Bhandari R, Akhter N, Warren J, Kasim A, Bambra C.

Geographical inequalities in general and physical health in a time of austerity: Baseline findings from the Stockton-on-Tees cohort study.

Health and Place 2017, 48, 111-122.

DOI link to article:

https://doi.org/10.1016/j.healthplace.2017.10.002

Date deposited:

27/09/2017

Embargo release date:

18 April 2019

Geographical inequalities in health in a time of austerity: Baseline findings from the Stockton-on-Tees cohort study

Background

Stockton-on-Tees has the highest health inequalities in England. Life expectancy at birth reveals a gap between the most and least deprived neighbourhoods of 17.3 years for men and 11.4 years for women (Public Health England, 2015). This is similar to differences in life expectancy between the US and Ghana or the UK and India (World Health Organization, 2016). Life expectancy though is only a headline indicator, signifying the need to explore the extent and determinants of other aspects of health inequalities in that area (Bambra, 2016). A complex relationship exists between place, the people who live there and health. Complex in the sense that the characteristics of people (composition) and the nature and attributes of the place (context) act individually and collectively (Macintyre et al., 2002, Cummins et al., 2007). Further, it has been argued that these health divides between areas are 'political' in nature, influenced by the wider socio-political and macroeconomic context, for example, economic recession and austerity (Schrecker and Bambra, 2015). In this study, we provide the first detailed empirical examination of the biggest geographical health divide in England by exploring the health gap between the most and least deprived areas of Stockton-on-Tees using validated measures of physical and general health within a household survey. We also pilot a different statistical technique to examine the contribution of compositional and contextual factors and their interaction in explaining this gap. Uniquely, we do this in a time of economic recession and austerity within the UK. The paper will, therefore, be of interest not only to those who study health inequalities in the UK but also to the international public health research community who are tackling similar geographical inequalities in health in major urban settings (Bambra, 2016).

Geographical inequalities in health

Neighbourhoods that are the most deprived have worse health than those that are less deprived – this follows a spatial gradient, with each increase in deprivation resulting in a decrease in average health. In England, the gap between the most and least deprived areas is 9 years average life expectancy for men and around 7 years for women. Traditionally, geographical research has tried to explain these differences at neighbourhood level health looking at compositional and contextual factors – and their interaction (Pickett and Pearl, 2001, Cummins et al., 2007).

The compositional explanation asserts that the health of a given area is the result of the characteristics of the people who live there (demographic, behavioural and socioeconomic). The contextual explanation, on the other hand, argues that area-level health is determined by the nature of the place itself, in terms of its economic, social, cultural and physical environment. The profile of the people within a community (demographic [age, sex and ethnicity], health-related behavioural [smoking, alcohol, physical activity, diet, drugs] and socio-economic [income, education, occupation]) influences its health outcomes.

The literature suggests that there are several interacting pathways linking individual-level socio-economic status and health: behavioural, material, and psychosocial (Bartley, 2004). The 'materialist' explanation argues that it is income-levels and what a decent or high income enables compared to a lower one such as access to health-benefitting goods and services and limiting exposures to particular material risk factors. The 'behavioural-cultural' theory asserts that the causal mechanisms are higher rates of health-damaging behaviours in lower socio-economic groups. The 'psychosocial' explanation focuses on the adverse biological consequences of psychological and social domination and subordination, superiority and inferiority.

The contextual perspective asserts that differential exposure to the 'local geographical circumstances', brings about the differences in health status of the population (Pearce, 2015). Galster (2010) for example has proposed four specific, yet broad mechanisms to describe the role of place in creating unequal health status: the social-interactive mechanism; the environmental mechanism; the geographical mechanism and the institutional mechanism. The social-interactive mechanism links health inequalities as the outcome of the influence one's social neighbourhood has in shaping the health affecting norms, values and attitudes (Brannstrom and Rojas, 2012). Environmental mechanism deals with the socio-spatial distribution of health-damaging factors ('pathogens' such as violence, pollutants) and health-promoting factors ('salutogens' such as public parks and healing places), which have a distinct concentration pattern, former being more common in the socially deprived areas and latter in less deprived neighbourhoods (Pearce, 2015). The geographical mechanism, on the other hand explains that people living in deprived locations for a long-term, with limited or poor quality services may lead to a vicious cycle of poverty and ill health (Hedman et al., 2015). Finally, institutional mechanisms seek to understand the health-affecting roles of institutions and services (also referred to as 'opportunity structures'; e.g. GP surgeries, fast food outlets) that are socially constructed and have possibilities of varied quality, availability and access (Macintyre et al., 2002, Sykes and Musterd, 2011).

Macintyre and Ellaway (2009) have argued that a clear differentiation between compositional and contextual factors determining health inequalities is, in general sense impossible as they are not mutually exclusive: the characteristics of individuals are influenced by the characteristics of the area. For example, compositional-level individual factors such as employment and job status of the people living in an area are influenced by the contextual-level characteristics of the local labour market, whilst these contextual factors are in turn influenced by the wider political and economic environment - with, recessions and austerity, impacting again on local labour markets (Bambra, 2016). Moving away then from the conventional approach of focusing only on the contribution of compositional *or* contextual factors, Cummins et al. (2007) therefore argue for a 'relational approach' that accounts for the horizontal and vertical interaction between these factors - in addition to their individual contributions. This approach not only reconnects people and place but attempts to signify the importance of scale in understanding geographical health inequalities. It highlights the dynamic nature of place—how it is constructed and represented in research and how it is embedded in an individual's life. Place in this relational sense may not be defined by geographical administrative boundaries but by 'nodes in networks' (Horlings, 2016). Multi-level modelling has been used as a way of determining the role of compositional factors, contextual factors and their interaction simultaneously (Curtis and Rees Jones, 1998, Duncan et al., 1998).

Recession, austerity and health inequalities

The financial crisis of 2007 - the worst since the Wall Street crash of 1929 led to the onset of what has been called the 'Great Recession'. There had been several post-war financial downturns in western European countries (e.g. the 1970s and 1990s) but none as serious (on economic and social grounds) as that which has affected the whole of Europe and the UK since 2008 (Ifanti et al., 2013). The UK had some austerity policies in hand such as tax reforms before the full crisis came into existence, this has been described by Blyth (2013) as 'pre-emptive tightening'. The crisis though accelerated after the imposition of austerity policies from 2010 onwards. UK austerity has been characterised by significant cuts to public service budgets, most notably in terms of local authority budgets, significant reductions in social security expenditure, alongside a strong emphasis on relying on a renewed market to cover the national deficit (Kitson et al., 2011). Though there have been strong voices against austerity, it remains in place and its impacts are ongoing (Baker, 2010). These funding and welfare cuts in the UK are geographically patterned and the worst hit areas are those that are already the most socially disadvantaged (Beatty and Fothergill, 2016). This has led to fears of widening deprivation and increases in health inequalities (Pearce, 2013, Beatty and Fothergill, 2016), (Bambra and Garthwaite, 2014).

