton-on-Tees in the North East of England, an area with very high spatial and socio-economic inequalities. Follow-up findings from a prospective cohort study of the gap in mental health and wellbeing between the most and least deprived neighbourhoods of Stockton-on-Tees is presented. It is the first quantitative study to use primary data to

intensively and longitudinally explore local inequalities in mental health and wellbeing during austerity and it also examines any changes in the underpinning social and behavioural determinants of health. Using a stratified random sampling technique, the data was analysed using linear mixed effects model (LMM) that explored any changes in the gap in mental health and wellbeing between people from the most and least deprived areas, alongside any changes in the material, psychosocial and behavioural determinants. The main findings are that the significant gap in mental health between the two areas remained constant over the 18-month study period, whilst there were no changes in the underlying determinants. These results may reflect our relatively short follow-up period or the fact that the cohort sample were older than the general population and pensioners in the UK have largely been protected from austerity. The study therefore potentially provides further empirical evidence to support assertions that social safety nets matter - particularly in times of economic upheaval.

Key Words: Social Determinants; Survey; Mental Wellbeing; Health Inequalities; Welfare;, Social Inequality; Austerity

1. Background

In response to the 2007/8 financial crisis and the subsequent 'Great Recession', the UK government pursued a policy of austerity, characterised by public spending cuts and reductions in working-age welfare benefits. This paper reports on a case study of the effects of this policy on local inequalities in mental health and wellbeing in the local authority of Stockton-on-Tees in the North East of England, an area with very high spatial and socio-economic inequalities. This paper presents follow-up findings from a prospective cohort study of the gap in mental health and wellbeing between the most and least deprived neighbourhoods of Stockton-on-Tees. It is the first quantitative study to use primary data to intensively and longitudinally explore local inequalities in mental health and wellbeing during

austerity and it also examines any changes in the underpinning social and behavioural determinants of health – the *pathways* potentially linking austerity with health inequalities.

1.1. 'Great Recession' and Austerity

The global financial crisis of 2007/8 led to a long period of recession across Europe. The catalyst for the slump was a downturn in the USA housing market which led to a massive collapse in financial markets across the world. Banks increasingly required state bailouts, stock markets posted massive falls which continued as the effects in the 'real' economy began to be felt with high unemployment rates of around 8.5% in the UK and the USA, 10-12% in France and Italy and more than 20% in Spain and Greece. The IMF announced that the global economy was experiencing its worst period for 60 years: the 'Great Recession' (Gamble, 2009). Government responses to the recession varied, in the UK (like a number of other countries most notably Spain or Greece), a strict policy of austerity was implemented from 2010 onwards (Kitson et al, 2011). This has been characterised by a drive to reduce public deficits via large scale cuts to central and local government budgets, reduced funding for the health care system, and large reductions in welfare services and working-age social security benefits. In a comparative European study, Reeves et al. (2013) found that the UK austerity policy was the third most extensive.

It is estimated that the UK welfare reforms enacted up to 2015 will take nearly £19bn a year out of the economy. This is equivalent to around £470 a year for every adult of working age in the country. The biggest financial losses arise from reforms to incapacity-related benefits (£4.3bn a year), changes to Tax Credits (£3.6bn a year) and the cap of 1 percent up-rating of most working-age benefits (£3.4bn a year) (Beatty and Fothergill, 2014). The 2010-2015 Housing Benefit reforms resulted in more modest losses – an estimated £490m a year arising from the under occupancy charge (most commonly referred to as 'bedroom tax'), for example – but for the households affected the sums are nevertheless still large (e.g. £12 per week reductions per 'spare room' for those on benefits that are only around £65 per week)

(Moffat et al, 2016) (for more details see [removed for anonymity] Authors, 2015). Research shows that these welfare cuts – alongside the steep reductions in local government budgets of up to 40% - have hit the poorest parts of the country the hardest (Fothergill and Beatty, 2016): austerity has disproportionately impacted on the availability of key services in these areas, widening social inequalities within them and spatial inequalities between them and other areas (Pearce, 2013; Authors, 2015). These 'reforms' have also disproportionately impacted on low income households of working-age (Browne and Levell 2010) whilst, in contrast, pensioner households have been more protected by, for example, the universal state pension 'Triple Lock' (a guarantee to increase the state pension every year by the higher of: inflation, average earnings or a minimum of 2.5%) and other universal allowances for the elderly such as the winter fuel allowance (Green et al, 2017).

1.2. Health Inequalities

It is well documented that there are significant inequalities in health by socio-economic status. For example, in England, men and women living in the most deprived neighbourhoods have a life expectancy of 9 and 7 years less respectively than those living in the least deprived (ONS, 2014). There are similarly stark inequalities in mental health with, for example, suicide and self-harm rates considerably higher in the most deprived neighbourhoods (Cairns et al, 2017). Baseline analysis of the Stockton-on-Tess cohort also found a significant gap in mental health and wellbeing between the most and least deprived areas (Authors, 2016).

These health inequalities are intimately linked to broader social and economic inequalities and so a widening of inequality, as a result of austerity, may lead to a further exacerbation of social and spatial health inequalities. There are three main *pathways* linking socio-economic status and health: materialist, psychosocial, and behavioural/cultural (Bartley, 2016; Skalická et al, 2009). The materialist explanation focuses on income and on what income enables – access to goods and services and exposures to material (physical) risk factors (e.g. poor

housing, inadequate diet, physical hazards at work, environmental exposures). Cohort studies have linked poorer mental health with poverty, unemployment, and low income (Bartley, 2016). Psychosocial explanations focus on how social inequality makes people feel – domination/subordination, superiority/inferiority, social support, demands and control – and the effects of the biological consequences of these feelings on health. Cohort studies have shown that over time stress has an impact on the body, leading to physical and mental ill-health (Marmot and Wilkinson, 2005). The behavioural explanation considers the association between socio-economic status and health to be a result of health-related behaviours as a result of adverse personal/psychological characteristics or because unhealthy behaviours may be more culturally acceptable amongst lower socio-economic groups (Bartley, 2016; Skalická et al, 2009). Consumption of high amounts of alcohol appears to be a particular risk factor for mental ill health – whilst other behavioural factors such as smoking have a more nuanced relationship (WHO and Calouste Gulbenkian Foundation, 2014). The baseline analysis of the Stockton-on-Tess cohort found material and psychosocial factors to be the most important determinants of inequalities in mental health (Authors, 2016).

1.3. Recession, Austerity and Health

The short term overall population health effects of recessions are rather mixed with the majority of international studies concluding that all-cause mortality, deaths from cardiovascular disease and from motor vehicle accidents and hazardous health behaviours *decrease* during economic downturns, whilst deaths from suicides, rates of mental ill health and chronic illnesses *increase* (Authors, 2011). Following the 2007/8 crisis, worldwide an excess of 4884 suicides were observed in 2009 (Corcoran et al. 2015) and over the next 3 years (2008-2010) an excess of 4750 suicides occurred in the USA, 1000 suicides in England, and 680 suicides in Spain. Areas of the UK with higher unemployment rates had greater increases in suicide rates (Hawton et al. 2016). There is also evidence of other

increases in poor mental health and wellbeing after the 'Great Recession' including self-harm and psychiatric morbidity (Barnes et al, 2017; Vizard and Obolenskaya, 2015).