However, there is little by way of empirical assessment of the effects of austerity on geographical inequalities in health (Pearce 2013). The studies that do exist however, have suggested a negative impact. For example, Niedzwiedz et al. (2016) found that reductions in spending levels and increased welfare conditionality adversely affected the mental health of disadvantaged social groups. Austerity measures have also affected vulnerable old-age adults as a study by Loopstra et al. (2016) has noted that rising mortality rates among pensioners were linked to reductions in social spending and social care. Loopstra et al. (2015) also found that food bank use is associated with cuts to local authority spending and central welfare spending. Across England, there has been a widening inequalities in mental health since 2010 (Barr et al., 2015) with the largest increases in poor mental health (including suicides, self-reported mental health problems and anti-depressant prescription rates) in the most deprived areas (Barr et al., 2016).

Furthermore, as well as being few in number, the studies in the UK conducted to date which explore the extent of geographical health inequalities during austerity have also been conducted on a national scale and utilised national level datasets. National level statistics are often criticised for failing to represent and explain the proximal area level situations or even the inequalities that persist between/in regional and local levels (Shouls et al., 1996, Cummins et al., 2005, Bambra, 2013). Those studies exploring different localities have also focused on local authority level data rather than looking at a finer geographical scale such as at a neighbourhood or ward level. The indicators used have often been mortality rather than morbidity. This identifies a clear need for more localised studies that apply geographical theories to better understand the extent and causes of geographical inequalities in health in this time of austerity. Furthermore, focusing at a local scale provides us with a unique opportunity to get detailed primary information on health and the social determinants at a small geographical scale, which is not the case with secondary data (such as the census or Health Survey for England).

This paper is the first to address this gap in the literature by estimating the magnitude of local inequalities in physical and general health during a time of austerity via a case study of Stockton on Tees - the local authority in England with the biggest health divide. For the international health geography literature, this study contributes in methodological terms by using a different statistical approach to the examination of the relative contribution of context, composition and their interaction (Skalicka et al., 2009, Copeland et al., 2015). It also contests the scales of contextual data that can explain the local health inequalities gap. Something which Pickett and Pearl (2001) have explicitly highlighted as needed in terms of enhancing our understanding of geographical health inequalities. It is also the first study to examine localised geographical inequalities in health in a time of austerity.

Methods

The 'Local Health Inequalities in an Age of Austerity: The Stockton-on-Tees Study' is a mixed method interdisciplinary case study that aims to explore key debates around localised health inequalities in an age of austerity. Using a case study approach provides the opportunity to advance research into health inequalities by combining the methods and insights of different disciplines to study the localised effects of the social and spatial determinants of health. This paper presents the baseline findings from a prospective cohort survey examining health inequalities between the most and least deprived lower super output areas (LSOAs) of Stockton-on-Tees. It is a common practice to report the baseline findings of a cohort study (Peter et al., 1998, Smith et al., 2007, McFall and Garrington, 2011, Booker et al., 2015) and papers dealing with subsequent waves using longitudinal analysis will follow.

The health gap in Stockton is examined using a random sample of adults aged over 18, split between participants from the 20 most and 20 least deprived LSOAs (Figure 1). LSOAs are small areas 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). When studying deprivation status and relating it to health inequalities, LSOA is usually the preferred smallest spatial unit in England (Cairns, 2013). We used the index of Multiple Deprivation (IMD) scores for England from the year 2010 to determine the 20 LSOAs in each extreme ends of deprivation within the borough. LSOA is the smallest geographical unit in England for which the IMD score is computed. IMD score is the key measure to identify area deprivation and its concentration in geographical units lower than local authorities in the England (Payne and Abel, 2012, Noble et al., 2006). An IMD score is constructed by combining 38 different weighted indicators representing income, employment, health and disability, education, barriers to different services, living environment and crime (Dept for Communities and Local Government, 2011).

The borough of Stockton-on-Tees was chosen as the site for analysis because it has the highest health inequalities between LSOAs within a local authority in England both for men (at a 17.3 year difference in life expectancy at birth) 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 – and we wanted to unpack the headline life expectancy gap by looking in more detail at other underpinning health measures as well as their determinants. Stockton-on-Tees has a population of 191,600 residents (Census, 2011) in its total area of 78.7 square miles and with a density of nearly 2,435 persons per square mile (Office for National Statistics, 2011) (Figure 1). Stockton has high levels of social inequalities, 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. Hardwick). These areas are often in close proximity to one another (as shown in Figure 1). Deprivation overall, is higher than the national average e.g. about 30% of the people living in Stockton-on-Tees fall in the most deprived quintiles, which is significantly higher than the national average of 20% (Public Health England, 2015).

Sampling Strategy

To identify the lowest and highest areas of deprivation in Stockton, we looked at the 120 lower super output areas (LSOA) in the local authority of Stockton on Tees, selecting the 20 with the lowest Index of Multiple Deprivation (IMD) scores from 2010 and the 20 with the highest IMD scores (IMD range 1.54-74.5) (Department for Communities and Local Government, 2011).

The final targeted sample size of 800 (400 in each group) was based on a conservative power calculation, derived from experience of previous health surveys in the same region of the UK (Warren et al., 2013a). The sampling process utilised EQ5D and SF8 (see outcome measures for detailed information on these indicators), which assumed a 5% difference between the least and most deprived areas and the possible attrition in the follow-up surveys. 20,013 eligible addresses and phone numbers were identified from the 40 study 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. Using a stratified random sampling technique (using “R” statistical software programme), we created a sample of 200 target households in each of the 40 LSOAs. Assuming a 10% enrolment rate, 8000 households (4000 each from the most and least deprived LSOAs) were sent study invitation letters by post in April and May 2014. 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). Recipients were able to contact the research team by phone to indicate if they would like to participate in the study and set up a time for a face-to-face interview and also to indicate if they did not want to participate (n=506). In regards to those who did not respond to the letter, research staff attempted to contact the households by visiting the address and returning on up to 4 occasions at differing times of the day. Additionally, up to 5 attempts were made to contact households by phone and at differing times of the day, when phone numbers were available.

An additional letter was also sent to households who had not responded, 4 weeks into the field period. However, 976 people refused to participate, there were 58 empty/derelict properties, and 5624 households were uncontactable (not responding to an average of 5 phone calls per property, 4 physical visits to properties, or repeated letters). This meant that in total we had actual contact with

2318 households of which 836 participated in the study giving a total response rate of just over 10% and 'contactable' response rate of 36%. We acknowledge that the response rate is low and comment further on the implications for this in the Limitations section later in the paper. However, it is worth noting at this point that the low response rate may undermine the representativeness of our sample - even though our random approach meant that everyone living in each of the sampled LSOAs had an equal chance of participating in the survey, our sample ended up being older and more female than would be expected based on census estimates of the general population (Table 2). Eligible participants were sampled by household, and then at the individual level by the use of a household selection grid. This was a multi-stage randomised sampling strategy (Devaus, 1991). A total of 836 participants completed the baseline survey, which was within our required sample size. Face-to-face interviews were conducted between April and June 2014: 397 in the most deprived areas and 439 in the least deprived areas. Participating individuals were sent a £10 high street voucher as a thank you for taking part. Figure 2 shows the sampling strategy adopted for the study.

The baseline survey included questions on health, demographics and the compositional and contextual determinants of health. Questions were matched whenever possible to those used in other surveys (such as the General Household Survey), to enable national level comparisons to be made.

The questionnaire was piloted and refined in December 2013 and January 2014 with a random sample of 24 households in two non-study areas: the 21st most (26% response rate) and 21st least deprived (35% response rate), lower super output areas which were not part of the study area.

Outcome measures

General health was assessed using EuroQol (EQ5D and EQ5D-VAS) and physical health was measured using 'quality metric short form (SF8)'. Both EuroQol and SF8 have been well-validated for use in the general population.

EuroQol consists of two parts: EQ5D questionnaire and the ‘Visual Analogue Scale’ (EQ5D-VAS), also known as health thermometer (EuroQol Research Foundation, 2016). The EQ5D questionnaire asked participants about their mobility, self-care, ability to carry out usual activities, pain and discomfort and level of anxiety and depression. The responses to these questions are converted to a scale between –0.594 and 1.00, the latter being better health. EQ5D-VAS represents the perceived health status of the participant, which is measured on a scale of 0-100, 0 being the worst and 100 the best health state they can imagine (Warren et al., 2014).

Using eight questions that focus on the health status of the participants during the last four weeks, SF8 produces two health scores: physical health score (SF8-PCS) and mental health score (SF8-MCS) (Warren et al., 2014). However, in this paper, the analysis is limited to SF8-PCS only and our linked study has used the SF8-MCS (see Mattheys et al. (2016)). The scores for this measure ranges between 0 and 100: the higher the score, better is the physical health state.

Explanatory variables

Explanatory variables were grouped into two broad categories: individual level compositional variables (includes material, psychosocial and behavioural variables) and contextual level variables (related to the neighbourhood where the individual lives). This reflects the composition-context theory of health inequalities. While all of the compositional variables come from the survey, some of the contextual variables were obtained from secondary sources such as Office for National Statistics (ONS), IMD and some were computed with ArcGIS using data from Ordnance Survey (see Web Appendix). Whenever possible, contextual data was obtained for the finer geographical units such as post codes. The included factors were chosen to cover the four main contextual domains of geographical theory as explored in the previous section: social-interactive, environmental, geographical and institutional (Bernard et al., 2007, Galster, 2010). These domains broadly represent the key mechanisms of neighbourhood effects on health and wellbeing. Galster (2010) has highlighted the significance of these domains in understanding and quantifying the causal relationship of contextual factors and health outcomes. The selection of the contextual factors was also determined by the availability of data at the geographical scale of our analysis. Outdoor living environment scores, which is a sub-domain of 'living environment deprivation domain' of IMD was the only contextual variable from secondary source that was retained in the final parsimonious model (Dept for Communities and Local Government, 2015).

Statistical analysis

A data cleansing process was carried out and missing data were excluded for both outcome measures and predictor variables so that complete data were available for all cases allowing comparison between models. Variables such as individual income were highly correlated with household income, but had high missing data, and therefore omitted from the analysis. Thus, the final analysis was performed on 356 participants from the most deprived and 377 from the least deprived LSOAs.

The analysis was carried out to establish: (1) the magnitude of inequalities in general health and physical wellbeing (as measured by EQ5D, EQ5D-VAS and SF8PCS); (2) the associations between compositional and contextual variables and the health outcomes; (3) relative explanatory contribution of the compositional and contextual variables; (4) 95% confidence interval was obtained from nonparametric bootstrapping (Politis, 2014). The gap in the health outcomes between the participants from the most and least deprived LSOAs is labelled as 'Deprivation' in the results and tables.

Percentage reduction, percentage change for the specific model (see **Equation 1**) and percentage contribution of the categories of explanatory factors (see **Equation 2**) were computed for each health outcome as well as the indirect (interactive) contribution (see Equation 3).

To explore the mean difference of the measures of health outcomes, multilevel models were applied. In doing so, the models were adjusted for age and gender and controlled for the potential clustering within the LSOAs. The analysis started with the univariate analysis of the individual variables to filter out redundant variables (Hosmer et al., 2013, Agresti, 2015). Final models were obtained using likelihood ratio test to ensure no substantial information was lost due to variable selection (Verbeke and Molenberghs, 2000). The relative contribution of the variable categories was then calculated from the final model. Direct (sole contribution) and indirect (interactions) contributions of the explanatory variable categories were computed to explain the inequalities.

Equation 1. Equation to determine percentage change between models

$$\% \, Change \, for \, Model \, Mx = 100 * \frac{Reference \, Model \, (M0) - Adjusted \, Model \, (Mx)}{Reference \, Model \, (M0)}$$

Equation 2. Equation to determine percentage contribution

$$\% \, contribution \, of \, category \, X = Total \, \% \, change \, (M15) - \% \, change \, of \, model \, without \, category \, X$$

Equation 3. Equation to determine indirect contribution

$$Indirect \, contribution = Total \, \% \, change \, (M15) - (\% \, contribution for \, material + \% \, contribution \, of \, psychosocial + \% \, contribution \, for \, behavioural + \% \, contribution \, of \, contextual)$$

In multilevel modelling, bootstrapping is the preferred approach to calculate confidence intervals of the indirect effects (Shrout and Bolger, 2002). For this study, the data was bootstrapped 10,001 times and 95% confidence intervals were calculated as 2.5% quantiles of the bootstrapped estimates to generate uncertainty bounds for the percentage contributions of various factors. The nonparametric bootstrapping was done in R. The whole process was carried out for all three health outcomes.

Results

Baseline characteristics

Table 1 shows the baseline information of the study participants that remained in the final analysis after excluding the missing data. These show that in terms of gender our sample has a higher proportion of women (60%) compared to the census data for Stockton for 2011 (51%). We also have an older population with 29 percent of our sample aged over 65 compared to about 16 percent in the census (Table 1 and 2) (Office for National Statistics, 2013). However, in terms of socio-economic status then our participants were broadly in keeping with the census as around 88% of households in the least deprived areas were owner occupied compared to 91% in the census. In the most deprived areas then 28% of our sample were owner occupiers compared to 38% recorded in the 2011 census. Our modelling, therefore, adjusts for age and gender to take this into account.

The proportion of participants reporting housing issues was significantly higher in the most deprived areas (inadequate heating—20% vs. 7%, dampness—26% vs. 3%, darkness—17% vs. 8% and lack of double glazing—5% vs. 2%). While smoking was more prevalent in the most deprived areas (37% vs. 10%), the use of alcohol was higher in the least deprived areas (79% vs. 59%). A higher proportion of participants from the most deprived areas reported noise problems (24% vs. 11%), pollution (13% vs. 3%) and crime (29% vs. 6%) in their neighbourhood. More than 12% of people from the most deprived areas felt unsafe walking alone in their neighbourhood after dark compared to less than 2% in the least deprived areas.