However, the effects of recessions on health and health inequalities vary by country – with more negative trends in mental health and wellbeing in those countries, including the UK, that implemented austerity (Stuckler and Basu, 2013; Basu et al. 2017). Following the 2008 recession, Greece, Italy and Spain imposed cuts in health and social protection budgets. These countries experienced worse health effects when compared to countries such as Germany, Iceland and Sweden who opted to maintain social safety nets over austerity (Stuckler and Basu 2013; Helliwell et al. 2017). Similarly, Karanikolos et al. (2013) found that across Europe, weak social protection systems increased the health and social crisis in Europe. Whilst there are few quantitative studies of the effects of austerity on health inequalities in the UK or elsewhere, initial studies such as that by Barr et al (2015a) suggest that inequalities in mental health and wellbeing increased at a higher rate between 2009 and 2013. Further, people living in more deprived areas have seen the largest increases in poor mental health (Barr et al, 2015b) and self-harm (Barnes et al, 2016). Internationally, Niedzwiedz et al. (2016) found that reductions in spending levels or increased conditionality may have adversely effected the mental health of disadvantaged social groups. These are in keeping with previous studies of the effects of public sector and welfare state contractions on increases in health inequalities in the UK, Finland, US and New Zealand in the 1980s and 1990s (Authors, 2016; Authors, 2015; Copeland et al, 2015; Kokkinen, et al, 2015; Authors et al, 2016).

The existing research literature therefore suggests: (1) health inequalities are linked to social inequalities; (2) the importance of social safety nets in mitigating health inequalities – particularly during economic downturns; and (3) that austerity is potentially increasing health inequalities by increasing social inequalities (Authors, 2016). It is in this context that this

paper reports on a case study of a cohort survey of the effects of austerity on local inequalities in mental health and wellbeing in the local authority of Stockton-on-Tees in the North East of England. It examines if there are any changes in the gap in mental health between the least and most deprived areas during a period of austerity and if there are any changes in the underlying social and behavioural determinants.

2. Methods

As part of the '*Local Health Inequalities in an Age of Austerity: The Stockton-on-Tees Study*', this paper presents the follow-up findings from a prospective 18-month cohort survey of mental health and wellbeing and the social and behavioural determinants of health, in the most and least deprived areas of the local authority. Stockton-on-Tees in the North East of England was chosen as the study site because it has the highest spatial health inequalities in England both for men (at a 17.3 year difference in life expectancy at birth between lower super output areas - LSOAs) and for women (11.4 year gap in life expectancy) (Public Health England, 2015). This makes it a particularly important site to analyse health inequalities during austerity. Stockton-on-Tees has a population of 191,600 residents (ONS, 2013). The population is overwhelmingly White (93.4%) although there is a small Asian/Asian British population (Indian 0.8%, Pakistani 1.6%, Bangladeshi 0.1%, Chinese 0.5%) (ONS, 2013). Stockton has high levels of social inequality, with some areas of the local authority with very low levels of deprivation (e.g. Ingleby Barwick) and others with high levels of deprivation (e.g. Town Centre). These areas are often in close proximity to one another. Deprivation overall is higher than the national average e.g. 21.9% of children live in poverty compared to 19.2% nationally (Public Health England, 2015).

2.1. Sampling and Data Collection

The baseline analysis and full details of the sampling technique are contained in Authors (2016). The survey used a random baseline sample of adults aged over 18, split between participants from the 20 most and 20 least deprived LSOAs of Stockton-on-Tees (derived using 2010 Index of Multiple Deprivation [IMD] scores for England). These are shown in Figure 1. LSOAs are small areas – 'neighbourhoods' - of relatively even size, with around 1500 people in each area; there are 32,484 LSOAs in England (Dept for Communities and Local Government, 2011). The IMD is a composite indicator that uses 38 separate indicators under seven distinct domains (Income, Employment, Health and Disability, Education Skills and Training, Barriers to Housing and Other Services, Crime and Living Environment). The IMD provides an overall score by drawing together weighted scores from each of these domains. The scores for each LSOA are then ranked so that there is a relative deprivation score for each LSOA in England, allowing different LSOAs to be compared (Dept for Communities and Local Government, 2011). It is the key measure to identify area level deprivation and its concentration in geographical units lower than local authorities in England (Payne and Abel 2012; Noble et al. 2006). Multistage sampling was used whereby 40 LSOAs were first grouped into the 20 most and 20 least deprived (IMD range 1.54-74.5). Within each group, a random sample of households (addresses) were selected and a single participant per household was determined using a household selection grid to ensure even distribution of age and gender (De Vaus, 1991).

20,013 eligible addresses and phone numbers were identified from the forty selected LSOAs, using the most recent Office for National Statistics (ONS) postcode lookup tables. The amount of eligible addresses ranged from 313 to 1380 addresses per LSOA. To meet the targeted number of 800 participants, 200 target households were randomly sampled in each of the 40 LSOAs assuming 90% non-response rate. The assumption of a 10% enrolment rate was because the survey used a postal initial recruitment approach and so response was expected to be lower than for other recruitment methods (Eriksen et al., 2011, Sinclair et al., 2012). A total of 8000 households (4000 each from the most and least

deprived LSOAs) were sent study invitation letters to obtain consent to participate in the study based on opt-in consenting approach. Participants were then surveyed four times over 18-months: April 2014 (baseline, wave 1, face-to-face), October 2014 (wave 2, telephone), April 2015 (wave 3, telephone) and October 2015 (wave 4, telephone). Only 2318 of the 8000 were contactable and a total of 836 participants completed the face-to-face baseline survey: 397 in the most deprived areas and 439 in the least deprived areas. This is a baseline response of 10% or 36% of contacted households (Authors, 2016). Attrition reduced the final wave 4 sample size to 310: 176 in the most deprived areas and 134 in the least deprived areas. This was only a 37% overall follow up rate but it fell within our original conservative power calculation (Authors, 2016). Full ethics was granted by [removed for anonymity] University ethics committee.

2.2. Outcome and Explanatory Measures

The questionnaires included questions on mental health, physical health, demographics and the social and behavioural determinants of health - reflecting the well-known theories of health inequalities. The main outcomes in this analysis are validated instruments of mental health: Warwick Edinburgh Mental Well Being Scale (WEMWBS) and the SF8. The primary explanatory variable is area-level deprivation ("Deprivation"), which takes value of 1 if a participant was from one of the twenty most deprived LSOAs and 0 if the participant was from one of the twenty least deprived LSOAs. Age and gender were used as controlled variables in the models, except where they were pre-defined. Other explanatory variables used included material factors (including measures of the physical environment [damp home, dark home, home is not warm enough in winter, problems with neighbourhood noise, problem with pollution and problems with crimes], educational status, housing tenure, household receipt of benefits, employment and household annual income), psychosocial factors (neighbourhood safety perception, lack of companionship, feeling left out and feeling isolated), and behavioural factors (smoking, alcohol consumption and physical exercise).

2.3. Statistical analysis

Descriptive analysis of the longitudinal data was done using summary statistics and visualisation aids. Continuous data were summarised using MEAN±SD, while the categorical variables were summarised using frequencies and percentages. The outcomes were analysed using linear mixed effects model (LMM) to account for correlation between the repeated observations per participant. All the analyses presented in this paper treated survey waves as a categorical variable and only random intercept is used in the linear mixed effect to capture intra-individual correlation. LMMs were fitted for the mental health outcomes with only the deprivation indicator and the waves as the predictor variables. Thereafter, an adjusted model was fitted for the association between mental health outcomes and the deprivation indicator by first including each of the explanatory covariates to the initial model and using likelihood ratio test statistics to test whether given the deprivation inequalities, the explanatory variable explains any residual variance in the mental health outcomes. This approach is similar to the univariate model building technique (Hosmer et al, 2013; Agresti, 2015), except that deprivation, age and gender and survey waves are included in each model in addition to each explanatory variable. The final most parsimonious model was obtained by combining all explanatory variables with either significant change over time or significant association with deprivation indicators. Likelihood ratio test was then used to remove redundant explanatory variable without substantial loss of information (Verbeke and Molenberghs, 2000).

2.4. Sensitivity Analyses

The survey participants are older than the general population and there is a higher representation of women (Authors, 2016). There is also considerable attrition over the four waves. So, even though the analysis adjusts for age and gender, a post-stratification

weighting scheme was devised and a sensitivity analysis was conducted using this weighted data (Lynn, 1996; Copas and Farewell, 1998; Spiess, 2005). A further challenge in the survey was item non-response where there were intermittent missing data in the explanatory variables. Additional analysis based on imputed data was therefore also conducted with each of the mental health outcomes and explanatory variables individually imputed, conditional on their baseline data, age and gender using the Markov Chain Monte Carlo (MCMC) method. The methods for the weighted LMM and MI are presented in Web Appendix 1.