Inequalities in general health outcomes

The reference models (see Table 3) estimate the gap in EQ5D-VAS, EQ5D and SF8PCS between the participants from the most and the least deprived LSOAs of Stockton-on-Tees Borough. When adjusting for age and gender, the estimated inequality gap for EQ5D-VAS, EQ5D and SF8PCS are 10.86

(95% Confidence interval: 5.89, 15.82), 0.12 (0.074, 0.17) and 4.77 (2.8, 6.73) respectively. People living in the least deprived areas have significantly better general and physical health scores compared to those living in the most deprived areas of the borough.

EQ5D-VAS, EQ5D and SF8PCS models: exploring the role of compositional and contextual factors

The associations between the health outcomes and compositional and contextual factors are presented in Table 4. Household income was the only material factor (positively) associated with EQ5D-VAS. In terms of psychosocial factors, people who are happier have higher EQ5D-VAS scores and those who felt left-out have significantly lower scores. In terms of behavioural factors, compared to people who exercise daily, those exercising less frequently have lower EQ5D-VAS scores. Likewise, people drinking alcohol had higher EQ5D-VAS scores. Among the contextual factors, feeling unsafe walking alone after dark, neighbourhood noise and pollution were all negatively associated with EQ5D-VAS scores.

For EQ5D scores, in material terms, households which had at least one workless member and houses with heating and dampness issues were the material factors and all were negatively associated. In terms of psychosocial factors, while happiness was positively associated, feeling of being left-out and isolated had negative association with EQ5D. The analysis of behavioural factors and EQ5D shows similar results as the EQ5D-VAS scores, higher frequency of physical exercise and use of alcohol were significantly associated with higher EQ5D scores. Among the contextual factors, feeling unsafe walking alone after dark, pollution/environmental problems and presence of crime and vandalism in the neighbourhood were negatively associated with the EQ5D scores.

Material factors of importance for the physical health scores as measured by SF8PCS were having a workless member or having a damp house: scores were lower. In terms of psychosocial factors, people who stayed happier were more likely to have better physical health. Exercise was positively and significantly associated with SF8PCS scores. In terms of the contextual factors, in keeping with the findings for EQ5D-VAS and EQ5D, a significant association was found with feeling unsafe walking alone after dark and SF8PCS scores. Finally, 'outdoor living environment deprivation scores' (a sub-domain of living environment deprivation domain) for IMD 2015 (Dept for Communities and Local Government, 2015) was significantly associated with lower SF8PCS scores.

Percentage contribution of compositional and contextual factors in health inequalities gap

Table 5 shows the percentage reduction in the inequality gap due to different categories of health determinants. The full model (M15) with all factors accounted for 72.23%, 90.12% and 95.4% reduction of inequality gap in EQ5D-VAS, EQ5D and SF8PCS respectively. The calculation of percentage change and the percentage contribution of the set of factors was done using **Equation 1** and **Equation 2**.

For EQ5D-VAS, all compositional factors combined explained 41.7% of the deprivation health gap but among its sub-categories, material factors were the most important contributing 20.4% explanation. The gap was least explained by the psychosocial factors (0.7% and 95% CI: -9.13, 11.31) followed by behavioural factors (4.3% and 95% CI: -5.07, 11.03). Their insignificant contribution is reinforced by their 95% confidence intervals obtained from nonparametric bootstrapping. Likewise, the bootstrapped confidence interval for the model with both behavioural and psychosocial factors combined (M8) indicate its lack of contribution to explaining health inequalities. Contextual factors, on the other hand, explained the gap by 14.6%. Meanwhile, the presence of high indirect effects (32.2%) indicates the important interaction of compositional and contextual factors in aggravating the inequalities.

All compositional factors combined explained more than 47% of inequalities gap for EQ5D scores (95% CI: 23.45, 58.81). When considering compositional categories, the highest contribution to the inequality gap was from material factors (23.3%). The contribution of psychosocial factors was less than a single percent, whilst only 7% for the behavioural factors. The bootstrapped confidence intervals at 95% for these categories (M2: -9.22, 9.64 and M3: -1.82, 13.13) as well as their combination (M8: -7.31, 15.81) also indicate an insignificant contribution. More than 18% of the gap was explained by the contextual factors. As with EQ5D-VAS, the high percentage of indirect effects points out the significant interaction that is present between the factors within compositional and contextual categories. The indirect contribution for EQ5D is the highest among the three health indicators included in our study.

The overall contribution of compositional factors to the inequalities gap for SF8PCS was 44.5%. Material factors explained about 32% of the gap followed by 5% by the behavioural factors and less than a percent by the psychosocial factors. The bootstrapped confidence interval for both psychosocial and behavioural factors, individually (-6.83, 9.8 and -6.3, 10.94 respectively) as well as their combination (-7.35, 16.35) indicate an insignificant explanation. Contextual factors on the other hand were able to explain 38 % of the inequalities gap. The indirect effects for SF8PCS was the least (21%) compared to other two measures, yet it indicates the presence of significant interaction.

Discussion

This study investigated the gap in general and physical health between the people living in the most and the least deprived neighbourhoods of the Borough of Stockton-on-Tees in England and utilised a composition-context approach to analyse the relative contribution of different risk factors. Three validated measures of health outcomes—two general and one physical health scores have been used: the EQ5D-VAS, the EQ5D and the SF8PCS (Garthwaite et al., 2014). A significant gap was found for all three measures, but this was more pronounced for the two EuroQol indicators: EQ5D-VAS and EQ5D.

People living in less deprived areas had higher chances of having better general and physical health. We found that people living in most deprived areas of Stockton-on-Tees can expect to have an 11 points lower score for EQ5D-VAS, 0.12 points lower scores for EQ5D and 4.8 points lower scores for SF8PCS than those living in the least deprived neighbourhoods. Likewise, direct contributions of compositional and contextual factors in creating the gap was 41.7 % and 14.6% respectively for EQ5D-VAS; 47.1% and 18.3% respectively for EQ5D; and 44.5% and 37.8% respectively for SF8PCS. Apart from the direct contributions, we found significant indirect contributions for all health measures indicating the presence of important interaction effects between the compositional and contextual factors in causing the health gap.

The relationship between health inequalities and the social determinants of health has been well established. Our study adds further to the substantial evidence on the role of individual/compositional (Marmot and Allen, 2014) and area level/contextual (Cummins et al., 2005) factors in creating the health gap. Association between individual level factors and health inequalities have been found which is consistent with previous research. Our research found material factors such as household income, worklessness within the household, dampness in the house and improper heating provisions to be the highest contributors to general health inequality and the second highest contributor to physical health inequality. A study from Norway has attributed material factors as the most important compositional factors in explaining the inequalities in mortality (Skalicka et al., 2009). The importance of household income to physical health inequalities is also demonstrated by Arber et al. (2014). Marmot and Bell (2012) show the indirect relationship of household poverty with health inequalities, which is mediated by household fuel poverty. Households in the fifth quintile of income had the highest level of fuel poverty forcing them to live in cold homes resulting in poor health. It is widely accepted that a two-way relationship exists between worklessness and poor health. Using data from population surveys for England, a study by Moller et al. (2013) has linked higher prevalence of morbidity and mortality with rising unemployment. Not just limited to individuals, health impacts of worklessness within the household extend to their families and beyond (Warren et al., 2013b, Bambra, 2011). In our research, people living in damp and cold houses had poorer scores for general and physical health, which matches with the qualitative findings from other research from the UK (Egan et al., 2015, Moffatt et al., 2016).

Compared to material and contextual factors, psychosocial and behavioural factors made relatively less contribution to the health inequality gap. Our analysis has found that psychosocial factors have less than a percentage contribution to the health inequality gap for all three health measures included in our study. A study by Moor et al. (2014) found a higher contribution of psychosocial and behavioural factors to self-rated general health among adolescents, which contrasts with our findings. This study though does not take the material and contextual factors into consideration. People who had higher happiness scores (scale of 0-10) were more likely to have higher scores for all three health outcomes, this fits well with the growing happiness literature (Friedli, 2009). Loneliness (feeling left out or isolated) was a significant contributor to EuroQol indicators but not for SF8PCS. These psychosocial factors often impact health from a behavioural pathway, for example, Lauder et al. (2006) have found lonely people had higher odds of adopting sedentary lifestyles and smoking. Consumption of alcohol was positively associated with better EQ5D-VAS and EQ5D scores, but not SF8PCS, which is similar to the finding by Bergman et al. (2013). Participants with less frequent exercising behaviour had higher chances of having poorer health, which is consistent with studies conducted in Spain, Switzerland and England (Galan et al., 2013, Chatton and Kayser, 2013, Maheswaran et al., 2013). The contribution of behavioural factors towards health inequality gap was relatively lower for all three health outcomes compared to material and contextual factors. In our linked study, Mattheys et al. (2016) found a similar relationship for inequalities in mental health outcomes.

Our study is one of the few studies looking at the relative contribution of contextual factors in the health inequality gap. Ross and Mirowsky (2008) have argued that to correctly infer the contextual effects, multilevel modelling with adjustment of comprehensive individual characteristics is to be adopted in the study. In our analysis, we have adjusted the results for age, gender and the deprivation status of the place to determine the contribution of contextual factors. Contextual factors were the biggest contributor to the inequality gap for SF8PCS scores (37.8%) and second biggest contributor after material factors for EQ5D (18.3%) and EQ5D-VAS (14.6%). People living in neighbourhoods where they felt unsafe walking alone after dark had higher chances of having significantly lower scores for all three health outcome measures included in our study. Ruijsbroek et al. (2015) have argued behavioural factors such as physical activities are often determined by contextual factors such as neighbourhood crime and feeling unsafe. Several studies have been able to associate neighbourhood safety with spatial health inequalities either directly (Baum et al., 2009, Smith et al., 2015, Tamayo et al., 2016) or indirectly through behavioural pathway, usually impacting the level of physical activity (Mason et al., 2013). People living in areas with higher level of outdoor air pollution and road traffic accidents, measured by the outdoor environmental score of IMD had higher chances of having significantly lower EQ5D scores. This is in keeping with a substantial body of literature suggests an association between health inequalities and levels of outdoor air pollution (Marshall et al., 2009, Cesaroni et al., 2012) and road traffic accidents (Ameratunga et al., 2006, Cairns et al., 2015) with deprived areas being disproportionately and adversely affected.

When looking from the composition-context distinction, our study has found relatively higher contribution of the compositional factors than the contextual factors, which is the case for all three health measures. This is in keeping with other research but it does suggest a stronger role for context than previous estimates (Macintyre et al, 1997). Most notably, though, our study shows the importance of the interaction of compositional and contextual variables, supporting a relational view of health and place (Cummins et al, 2007). Our research has found substantial indirect effects for all three health outcomes: 41.4% for EQ5D, 32.2% for EQ5D-VAS and 20.6% for SF8PCS. This is an indication of the interaction of the factors representing the different groups of explanatory variables.

For all three outcome measures, the combined analysis explains the highest amount of the health gap, which demonstrates the important interaction between the individual-level material and contextual-environmental factors in causing the health gap. A study done by De Clercq et al. (2012) among Flemish communities has revealed a complex interaction between individual material factors and the neighbourhood context to produce health inequalities. This further adds to the significance of ‘mutually reinforcing’ nature of compositional and contextual factors and justifies the need of ‘relational approach’ in understanding the contribution of individual-level and area-level factors (Cummins et al., 2007). In our study, the secondary data sources used to measure context were based on fixed administrative boundaries and they had little influence on the health gap. However, the contextual factors from the survey measured at an individual level made a significant contribution to the health inequalities gap. This may be because individuals have relatively dynamic and fluid area definitions. They were not confined to the LSOAs of the study but to how participants viewed the relational structure of the neighbourhoods they felt that they belonged to and therefore there was variation by individual (Bernard et al., 2007, Horlings, 2016). This level of data is not usually available at a national or regional scale, which validates the relational approach that was adopted at a local level.

Our study is also the first to examine localised geographical inequalities in health in a detailed way using multiple health indicators in a time of austerity. The context of austerity is important when thinking about how local-contextual factors and compositional-individual factors influence health and the health inequalities gap. It is increasingly argued in the health inequalities literature that the influence of context/place should not just be considered as a purely local or neighbourhood level but at a more macro or societal level: a vectoral approach (Cummins et al., 2007, Bambra, 2016). When the survey was conducted in 2014, it was done so in a context of significant reductions to Social Security benefits and local government services in Stockton on Tees. However, as this paper is based on the analysis of the baseline survey, we cannot present the effects of austerity itself - or the changes it entails in terms of individual and area-level circumstances - on health inequalities. However, the findings suggest a link between health and the material conditions of households. Furthermore, the clear health gap between those living in most and least deprived areas indicate that any (negative) impact of welfare reform on material conditions in deprived areas could result in the widening of this gap. This is in keeping with previous research into the effects of austerity and welfare reform on health conducted at the national level (Barnes et al, 2016; Niedzwiedz et al, 2016; Loopstra et al, 2015, 2016; Barr et al, 2015a; 2015b). In this context, findings from the follow-up waves of the Stockton-on-Tees cohort study will be able to examine whether inequalities in general and physical health change during austerity - and the role of compositional and contextual factors in explaining any such changes.