3. Results

3.1. Demographic Characteristics

Table 1 shows the demographic characteristics of the cohort by wave and deprivation. At baseline, 27.5% of the participants in the most-deprived areas were aged 65 years or over, whilst 32.8% were in the least-deprived areas**.** In the later waves, the percentages of older participants tended to increase to 38.1% in the most deprived and 46.2% in the least deprived areas by wave 4. There were more women than men participating in the study – although this did not increase substantially over the four waves: from 57% to 59% in the most deprived areas and from 59% to 61% for the least deprived. Throughout the study, the proportions of single participants were much higher in the most deprived areas (35% to 39%) compared to the least deprived areas (11% to 17%).

3.2. Inequalities in Mental Health and Wellbeing

Table 2 provides the mental health scores for SF8MCS and WEMWBS by deprivation level for each wave. The average change in both mental health outcomes are also plotted overtime in Figure 2. These show that the average SF8MCS and WEMWBS scores for both the most and least deprived areas do not increase significantly or linearly over time and there is no increase in the mental health gap between the two types of areas over the four

waves. The significant inequalities in mental health scores between the least and most deprived areas detected at baseline (Authors, 2016) did not change over the following 18 months.

The results from the LMMs are presented in Table 3. In keeping with the visualisation of the average scores in Figure 2, the results show that the gap in mental health and wellbeing did not change during the 18-month study period. The average difference between the most and least deprived areas for both the SF8MCS and WEMWBS at Wave 1 are not statistically different from the mean difference between the most and least deprived areas at Wave 2 (effect estimates: SF8MCS -0.45; -2.05, 1.14; WEMWBS -0.21, -1.85, 1.43), Wave 3 (SF8MCS -0.18; -1.90, 1.53; WEMWBS -1.12, -3.71, 1.48) or Wave 4 (SF8MCS -0.50; -2.36, 1.36; WEMWBS -0.87, -1.16, 2.90). In general, the average mental health and wellbeing scores are constant over the study period in both the most and least deprived areas. However, the results show that people living in the most deprived areas have statistically significantly lower mental health and wellbeing scores than those living in the least deprived areas across all waves. Sensitively analyses of the data applying weights (weighted LMM) and multiple imputations (MI) resulted in similar findings as analysing the data without weighting (LMM).

3.3. Material, Psychosocial and Behavioural Factors

Tables 4-6 show the material, psychosocial and behavioural factors by wave and deprivation. Table 4 shows very large differences at all waves in material factors between people living in the most and the least deprived areas in terms of the majority of social, economic and physical environment variables. Differences in terms of benefit receipt and a warm house were smaller though – perhaps because pensions are a universal benefit and an additional winter fuel allowance is also provided to all pensioners. Table 5 shows similarly large and constant differences across waves in the psychosocial factors – these were largely better in the least deprived areas than the most deprived with the exception of having a

social meeting everyday which was more common in the most deprived areas but average happiness score remained roughly 0.4-0.5 lower than those living in least deprived areas. In terms of the behavioural factors, Table 6 shows that alcohol consumption was much lower and daily exercise (which included walking) was a little higher amongst participants in the most deprived areas. On average, fruit and vegetable consumption was one portion per day higher in the least deprived areas whilst smoking was more than 20 percentage points higher in the most deprived areas. These behavioural patterns remained fairly static across the four waves.

A parsimonious LMM was fitted for each of the mental health outcomes to see if there were any changes over time in the associations with material, psychosocial and behavioural factors. A likelihood ratio test was used to remove redundant factors without significant loss of information. The most parsimonious model for SF8MCS and WEMWBS are respectively presented in Tables 7 and 8. These show firstly that a significant difference in mental health and wellbeing between the most and least deprived areas at each wave remained even after adjusting for the material, psychosocial and behavioural explanatory factors. However, again, there was still no significant change in the size of the area gaps in SF8MCS and WEMWBS. Secondly, there were also no significant changes in which factors were most associated with the mental health outcomes. In keeping with our baseline results, material and psychosocial factors remained the most significant (Authors, 2016). Participants who lived in accommodation with at least one dark room, those who more often felt lack of companion, felt left out and felt isolated had worse SF8MCS scores than those with no dark room or who hardly left lack of companionship, left out or isolated. Happiness, being in employment and alcohol use remained positively associated with SF8MCS scores. The happier a participant was, the better is their SF8MCS score and those in employment had better mental health score than those unemployed. The results from the analysis of WEMWBS are consistent with the results from SF8MCS. Additionally, participants who felt very safe whilst walking in the neighbourhood had better WEMWBS score than those who

felt unsafe. Those who regularly do physical activity also had better WEMWBS scores than those that rarely do exercise; and smokers had worst scores than non-smokers.

4. Discussion

This study set out to longitudinally explore local inequalities in mental health and wellbeing during austerity and to examine any changes in the social and behavioural *pathways* potentially linking austerity with health. It has found a large mental health gap between the least and most deprived neighbourhoods of the case study site, Stockton on Tees - but no change in the gap over time. It also found no changes in terms of the social and behavioural determinants of health – the *pathways* linking austerity and mental health. These findings are in contrast to other research - both in the UK and internationally - into the health impacts of austerity and associated welfare reform and public service budget reductions. For example, Barr et al (2015a) suggest that geographical inequalities in mental health and wellbeing in the UK increased after austerity and that people living in more deprived areas experienced a larger increase in poor mental health (Barr et al, 2015b) and self-harm (Barnes et al, 2016). Similarly, qualitative research with people with existing mental health conditions also found that austerity exacerbated their situation (Authors, 2018). Internationally, Karanikolos et al. (2013), Stuckler and Basu (2013), Niedzwiedz et al (2016) and Helliwell et al, (2017) also found that weakened social protection systems adversely effected mental health in Europe, particularly amongst the most disadvantaged social groups.

There are several potential explanations for the differences between the results presented in this paper and the wider literature. Firstly, this study found no changes in the underpinning *pathways*. Using the social determinants of health framework, a change in mental health would need to be precipitated by a change in the social conditions in which people are living

or their health behaviours (Smith et al, 2016). On this basis then, it is not surprising that no change in the mental health gap was detected in the survey as there was no change in the underlying causal *pathways*. Further, there was already a big mental health gap at baseline and people in the most deprived neighbourhoods were already living in very difficult circumstances so there may not have been much further potential for deterioration.

Secondly, the follow-up length and timing of the study might also be factors behind our potentially anomalous findings. The survey only had an 18-month follow-up and, whilst mental health is a fairly responsive and sensitive indicator, this still might not have been long enough to detect changes either in the underpinning pathways or the mental health outcomes themselves. For example, this means that there was little time for any significant changes in area characteristics to occur or to impact on health outcomes (Norman, 2018). Further, the timing of the baseline survey (in 2014) was in a period *after* the economic recession and *after* some austerity measures had already been implemented (Authors, 2015). Indeed, by way of example, the unemployment rate in Stockton on Tees peaked in 2013 and then rapidly improved, returning to pre-recession levels by 2016 (Public Health England, 2017). In terms of austerity measures, the Household Benefit Cap, the Under Occupancy Charge (better known as the 'bedroom tax', and various other welfare restrictions were all introduced by 2013 (for an austerity timeline see Authors, 2016). This means that an austerity- or recession-related deterioration in mental health - as expected by the wider literature - may have already occurred before the baseline was conducted. Our original intention was to have a longer follow-up period but the high-level of attrition meant that in order to maintain power, we had to prematurely end data collection.