Limitations

Although our study is based on a stratified random sample, it is subject to a number of important limitations. Firstly, despite multiple contact attempts, we had a low response rate with only c36% of contacted households (and only c10% of all of our 8000 sampling frame) participating in the survey. This was perhaps partly due to the opt-in approach and the use of a postal letter to recruit people in the first instance. However, it is worth noting that the low response rate may undermine the representativeness of our sample. Even though our random approach meant that every household in each of the sampled LSOAs had an equal chance of participating in the survey, our sample ended up being older and more female than would be expected based on census estimates of the general population (Table 2). We adjusted for both age and gender in our models to account for this - but these factors may still effect the generalisability of our findings. There is also the strong possibility of other response bias in our sample and particularly a 'healthy responder effect', whereby people with health problems are less likely to respond to research requests (Manuel et al., 2016). Our findings should therefore be interpreted with a certain amount of caution. Although the data was collected on a face-to-face basis by trained interviewers, the outcome measures are still all self-reported and these measures may have limited precision and reliability (Mathews and May, 2007). Further, though the health outcome measures used in this research were validated ones, other measures could also have been used (Meltzer, 2003). In addition, the findings presented in this paper are only a baseline snapshot and to see how austerity is linked to health inequalities in Stockton-on-Tees will require a longitudinal approach. Finally, when presenting the contribution of the contextual factors towards the health gap, the duration of exposure to these factors is not known as this is a cross sectional study. Considering all these limitations, it would require careful interpretations and inference of the findings.

Conclusion

This study makes an important contribution to the ongoing international scholarly debate about context and composition in the aetiology of geographical inequalities in health. Using a detailed health and social determinants survey of a random stratified sample of individuals living in the most and least deprived neighbourhoods of Stockton on Tees, it found a significant health gap across a variety of validated measures. It also piloted the use of a different statistical approach to the examination of the relative contribution of compositional and contextual factors and their interactions in explaining these gaps - within the macroeconomic context of austerity. We found significant direct as well as indirect contributions of individual-compositional and area-level contextual factors in determining this gap, with individual-level material factors accounting for the majority. Our study has further established that ‘place’ and its attributes matter for health inequalities, these contextual factors either contribute directly or interact with the compositional factors in leading to the health gap. The study therefore provides empirical evidence to support existing theoretical assertions that composition and context should be looked at from a relational perspective (Cummins et al., 2007).

References

AGRESTI, A. 2015. *Foundations of linear and generalized linear models,* New Jersey, John Wiley & Sons.

AMERATUNGA, S., HIJAR, M. & NORTON, R. 2006. Road-traffic injuries: confronting disparities to address a global-health problem. *Lancet,* 367**,** 1533-1540.

ARBER, S., FENN, K. & MEADOWS, R. 2014. Subjective financial well-being, income and health inequalities in mid and later life in Britain. *Social Science & Medicine,* 100**,** 12-20.

BAKER, A. 2010. *Austerity in the UK: Why it is not common sense but politically driven nonsense* [Online]. Centre for Progressive Economics. Available: http://www.qub.ie/schools/SchoolofPoliticsInternationalStudiesandPhilosophy/FileStore/Stafffiles/AndrewBaker/Filetoupload,224825,en.pdf [Accessed 10/04/2015].

BAMBRA, C. 2011. *Work, worklessness, and the political economy of health*, Oxford University Press.

BAMBRA, C. (ed.) 2013. *'All in it together'? Health inequalities, austerity and the 'great recession',* London: Demos Collection.

BAMBRA, C. 2016. *Health divides : where you live can kill you,* Bristol, UK, Policy Press.

BAMBRA, C. & GARTHWAITE, K. 2014. Welfare and Austerity. *Inquiry into Health Equity in the North of England.* Department of Geography, Durham University and Fuse: UKCRC Centre for Excellence in Translational Research in Public Health.

BARR, B., KINDERMAN, P. & WHITEHEAD, M. 2015. Trends in mental health inequalities in England during a period of recession, austerity and welfare reform 2004 to 2013. *Soc Sci Med,* 147**,** 324-31.

BARR, B., TAYLOR-ROBINSON, D., STUCKLER, D., LOOPSTRA, R., REEVES, A. & WHITEHEAD, M. 2016. 'First, do no harm': are disability assessments associated with adverse trends in mental health? A longitudinal ecological study. *J Epidemiol Community Health,* 70**,** 339-45.

BARTLEY, M. 2004. *Health inequality : an introduction to theories, concepts and methods,* Cambridge, Polity Press in association with Blackwell.

BAUM, F. E., ZIERSCH, A. M., ZHANG, G. Y. & OSBORNE, K. 2009. Do perceived neighbourhood cohesion and safety contribute to neighbourhood differences in health? *Health & Place,* 15**,** 925-934.

BEATTY, C. & FOTHERGILL, S. 2016. The Uneven Impact of Welfare Reform: The financial losses to places and people.

BERGMAN, S., SYMEONIDOU, S., ANDERSSON, M. L., SODERLIN, M. K. & GRP, B. S. 2013. Alcohol consumption is associated with lower self-reported disease activity and better health-related quality of life in female rheumatoid arthritis patients in Sweden: data from BARFOT, a multicenter study on early RA. *Bmc Musculoskeletal Disorders,* 14.

BERNARD, P., CHARAFEDDINE, R., FROHLICH, K. L., DANIEL, M., KESTENS, Y. & POTVIN, L. 2007. Health inequalities and place: a theoretical conception of neighbourhood. *Social Science & Medicine,* 65**,** 1839-1852.

BLYTH, M. 2013. Austerity : the history of a dangerous idea. Oxford ; New York: Oxford University Press,.

BOOKER, C. L., SKEW, A. J., KELLY, Y. J. & SACKER, A. 2015. Media Use, Sports Participation, and Well-Being in Adolescence: Cross-Sectional Findings From the UK Household Longitudinal Study. *American Journal of Public Health,* 105**,** 173-179.

BRANNSTROM, L. & ROJAS, Y. 2012. Rethinking the Long-Term Consequences of Growing Up in a Disadvantaged Neighbourhood: Lessons from Sweden. *Housing Studies,* 27**,** 729-747.

CAIRNS, J., WARREN, J., GARTHWAITE, K., GREIG, G. & BAMBRA, C. 2015. Go slow: an umbrella review of the effects of 20 mph zones and limits on health and health inequalities. *Journal of Public Health,* 37**,** 515-520.