Thirdly, the nature of the survey sample may also be an issue. We focused on the two extremes - the most and least deprived neighbourhoods. This means that we may have missed any impacts on mental health of those in the middle of the socio-spatial gradient (the so called 'squeezed middle') such as people who lost access to working tax credits or child

benefit payments suffered unemployment wage reductions. Participants in both types of neighbourhood were also generally older than the general population of Stockton on Tees. This is potentially significant as austerity measures particularly with regards to welfare reform, were targeted at working age people as well as children. Pensioners were largely protected (with the exception of reductions in social care which impacted most on the very old >85 years, Hiam et al, 2017). Most notably, the universal state pension and other universal allowances for the elderly such as the winter fuel allowance (Green et al, 2017) were either left untouched during austerity or were enhanced (e.g. the pensions 'Triple Lock') whilst working age and child related benefits were cut (Green et al, 2017). Arguably then, the survey findings presented in this paper are actually in keeping with the wider literature as the fact that the gap in mental health amongst an older group did not change over time potentially shows the importance of maintaining social safety nets. This is in keeping with other studies of the importance of pensions for health and health inequalities including pan-European research by Lundberg and colleagues (2008) who found that increased expenditure on pensions improved older age mortality; Authors (2015) who highlighted the importance of pensions for post-65 life expectancy; and Copeland et al who noted the importance of social safety nets for stabilising health inequalities during times of recession.

5. Limitations

The study is subject to a number of important limitations. The baseline sample size was moderate (although within power calculations) and the response rate was low with only c36% of contacted households (and only c10% of all of our 8000 sampling frame) participating in the survey. The survey also experienced high attrition with only 37% in the final wave (Authors, 2017). This may undermine the representativeness of the cohort sample and indeed, older people and women were over represented compared to the general population. Whilst models were adjusted and a weighted sensitivity analysis was conducted - these factors may still effect the generalisability of the findings. There is also the strong

possibility of a 'healthy responder effect', whereby people with health problems are less likely to respond to research requests. This may also have resulted in selective recruitment and attrition rates. Sensitivity analysis using multiple imputation was used but the findings should still be interpreted with a certain amount of caution. The survey sample was though a static population with evidence of ageing in place – perhaps a side-effect of being an older sample (Norman, 2018). The survey also relies on self-reported health measures which may have limited precision and reliability (although there is a strong association between self-reported health and more objective outcomes including mortality, see Authors, 2007). Finally, this study relates only to just one place – Stockton-on-Tees. This local authority has the highest gap in life expectancy between people the most and least deprived areas in the whole of England and the results may not be generalisable to other places.

6. Conclusion

This study makes an important contribution to the ongoing international scholarly debate about the effects of austerity on geographical inequalities in health. Using a detailed longitudinal survey of a random stratified sample of individuals living in the most and least deprived neighbourhoods of Stockton on Tees, it found a significant mental health gap but no changes in this gap over an 18-month period in which the UK experienced austerity. The age distribution of the sample may be an important factor behind why there were no changes in inequalities in mental health detected, as older people were largely exempted from welfare reform. The study therefore potentially provides further empirical evidence to support assertions that social safety nets matter particularly in times of economic upheaval. However, study limitations mean that the findings should be interpreted with some caution.

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Conflict of Interest

The authors have no conflict of interest regarding the publication of this article.

Ethical approval:

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References

Agresti, A. (2015). Foundations of linear and generalized linear models (Wiley series in probability and statistics). New Jersey: John Wiley & Sons.

Authors (2007). The utility of medically certified sickness absence as an updatable indicator of population health. *Population, Space and Place*, 13: 333-352.

Authors (2011). Work, Worklessness and the Political Economy of Health. Oxford: Oxford University Press.

Authors (2015). Austerity, welfare reform and the English health divide. *Area,* 47.3: 341–343, doi: 10.1111/area.12191

Authors (2015). Chapter 12: All in it together? Health Inequalities, Welfare Austerity and the 'Great Recession' in Smith, KE., Hill, S. and Bambra, C. (eds) Health Inequalities: Critical Perspectives. OUP 2016.

Authors (2015). How Politics Makes Us Sick – Neoliberal Epidemics. London: Palgrave Macmillan.

Authors (2016). Shorter lives in stingier states: Social policy shortcomings help explain the US mortality disadvantage. *Social Science and Medicine,* 170: 30-38.

Authors (2016). Inequalities in Mental Health in a Time of Austerity: Baseline findings from the Stockton on Tees Cohort Study. *SSM Population Health*, 2: 350–359.

Authors (2016). Health Divides: where you live can kill you, Bristol: Policy Press.

Authors (2016). Recommodification, Unemployment, and Health Inequalities: Trends in England and Sweden 1991-2011. *International Journal of Health Services*, 46: 300-324.

Authors (2017). Geographical inequalities in general and physical health in a time of austerity: Baseline findings from the Stockton-on-Tees cohort study. *Health and Place,* 48: 111–122.

Authors (2018). 'Treading in sand': a qualitative study of the impact of austerity on inequalities in mental health. *Social Policy and Administration,* https://doi.org/10.1111/spol.12348.

Beatty, C. and Fothergill, S. (2014). *The local and regional impact of the UK's welfare reforms. Cambridge Journal of Regions Economy and Society*, 7: p. 63-79.

Barnes, M.C., Gunnell, D., Davies, R., Hawton, K., Kapur, N., Potokar, J., and Donovan, J.L. (2016). Understanding vulnerability to self-harm in times of economic hardship and austerity: a qualitative study. *BMJ Open,* 6:e010131.

Barnes, M.C., Donovan, J.L., Wilson, C., Chatwin, J., Davies, R., Potokar, J., et al. (2017). Seeking help in times of economic hardship: access, experiences of services and unmet need. *BMC Psychiatry*, 17: 84.

Barr, B, Kinderman, P, and Whitehead, P. (2015a). Trends in mental health inequalities in England during a period of recession, austerity and welfare reform 2004-2013. *Social Science and Medicine,* 147: 324-331.

Barr, B, Taylor-Robinson, D, Stuckler, D, Loodstra, R, Reeves, A, Whitehead, M (2015b). 'First, do no harm': are disability assessments associated with adverse trends in mental health? A longitudinal ecological study. *Journal of Epidemiology and Community Health*, 0: 1-7.

Bartley, M. (2016). Health Inequality: An introduction to theories, concepts and methods. Cambridge: Polity Press.

Basu, S., Carney, M. A., & Kenworthy, N. J. (2017). Ten years after the financial crisis: The long reach of austerity and its global impacts on health. *Social Science & Medicine*, 187: 203-207, doi:https://doi.org/10.1016/j.socscimed.2017.06.026.

Beatty, C. and Fothergill, S. (2016). The uneven impact of welfare reform. The financial losses to places and people. Centre for Regional Economic and Social Research, Sheffield Hallam University. http://www.shu.ac.uk/research/cresr/sites/shu.ac.uk/files/welfare-reform-2016_1.pdf [accessed 21/3/18]

Browne, J. and Levell, P. (2010). The Distributional Effect of Tax and Benefit Reforms to Be Introduced between June 2010 and April 2014: A Revised Assessment. London: Institute for Fiscal Studies.

Cairns, J.M., Graham, E. and Bambra C. (2017). Area-level socioeconomic disadvantage and suicidal behaviour in Europe: a systematic review. *Social Science & Medicine*, 192: 102-111.

Copas, A. J., & Farewell, V. T. (1998). Dealing with non-ignorable non-response by using an 'enthusiasm-to-respond'variable. *Journal of the Royal Statistical Society: Series A* (*Statistics in Society*), 161(3): 385-396.

Copeland, A., Bambra, C., Nylen, L., Kasim, A.S., Riva, M., Curtis, S., and Burstrom, B. (2015). All in it together? The effects of recession on population health and health inequalities in England and Sweden, 1991 to 2010. *International Journal of Health Services*, 45 (1): 3-24.

Corcoran, P., Griffin, E., Arensman, E., Fitzgerald, A.P., & Perry, I.J. (2015). Impact of the economic recession and subsequent austerity on suicide and self-harm in Ireland: An interrupted time series analysis. *International Journal of Epidemiology*, 44: 969-977.

Dept for Communities and Local Government (2011). English Indices of Deprivation 2010 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6871/1871208.pdf [accessed 12.10.2015]

De Vaus, D.A., (1991). Surveys in social research. London, UK: UCL Press Ltd.

Eriksen, L., Gronbael, M., Helge, J.W., Tolstrup, J.S., and Curtis, T. (2011). The Danish Health Examination Survey 2007-2008 (DANHES 2007-2008). *Scandinavian Journal of Public Health*, 39: 203-11.

Gamble, A. (2009). The spectre at the feast: capitalist crisis and the politics of recession. Basingstoke: Palgrave.

Green, J.M., Buckner, S., Milton, S., Powell, K., Salway, S. & Moffatt, S. (2017). A model of how targeted and universal welfare entitlements impact on material, psycho-social and structural determinants of health in older adults. *Social Science & Medicine*, 187: 20-28.

Hawton, K., Bergen, H., & Geulayov, G. (2016). Impact of the recent recession on self-harm: a longitudinal ecologic and patient level investigation from multicentre study of self-harm in England. *Journal of Affective Disorder*, 191, doi:10.1016/j.jad.2015.11.001.

Hiam, L., Dorling, D., Harrison, D., and McKee, M. (2017). Why has mortality in England and Wales been increasing? An iterative demographic analysis. *Journal of the Royal Society of Medicine*, 110: 153-162.

Helliwell, J.F., Huang, H., & Wang, S. (2017). The Social Foundations of World Happiness. World Happiness Report 2017, 8.

Hosmer, D.W., Lemeshow, S., & Sturdivant, R. (2013). Applied logistic regression (Third edition / ed., Vol. 398, Wiley series in probability and statistics). London: John Wiley & Sons.

Karanikolos, M., Mladovsky, P., Cylus, J., Thomson, S., Basu, S., Stuckler, D., et al. (2013). Financial crisis, austerity, and health in Europe. *The Lancet*, 381(9874): 1323-1331.

Kitson, M., Martin, R., and Tyler, P. (2011). The geographies of austerity. *Cambridge Journal of Regions, Economy and Society,* 4: 289-302.

Kokkinen, L., Muntaner, C., Kouvonen, A.*, et al.* (2015). Welfare state retrenchment and increasing mental health inequality by educational credentials in Finland: a multicohort study, *BMJ Open,* 2015, 5:e007297. doi: 10.1136/bmjopen-2014-007297.

Lundberg, O., Yngwe, M., Kölegård Stjärne, M., Elstad, J., Ferrarini, T., Kangas, O. (2008). The role of welfare state principles and generosity in social policy programmes for public health: an international comparative study. *The Lancet,* 372: 1633–40.

Lynn, P. (1996). Weighting for non-response. *Survey and statistical computing*, 205-214.

Marmot, M. and Wilkinson, R. (2005). *Social Determinants of Health*. Oxford: Oxford University Press.

Moffatt, S., Lawson, S., Patterson, R., Holding, E., Dennison, A., Sowden, S., Brown, J. (2016). A qualitative study of the impact of the UK 'bedroom tax. *Journal of Public Health*, 38: 197–205.

Niedzwiedz, C.L. Mitchell, R.J., Shortt, N.K. & Pearce, J.R. (2016). Social protection spending and inequalities in depressive symptoms across Europe. *Social Psychiatry and Psychiatric Epidemiology*, pp. 1-10.

Noble, M., Wright, G., Smith, G., & Dibben, C. (2006). Measuring multiple deprivation at the small-area level. *Environment and planning A*, 38(1): 169-185.

Norman P (2018). Clarity in research frameworks for studying 'health selective migration'. Commentary in *Journal of Epidemiology & Community Health.* DOI:10.1136/jech-2018-210678 .

ONS – Office for National Statistics (2013). Usual resident population. https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates [accessed 21/3/2018].

ONS - Office for National Statistics (2014). Disability-Free Life Expectancy (DFLE) and Life Expectancy (LE) at birth by Upper Tier Local Authority at birth, England. https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandlifeexpectancies/bulletins/disabilityfreelifeexpectancybyuppertierlocalauthority/england2012to2014 [accessed 21/2/2018].

Payne, R.A., & Abel, G.A. (2012). UK indices of multiple deprivation-a way to make comparisons across constituent countries easier. *Health Statistics Quarterly, 4 (13.5)*: 13-5.

Pearce, J. (2013). Commentary: Financial crisis, austerity policies, and geographical inequalities in health'. *Environment and Planning A*, 45: 2030-2045.

Public Health England (2015). Stockton-on-Tees Health Profile 2015. APHO http://www.apho.org.uk/resource/item.aspx?RID=50336 [accessed 1.10.17].

Public Health England (2017). Stockton-on-Tees Health Profile 2017. https://fingertips.phe.org.uk/search/employment#page/4/gid/1/pat/6/par/E12000001/ati/101/are/E06000004/iid/91126/age/164/sex/4 [accessed 3.10.17].

Reeves, A., Basu, S., McKee, M., Marmot, M., & Stuckler, D. (2013). Austere or not? UK coalition government budgets and health inequalities. *Journal of the Royal Society of Medicine*, 106(11): 432-436, doi:10.1177/0141076813501101.

Sinclair, M., O'Toole, J., Malawararachchi, M. And Leder. K. (2012). Comparison of response rates and cost-effectiveness for a community-based survey: postal, internet and telephone modes with generic or personalised recruitment approaches. *BMC Medical Research Methodology*, 12: 132.

Skalická, V., Lenthe, F., Bambra, C., Krokstad, S., and Mackenbach J. (2009). Material, psychosocial, behavioural and biomedical factors in the explanation of socio-economic inequalities in mortality: evidence from the HUNT study. *International Journal of Epidemiology*, 38:1272–1284.

Smith, KE., Hill, S., and Bambra, C. (eds) (2016). *Health Inequalities: Critical Perspectives,* Oxford: Oxford University Press.

Spiess, M. (2005). Derivation of design weights: The case of the German socio-economic panel (SOEP). Data Documentation.

Stuckler, D and Basu, S. (2013). The Body Economic. Why Austerity Kills. London: Thomas Allen.

Verbeke, G., & Molenberghs, G. (2000). Linear mixed models for longitudinal data. (pp. 240-268). New York: Springer-Verlag.

Vizard, P., & Obolenskaya, P. (2015). The Coalition's Record on Health: Policy, Spending and Outcomes 2010-2015. Social Policy in a Cold Climate Working Paper, 16.

WHO and Calouste Foundation (2014). *Social Determinants of Mental Health*. Geneva: WHO.

Figure 1: Maps of Stockton-on-Tees including the most and least deprived neighbourhoods used in the survey