CESARONI, G., BOOGAARD, H., JONKERS, S., PORTA, D., BADALONI, C., CATTANI, G., FORASTIERE, F. & HOEK, G. 2012. Health benefits of traffic-related air pollution reduction in different

socioeconomic groups: the effect of low-emission zoning in Rome. *Occupational and Environmental Medicine,* 69**,** 133-139.
CHATTON, A. & KAYSER, B. 2013. Self-reported health, physical activity and socio-economic status of middle-aged and elderly participants to a popular road running race in Switzerland: better off than the general population? *Swiss Med Wkly,* 143**,** w13710.
COPELAND, A., KASIM, A. & BAMBRA, C. 2015. Grim up North or Northern grit? Recessions and the English spatial health divide (1991-2010). *J Public Health (Oxf),* 37**,** 34-9.
CUMMINS, S., CURTIS, S., DIEZ-ROUX, A. V. & MACINTYRE, S. 2007. Understanding and representing 'place' in health research: a relational approach. *Soc Sci Med,* 65**,** 1825-38.
CUMMINS, S., STAFFORD, M., MACINTYRE, S., MARMOT, M. & ELLAWAY, A. 2005. Neighbourhood environment and its association with self rated health: evidence from Scotland and England. *Journal of Epidemiology and Community Health,* 59**,** 207-213.
CURTIS, S. & REES JONES, I. 1998. Is there a place for geography in the analysis of health inequality? *Sociology of health & illness,* 20**,** 645-672.
DE CLERCQ, B., VYNCKE, V., HUBLET, A., ELGAR, F. J., RAVENS-SIEBERER, U., CURRIE, C., HOOGHE, M., IEVEN, A. & MAES, L. 2012. Social capital and social inequality in adolescents' health in 601 Flemish communities: A multilevel analysis. *Social Science & Medicine,* 74**,** 202-210.
DEPT FOR COMMUNITIES AND LOCAL GOVERNMENT 2015. English Indices of Deprivation 2015. *Underlying indicators.*
DUNCAN, C., JONES, K. & MOON, G. 1998. Context, composition and heterogeneity: using multilevel models in health research. *Social science & medicine,* 46**,** 97-117.
EGAN, M., LAWSON, L., KEARNS, A., CONWAY, E. & NEARY, J. 2015. Neighbourhood demolition, relocation and health. A qualitative longitudinal study of housing-led urban regeneration in Glasgow, UK. *Health & Place,* 33**,** 101-108.
ERIKSEN, L., GRONBAEK, M., HELGE, J. W., TOLSTRUP, J. S. & CURTIS, T. 2011. The Danish Health Examination Survey 2007-2008 (DANHES 2007-2008). *Scand J Public Health,* 39**,** 203-11.
EUROQOL RESEARCH FOUNDATION. 2016. *EQ-5D Nomenclature* [Online]. Available: http://www.euroqol.org/about-eq-5d/eq-5d-nomenclature.html [Accessed 05/10/2016 2016].
FRIEDLI, L. 2009. Mental health, resilience and inequalities. Copenhagen: WHO Regional Office for Europe
GALAN, I., BOIX, R., MEDRANO, M. J., RAMOS, P., RIVERA, F., PASTOR-BARRIUSO, R. & MORENO, C. 2013. Physical activity and self-reported health status among adolescents: a cross-sectional population-based study. *BMJ Open,* 3.
GALSTER, G. C. 2010. The mechanism (s) of neighbourhood effects: Theory, evidence, and policy implications. *Neighbourhood effects research: New perspectives.* Springer.
GARTHWAITE, K., BAMBRA, C., WARREN, J., KASIM, A. & GREIG, G. 2014. Shifting the Goalposts: A Longitudinal Mixed-Methods Study of the Health of Long-Term Incapacity Benefit Recipients during a Period of Substantial Change to the UK Social Security System. *Journal of Social Policy,* 43**,** 311-330.
HEDMAN, L., MANLEY, D., VAN HAM, M. & OSTH, J. 2015. Cumulative exposure to disadvantage and the intergenerational transmission of neighbourhood effects. *Journal of Economic Geography,* 15**,** 195-215.
HORLINGS, L. G. 2016. Connecting people to place: sustainable place-shaping practices as transformative power. *Current Opinion in Environmental Sustainability,* 20**,** 32-40.
HOSMER, D. W., LEMESHOW, S. & STURDIVANT, R. X. 2013. *Applied logistic regression*, John Wiley & Sons.
IFANTI, A. A., ARGYRIOU, A. A., KALOFONOU, F. H. & KALOFONOS, H. P. 2013. Financial crisis and austerity measures in Greece: their impact on health promotion policies and public health care. *Health policy (Amsterdam, Netherlands),* 113**,** 8-12.

KITSON, M., MARTIN, R. & TYLER, P. 2011. The geographies of austerity. *Cambridge journal of regions, economy and society,* 4**,** 289-302.

LAUDER, W., MUMMERY, K., JONES, M. & CAPERCHIONE, C. 2006. A comparison of health behaviours in lonely and non-lonely populations. *Psychol Health Med,* 11**,** 233-45.

LOOPSTRA, R., MCKEE, M., KATIKIREDDI, S. V., TAYLOR-ROBINSON, D., BARR, B. & STUCKLER, D. 2016. Austerity and old-age mortality in England: a longitudinal cross-local area analysis, 2007-2013. *J R Soc Med,* 109**,** 109-16.

LOOPSTRA, R., REEVES, A., TAYLOR-ROBINSON, D., BARR, B., MCKEE, M. & STUCKLER, D. 2015. Austerity, sanctions, and the rise of food banks in the UK. *BMJ,* 350**,** h1775.

MACINTYRE, S. & ELLAWAY, A. 2009. Neighbourhood influences on health. *In:* GRAHAM, H. (ed.) *Understanding health inequalities.* Second ed.: McGraw-Hill International.

MACINTYRE, S., ELLAWAY, A. & CUMMINS, S. 2002. Place effects on health: how can we conceptualise, operationalise and measure them? *Soc Sci Med,* 55**,** 125-39.

MAHESWARAN, H., PETROU, S., REES, K. & STRANGES, S. 2013. Estimating EQ-5D utility values for major health behavioural risk factors in England. *Journal of Epidemiology and Community Health,* 67**,** 172-180.

MANUEL, D. G., PEREZ, R., SANMARTIN, C., TALJAARD, M., HENNESSY, D., WILSON, K., TANUSEPUTRO, P., MANSON, H., BENNETT, C., TUNA, M., FISHER, S. & ROSELLA, L. C. 2016. Measuring Burden of Unhealthy Behaviours Using a Multivariable Predictive Approach: Life Expectancy Lost in Canada Attributable to Smoking, Alcohol, Physical Inactivity, and Diet. *Plos Medicine,* 13.

MARMOT, M. & ALLEN, J. J. 2014. Social Determinants of Health Equity. *American Journal of Public Health,* 104**,** S517-S519.

MARMOT, M. & BELL, R. 2012. Fair society, healthy lives. *Public Health,* 126**,** S4-S10.

MARSHALL, J. D., BRAUER, M. & FRANK, L. D. 2009. Healthy Neighborhoods: Walkability and Air Pollution. *Environmental Health Perspectives,* 117**,** 1752-1759.

MASON, P., KEARNS, A. & LIVINGSTON, M. 2013. "Safe Going": The influence of crime rates and perceived crime and safety on walking in deprived neighbourhoods. *Social Science & Medicine,* 91**,** 15-24.

MATHEWS, W. C. & MAY, S. 2007. EuroQol (EQ-5D) measure of quality of life predicts mortality, emergency department utilization, and hospital discharge rates in HIV-infected adults under care. *Health Qual Life Outcomes,* 5**,** 5.