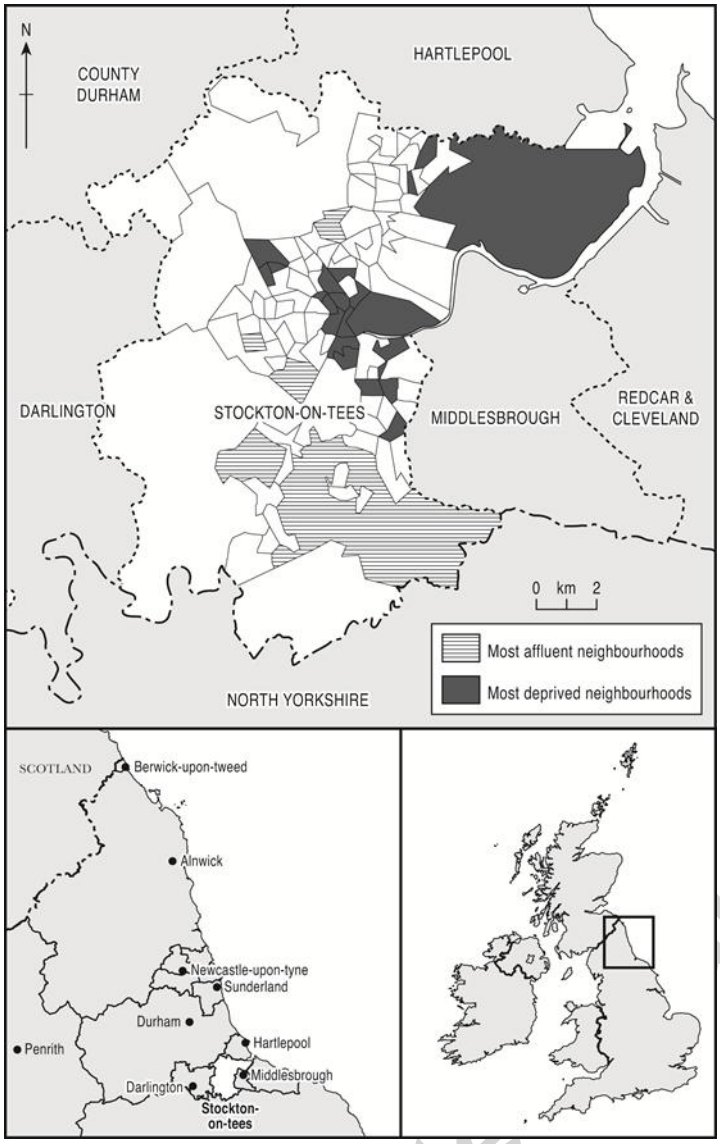

Figure 2: Mean Warwick Edinburgh Mental Wellbeing Score (WEMWBS) and SF8 Mental Component Summary scores (SF8MCS) by deprivation and across waves

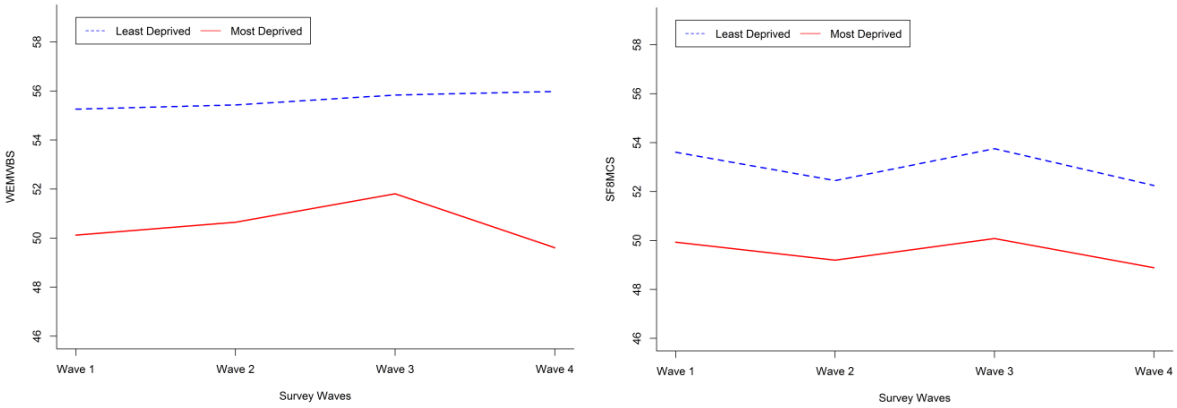

Table 1: Summary statistics (%, n/N) for demographic indicators across waves and by deprivation

	Variable	Wave1	Wave2	Wave3	Wave4
Most deprived	Age >=65 (%)	27.5 (109/ 397)	33.6 (77/ 229)	35.3 (77/ 218)	38.1 (67/ 176)
	Female (%)	59.4 (236/ 397)	57.2 (131/ 229)	57.8 (126/ 218)	56.8 (100/ 176)
	Single (%)	39.0 (155/ 397)	28.8 (66/ 229)	28.4 (62/ 218)	25.0 (44/ 221)
Least deprived	Age >=65 (%)	32.8 (144/ 439)	40.6 (116/ 286)	43.2 (112/ 259)	46.2 (108/ 234)
	Female (%)	58.8 (258/ 439)	60.8 (174/ 286)	61.5 (160/ 260)	60.3 (141/ 234)
	Single (%)	17.3 (76/ 439)	14.0 (40/ 286)	12.7 (33/ 260)	10.7 (25/ 234)

Table 2: Summary statistics for mental health outcomes (Mean, standard deviation) by deprivation and across waves

	Variable	Wave1	Wave2	Wave3	Wave4
Most deprived	SF8MC (Mean, SD)	49.5 ± 11.8	49.4 ± 10.8	49.7 ± 10.7	48.7 ± 11.0
	WEMWBS (Mean, SD)	49.7 ± 12.6	50.6 ± 11.6	51.7 ± 11.5 (218)	50.1 ± 12.5
Least deprived	SF8MCS (Mean, SD)	53.5 ± 8.4	52.4 ± 9.0	53.7 ± 7.7	52.2 ± 8.5
	WEMWBS (Mean, SD)	54.8 ± 10.2	55.3 ± 9.2	55.8 ± 11.1	55.8 ± 9.7

Table 3: Association with time and deprivation for SF8 Mental Component (SF8MC) score and Warwick Edinburgh Mental Wellbeing Score (WEMWBS) by deprivation and across waves

		SF8MCs			WEMWBS		
Effects	**Time**	**Linear Mixed Model (LMM)**	**Weighted LMM**	**Multiple Imputations LMM**	**Linear Mixed Model (LMM)**	**Weighted LMM**	**Multiple Imputations LMM**
Intercept		52.09 (49.80, 54.37)	52.92 (51.01, 54.84)	51.36 (49.15, 53.56)	50.32 (47.98,52.66)	51.93 (50.00, 53.97)	49.61 (47.08, 52.14)
Age		-0.02 (-0.05, 0.02)	-0.06 (-0.09, -0.02)	0.00 (-0.4, 0.03)	0.00 (-0.04, 0.04)	-0.05 (-0.08, -0.01)	0.02 (-0.03, 0.06)
Gender	Female	-2.30 (-3.56, -1.04)	-0.54 (-1.76, 0.67)	-2.37 (-3.71, -1.04)	-0.39 (-1.62, 0.84)	0.24 (-0.98, 1.46)	-0.52 (-1.80, 0.76)
	Male	**Ref**	**Ref**	**Ref**	**Ref**	**Ref**	**Ref**
Time	Wave 4	-1.07 (-2.47, 0.32)	-1.23 (-2.57, 0.10)	-1.37 (-2.81, 0.06)	-0.53 (-2.06, 0.99)	-1.48 (-3.01, 0.05)	-1.16 (-2.95, 0.62)
	Wave 3	0.19 (-1.07, 1.45)	-0.67 (-1.97, 0.62)	0.11 (-1.02, 1.25)	1.69 (-0.22, 3.60)	1.92 (0.06, 3.78)	1.79 (-0.13, 3.71)
	Wave 2	-0.55 (-1.73, 0.64)	-1.36 (-2.57, -0.15)	-0.80 (-2.01, 0.410)	0.37 (-0.85, 1.59)	0.14 (-1.13, 1.40)	0.09 (-1.47, 1.65)
	Wave 1	**Ref**	**Ref**	**Ref**	**Ref**	**Ref**	**Ref**
Deprived	Least deprived	3.71 (2.26, 5.15)	4.43 (3.04, 5.82)	3.64 (2.21, 5.06)	5.16 (3.55, 6.77)	6.1 (4.49, 7.71)	5.10 (3.47, 6.73)
	Most deprived	**Ref**	**Ref**	**Ref**	**Ref**	**Ref**	**Ref**
Time* Deprivation	Least deprived, Wave 4	-0.50 (-2.36, 1.36)	-0.82 (-2.67, 1.02)	-0.14 (-2.09, 1.81)	0.87 (-1.16, 2.90)	1.48 (-0.64, 3.61)	1.35 (-0.86, 3.56)
	Least deprived, Wave 3	-0.18 (-1.90, 1.53)	0.53 (-1.27, 2.34)	0.10 (-1.47, 1.67)	-1.12 (-3.71, 1.48)	0.14 (-2.46, 2.74)	-0.85 (-3.67, 1.97)
	Least deprived, Wave 2	-0.45 (-2.05, 1.14)	-0.03 (-1.74, 1.67)	-0.23 (-1.87, 1.41)	-0.21 (-1.85, 1.43)	-0.24 (-2.02, 1.54)	-0.10 (-2.38, 2.19)
	Most deprived, Wave 1	**Ref**	**Ref**	**Ref**	**Ref**	**Ref**	**Ref**

Table 4: Summary statistics (%, n/N and median) for material factors across waves and by deprivation

	Variable	Wave1	Wave2	Wave3	Wave4
Most deprived	No formal education	46.7(185/396)	46.1(105/228)	46.1(100/217)	46.0(81/176)
	Tenure-Rent	72.0(286/397)	66.8(153/229)	65.7(132/201)	64.1(109/170)
	Annual income*	£26916 (377)	£29716 (222)	£30657 (208)	£33413 (170)
	Benefit	88.2 (350/ 397)	83.0 (190/ 229)	83.0 (181/ 218)	81.8 (144/ 176)
	Housing benefit	54.7(217/397)	38.4(88/229)	46.8(102/218)	41.5 (73/176)
	Workless household	67.8 (269/ 397)	-	-	-
	Employed	23.9 (95/ 397)	25.8 (59/ 229)	26.6 (58/ 218)	26.1 (46/ 176)
	Dark	18.1 (72/ 397)	18.3 (42/ 229)	19.9 (40/ 201)	6.8 (12/ 176)
	Damp	25.4 (101/ 397)	21.8 (50/ 229)	18.9 (38/ 201)	13.6 (24/ 176)
	Warmth	80.3 (318/ 396)	78.2 (179/ 229)	76.6 (154/ 201)	86.9 (153/ 176)
	Noise	22.9 (91/ 397)	22.7 (52/ 229)	20.4 (41/ 201)	17.6 (31/ 176)
	Pollution	13.1 (52/ 397)	14.8 (34/ 229)	13.9 (28/ 201)	12.5 (22/ 176)
	Crime	28.0 (111/ 397)	31.9 (73/ 229)	31.3 (63/ 201)	24.4 (43/176)
Least deprived	No formal education	24.1 (106/ 439)	22.0 (63/ 286)	21.9 (57/ 260)	21.8 (51/ 234)
	Tenure-rent	11.6 (51/ 439)	8.7 (25/ 286)	8.5 (22/ 260)	6.4 (15/ 234)
	Annual income*	£110,173 (388)	£111,990 (258)	£106,268 (238)	£94,603 (215)
	Benefit	70.4 (309/ 439)	66.8 (191/ 286)	71.9 (187/ 260)	72.6 (170/ 234)
	Housing benefit	4.1 (18/ 439)	3.1 (9/ 286)	2.7 (7/ 260)	1.3 (3/ 234)
	Workless household	36.7 (161/ 439)	-	-	-
	Employed	46.9 (206/ 439)	39.9 (114/ 286)	40.4 (105/ 260)	38.5 (90/ 234)
	Dark	9.3 (41/ 439)	8.4 (24/ 286)	9.2 (24/ 260)	2.1 (5/ 234)
	Damp	2.3 (10/ 438)	1.4 (4/ 285)	0.8 (2/ 259)	0.9 (2/ 234)
	Warmth	93.4 (410/ 439)	89.9 (257/ 286)	85.4 (222/ 260)	97.4 (228/ 234)
	Noise	10.5 (46/ 439)	11.5 (33/ 286)	10.8 (28/ 260)	6.0 (14/ 234)
	Pollution	3.4 (15/ 439)	4.5 (13/ 286)	4.2 (11/ 260)	1.7 (4/ 234)
	Crime	6.4 (28/ 439)	6.3 (18/ 286)	6.5 (17/ 260)	5.1 (12/ 234)

*Median income

Table 5: Summary statistics (%, n/N or Mean, standard deviation) for psychosocial factors across waves and by deprivation

	Variable	Wave1	Wave2	Wave3	Wave4
Most deprived	Often lack companion	12.1 (48, 397)	14.1 (33, 229)	15.1 (33/ 218)	10.2 (18, 176)
	Often felt left out	11.1 (44, 397)	10.9 (25, 229)	8.7 (19, 218)	8.0 (14, 176)
	Often felt isolated	11.8 (47, 397)	11.8 (27, 229)	10.6 (23, 218)	10.8 (19, 176)
	Social meeting (everyday)	24.7 (98/ 397)	21.0 (48/ 229)	22.5 (49/ 218)	13.1 (23/ 176)
	Safety -unsafe	34.0(130/382)	35.7(79/221)	34.8(73/210)	25.6(40/156)
	Happiness	7.4±2.1	7.4±2.0	7.4±2.0	7.5±1.9
Least deprived	Often lack companion	6.4 (28, 438)	8.0 (23, 286)	6.9 (18, 260)	4.7 (11, 234)
	Often felt left out	3.9 (17, 438)	2.8 (8, 286)	2.7 (7, 260)	3.0 (7, 234)
	Often felt isolated	4.1 (18, 438)	3.8 (11, 286)	2.7 (7, 260)	4.3 (10, 234)

	Social meeting (everyday)	15.3 (67/ 438)	15.4 (44/ 286)	14.6 (38/ 260)	9.0 (21/ 234)
	Safety -unsafe	2.7(29/435)	6.4(18/283)	6.6(17/258)	7.6(17/225)
	Happiness	7.9±1.6	7.8±1.5	7.9±1.4	8.0±1.4

Table 6: Summary statistics (%, n/mean, SD) for behavioural factors across waves and by deprivation

	Variable	Wave1	Wave2	Wave3	Wave4
Most Deprived	Drink alcohol	57.2 (227/ 397)	41.0 (94/ 229)	41.7 (91/ 218)	50.6 (89/ 176)
	Exercise everyday	34.5 (137/ 397)	41.5 (95/ 229)	45.0 (98/ 218)	31.8 (56/ 176)
	Fruits & Veg	2.9±2.0	2.9±2.1	2.9±2.0	2.9±1..9
	Smoking	36.8 (146, 3970	28.8 (66, 229)	28.0 (61, 218)	25.6 (45, 176)
Least Deprived	Drink alcohol	75.9 (333/ 439)	67.1 (192/ 286)	65.0 (169/ 260)	70.1 (164/ 234)
	Exercise	28.9 (127/ 439)	31.1 (89/ 286)	34.2 (89/ 260)	28.6 (67/ 234)
	Fruits & Veg portion	4.0±2.0	3.8±1.8	3.8±1.8	3.9±1.8
	Smoking	9.8 (43, 439)	7.0 (20, 286)	7.7 (20, 260)	5.6 (13, 234)

Table 7: Multivariate analysis of SF8 Mental Component Summary (SF8MCS) by deprivation and across waves