MATTHEYS, K., BAMBRA, C., WARREN, J., KASIM, A. & AKHTER, N. 2016. Inequalities in mental health and well-being in a time of austerity: Baseline findings from the Stockton-on-Tees cohort study. *SSM - Population Health,* 2**,** 350-359.

MCFALL, S. L. & GARRINGTON, C. 2011. Understanding society: early findings from the first wave of the UK's Household Longitudinal Study. University of Essex: Institute for Social and Economic Research.

MELTZER, H. General measures of health for use in Health Interview surveys and Censuses: The UK Experience. Presentation to Washington City Group meeting, Ottawa, 2003. 8-10.

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'. *J Public Health (Oxf),* 38**,** 197-205.

MOLLER, H., HAIGH, F., HARWOOD, C., KINSELLA, T. & POPE, D. 2013. Rising unemployment and increasing spatial health inequalities in England: further extension of the NorthSouth divide. *Journal of Public Health,* 35**,** 313-321.

MOOR, I., RATHMANN, K., STRONKS, K., LEVIN, K., SPALLEK, J. & RICHTER, M. 2014. Psychosocial and behavioural factors in the explanation of socioeconomic inequalities in adolescent health: a multilevel analysis in 28 European and North American countries. *Journal of Epidemiology and Community Health,* 68**,** 912-921.

NIEDZWIEDZ, C. L., MITCHELL, R. J., SHORTT, N. K. & PEARCE, J. R. 2016. Social protection spending and inequalities in depressive symptoms across Europe. *Soc Psychiatry Psychiatr Epidemiol,* 51**,** 1005-14.

OFFICE FOR NATIONAL STATISTICS 2013. Usual resident population. *In:* OFFICE FOR NATIONAL STATISTICS (ed.). Nomis.

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

PEARCE, J. 2015. Invited commentary: history of place, life course, and health inequalities-historical geographic information systems and epidemiologic research. *Am J Epidemiol,* 181**,** 26-9.

PETER, R., ALFREDSSON, L., HAMMAR, N., SIEGRIST, J., THEORELL, T. & WESTERHOLM, P. 1998. High effort, low reward, and cardiovascular risk factors in employed Swedish men and women: baseline results from the WOLF Study. *J Epidemiol Community Health,* 52**,** 540-7.

PICKETT, K. E. & PEARL, M. 2001. Multilevel analyses of neighbourhood socioeconomic context and health outcomes: a critical review. *Journal of epidemiology and community health,* 55**,** 111-122.

POLITIS, D. N. 2014. Bootstrap Confidence Intervals in Nonparametric Regression Without an Additive Model. *In:* AKRITAS, G. M., LAHIRI, N. S. & POLITIS, N. D. (eds.) *Topics in Nonparametric Statistics: Proceedings of the First Conference of the International Society for Nonparametric Statistics.* New York, NY: Springer New York.

PUBLIC HEALTH ENGLAND. 2015. *Stockton-on-Tees: Health Profile 2015* [Online]. APHO. Available: http://www.apho.org.uk/resource/item.aspx?RID=171624 [Accessed 14/07/2016].

ROSS, C. E. & MIROWSKY, J. 2008. Neighborhood socioeconomic status and health: Context or composition? *City & Community,* 7**,** 163-179.

RUIJSBROEK, A., DROOMERS, M., GROENEWEGEN, P. P., HARDYNS, W. & STRONKS, K. 2015. Social safety, self-rated general health and physical activity: Changes in area crime, area safety feelings and the role of social cohesion. *Health & Place,* 31**,** 39-45.

SCHRECKER, T. & BAMBRA, C. 2015. *How politics makes us sick : neoliberal epidemics,* Houndmills, Basingstoke, Hampshire ; New York, NY, Palgrave Macmillan.

SHOULS, S., CONGDON, P. & CURTIS, S. 1996. Modelling inequality in reported long term illness in the UK: combining individual and area characteristics. *Journal of Epidemiology and Community Health,* 50**,** 366-376.

SHROUT, P. E. & BOLGER, N. 2002. Mediation in experimental and nonexperimental studies: new procedures and recommendations. *Psychol Methods,* 7**,** 422-45.

SINCLAIR, M., O'TOOLE, J., MALAWARAARACHCHI, M. & 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 Med Res Methodol,* 12**,** 132.

SKALICKA, V., VAN LENTHE, F., BAMBRA, C., KROKSTAD, S. & MACKENBACH, J. 2009. Material, psychosocial, behavioural and biomedical factors in the explanation of relative socio-economic inequalities in mortality: evidence from the HUNT study. *Int J Epidemiol,* 38**,** 1272-84.

SMITH, N. R., LEWIS, D. J., FAHY, A., ELDRIDGE, S., TAYLOR, S. J. C., MOORE, D. G., CLARK, C., STANSFELD, S. A. & CUMMINS, S. 2015. Individual socio-demographic factors and perceptions of the environment as determinants of inequalities in adolescent physical and psychological health: the Olympic Regeneration in East London (ORiEL) study. *Bmc Public Health,* 15.

SMITH, T. C., ZAMORSKI, M., SMITH, B., RIDDLE, J. R., LEARDMANN, C. A., WELLS, T. S., ENGEL, C. C., HOGE, C. W., ADKINS, J., BLAZE, D. & MILLENNIUM COHORT STUDY, T. 2007. The physical and mental health of a large military cohort: baseline functional health status of the Millennium Cohort. *BMC Public Health,* 7**,** 340.

SYKES, B. & MUSTERD, S. 2011. Examining Neighbourhood and School Effects Simultaneously: What Does the Dutch Evidence Show? *Urban Studies,* 48**,** 1307-1331.

TAMAYO, A., KARTER, A. J., MUJAHID, M. S., WARTON, E. M., MOFFET, H. H., ADLER, N., SCHILLINGER, D., O'CONNELL, B. H. & LARAIA, B. 2016. Associations of perceived neighborhood safety and crime with cardiometabolic risk factors among a population with type 2 diabetes. *Health & Place,* 39**,** 116-121.

VERBEKE, G. & MOLENBERGHS, G. 2000. Linear mixed models for longitudinal data Springer-Verlag. *New York*.

WARREN, J., BAMBRA, C., KASIM, A., GARTHWAITE, K., MASON, J. & BOOTH, M. 2014. Prospective pilot evaluation of the effectiveness and cost-utility of a health first case management service for long-term Incapacity Benefit recipients. *Journal of Public Health,* 36**,** 117-125.

WARREN, J., GARTHWAITE, K. & BAMBRA, C. 2013a. A health problem? Health and employability in the UK labour market. *Disability Benefits, Welfare Reform and Employment Policy.* Springer.

WARREN, J., WISTOW, J. & BAMBRA, C. 2013b. Applying Qualitative Comparative Analysis (QCA) to evaluate a public health policy initiative in the North East of England. *Policy and Society,* 32**,** 289-301.

WORLD HEALTH ORGANIZATION 2016. Life expectancy Data by country. *Global Health Observatory data repository.*