Effects	Levels	Linear Mixed Model (LMM)	Weighted LMM	Multiple Imputations LMM
Intercept		42.42 (38.86, 45.99)	43.88 (40.58, 47.18)	26.37 (23.48, 29.27)
Age		0.02 (-0.01, 0.05)	0.00 (-0.03, 0.02)	0.00 (-0.03, 0.02)
Gender	Female	-1.23 (-2.18, -0.28)	-0.46 (-1.38, 0.45)	-1.79 (-2.70, -0.88)
	Male	**Ref**	**Ref**	**Ref**
Time	Wave 4	-1.45 (-2.85, -0.05)	-2.00 (-3.32, -0.67)	-1.40 (-2.46, -0.35)
	Wave 3	0.10 (-1.18, 1.37)	-0.23 (-1.44, 0.97)	0.12 (-0.88, 1.13)
	Wave 2	-0.35 (-1.61, 0.91)	-1.47 (-2.74, -0.20)	-0.78 (-1.79, 0.22)
	Wave 1	**Ref**	**Ref**	**Ref**
Deprivation	Least deprived	1.63 (-0.14, 3.40)	1.62 (-0.12, 3.37)	1.07 (-0.58, 2.71)
	Most deprived	**Ref**	**Ref**	**Ref**
Deprivation * time	Least, Wave 4	-0.11 (-1.90, 1.68)	0.05 (-1.70, 1.80)	-0.29 (-1.69, 1.11)
	Least, Wave 3	0.04 (-1.57, 1.65)	0.33 (-1.25, 1.91)	0.17 (-1.12, 1.46)
	Least, Wave 2	-0.64 (-2.26, 0.97)	-0.11 (-1.81, 1.58)	0.10 (-1.24, 1.43)
	Most, Wave 1	**Ref**	**Ref**	**Ref**
Employment		1.61 (0.58, 2.65)	2.40 (1.45, 3.35)	1.54 (0.51, 2.58)
Income		0.03 (-0.07, 0.13)	0.00 (-0.09, 0.09)	0.03 (-0.05, 0.11)
Dark		-2.65 (-4.36, -0.94)	-2.03 (-3.65, -0.40)	-2.22 (-3.94, -0.49)
Dark *time	Wave 4	-3.87 (-7.86, 0.13)	-2.87 (-6.90, 1.17)	0.54 (-2.16, 3.24)
	Wave 3	2.13 (-0.21, 4.48)	3.19 (0.90, 5.47)	1.76 (-0.21, 3.74)
	Wave 2	1.48 (-0.91, 3.88)	2.31 (-0.20, 4.83)	1.37 (-0.58, 3.32)
	Wave 1	**Ref**	**Ref**	**Ref**
Lack of companion		-1.32 (-2.03, -0.61)	-1.51 (-2.22, -0.80)	-0.33 (-0.90, 0.24)
Feeling left out		-1.50 (-2.33, -0.67)	-1.64 (-2.45, -0.84)	-0.46 (-1.18, 0.26)
Feeling isolated		-1.88 (-2.70, -1.07)	-2.19 (-2.96, -1.41)	-0.40 (-1.03, 0.24)
Happiness scale		1.89 (1.64, 2.13)	1.87 (1.62, 2.11)	3.51 (3.31, 3.71)
Safety perception		-0.83 (-.34, -0.31)	-0.84 (-1.35, -0.33)	-0.24 (-0.60, 0.13)
Alcohol use		2.28 (1.13, 3.44)	1.67 (0.60, 2.74)	1.12 (0.17, 2.07))
Alcohol use* deprivation	Least deprived	-2.30 (-3.94, -0.67)	-2.25 (-3.85, -0.65)	-0.81 (-2.15, 0.54)
	Most deprived	**Ref**	**Ref**	**Ref**
Intake of fruit-veg		0.06 (-0.14, 0.26)	0.26 (-3.85, -0.65)	0.04 (-0.13, 0.21)

Table 8: Multivariate analysis of Warwick Edinburgh Mental Wellbeing Score (WEMWBS) by deprivation and across waves

Effects	Levels	Linear Mixed Model (LMM)	Weighted LMM	Mixed Imputation LMM
Intercept		32.35 (27.93, 36.76)	34.82 (30.49, 39.14)	33.72 (29.07, 38.37)
Age		0.03 (0.01, 0.06)	0.00 (-0.03, 0.03)	0.01 (-0.03, 0.04)
Gender	Female	0.57 (-0.42, 1.56)	0.72 (-0.28, 1.72)	0.17 (-0.96, 1.31)
Time	Wave 4	0.57 (-4.49, 5.63)	-1.08 (-6.51, 4.35)	5.44 (0.90, 9.98)
	Wave 3	27.68 (21.73, 33.62)	31.89 (26.11, 37.66)	23.18 (17.87, 28.49)
	Wave 2	3.64 (-0.31, 7.59(	2.08 (-2.28, 1.72)	6.81 (2.71, 10.87)
	Wave 1	**Ref**	**Ref**	**Ref**
Deprivation	Least deprived	0.07 (-1.43, 1.57)	0.69 (-0.85, 2.24)	0.99 (-0.57, 2.54)
	Most deprived	**Ref**	**Ref**	**Ref**
Deprivation * time	Least, Wave 4	1.35 (-0.78, 3.48)	1.83 (-0.44, 4.10)	2.13 (-0.17, 4.43)
	Least, Wave 3	3.09 (0.47, 5.72)	4.22 (1.57, 6.86)	2.37 (-0.74, 5.48)
	Least, Wave 2	0.85 (-0.91, 2.61)	0.75 (-1.20, 2.69)	1.14 (-0.92, 3.19)
	Most, Wave 1	**Ref**	**Ref**	**Ref**
Income		0.20 (0.11, 0.30)	0.18 (0.08, 0.27)	0.18 (0.07, 0.29)
Feeling left out		-1.83 (-2.72, -0.93)	-1.48 (-2.38, -0.58)	-1.23 (-2.05, -0.41)
Feeling isolated		-1.05 (-1.96, 00.14)	-1.53 (-2.44, -0.62)	-0.91 (-1.77, -0.04)

Happiness scale		2.66 (2.31, 3.00)	2.64 (2.25, 2.99)	2.38 (2.03, 2.73)
Safety perception		-0.91 (-1.46, -0.36)	-0.92 (-1.49, -0.35)	-0.40 (-1.02, 0.21)
Happiness scale*Time	Wave 4	0.01 (-0.60, 0.62)	0.02 (-0.46, 0.86)	-0.75 (-1.38, -0.12)
	Wave 3	-3.38 (-4.10, -2.65)	-3.96 (-4.68, -3.25)	-2.74 (-3.37, -2.11)
	Wave 2	-0.35 (-0.82, 0.12)	-0.17 (-0.69, 0.36)	-0.80 (-1.28, -0.31)
	Wave 1	Ref	Ref	Ref
Exercise		-0.40 (-0.62, -0.18)	-0.49 (-0.73, -0.26)	-0.30 (-0.51, -0.08)
Smoking		-1.05 (-2.62, 0.51)	-1.68 (-3.22, -0.13)	-1.09 (-2.64, 0.46)
Alcohol use		2.77 (1.43, 4.11)	2.33 (0.94, 3.73)	2.52 (1.18, 3.85)
Intake of fruit-veg		0.09 (-0.13, 0.32)	0.23 (0.00, 0.47)	0.16 (-0.10, 0.42)
Alcohol use *Time	Wave 4	-1.62 (-3.78, 0.54)	-2.73 (-5.00, -0.45)	-1.70 (-3.90, 0.49)
	Wave 3	-5.38 (-7.92, -2.84)	-5.47 (-8.01, -2.93)	-4.12 (-6.35, -1.89)
	Wave 2	-1.95 (-3.76, -0.15)	-2.53 (-4.48, -0.58)	-1.88 (-3.60, -0.16)
	Wave 1	**Ref**	**Ref**	**Ref**
Smoking *Time	Wave 4	-2.62 (-5.61, 0.370	-1.63 (-4.59, 1.32)	-0.48 (-2.60, 1.65)
	Wave 3	3.21 (-0.15, 6.56)	4.60 (1.44, 7.76)	2.36 (-1.18, 5.89)
	Wave 2	0.98 (-1.27, 3.24)	1.52 (-0.74, 3.79)	0.55 (-1.67, 2.77)
	Wave 1	**Ref**	**Ref**	**Ref**

Highlights

- First quantitative study to use primary data to intensively and longitudinally explore local inequalities in mental health and wellbeing during austerity.
- Also examines any changes in the material, psychosocial and behavioural determinants.
- Finds that the significant gap in mental health between the two areas remained constant over the 18-month study period, whilst there were no changes in the underlying determinants.
- The stability of inequalities in mental health and wellbeing during austerity may have been because the sample was older than the general population and pensioners in the UK have largely been shielded from austerity.
- Discusses the importance of universal benefits in the context of health inequalities and austerity.