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Does income relate to health due to psychosocial or material factors? Consistent support for the psychosocial hypothesis requires operationalization with income rank not the Yitzhaki Index

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ABSTRACT

Research on why income influences health has produced mixed findings. Many, but not all, studies suggest that the relationship between income and health is due to income indicating psychosocial position rather than the associated material benefits. The inconsistent findings may be partly due to the use of the Yitzhaki Index, a function which calculates the accumulated income shortfall for an individual relative to those with higher income, in order to represent the psychosocial position conferred by income. The current study tests whether an alternative specification – income rank – provides more consistent conclusions regarding the psychosocial effect of income on health. We used data from two nationally representative samples: 14,224 observations from 9,404 participants across three waves (2004, 2008, and 2012) of the English Longitudinal Study of Ageing (ELSA) and 29,237 observations from 8,441 individuals across seven waves (2007–2013) of the Longitudinal Internet Studies for the Social Sciences (LISS). Multilevel regression models indicated that income rank was a stronger and more consistent predictor than both the Yitzhaki Index and actual income of self-rated and objective health. The psychosocial hypothesis is more consistently supported when income rank is used to test it.

1. Introduction

A large body of research has investigated why an individual's income negatively relates to their health. Two distinct hypotheses have been offered to explain the association between income and health at the individual level. The materialist hypothesis posits that individuals with lower income are less likely to have good health than individuals with higher income because they lack material resources that are conducive to good health (Lynch et al., 2000). This hypothesis can be contrasted with the *psychosocial hypothesis* (Subramanian and Kawachi, 2004; Wilkinson and Pickett, 2006, 2009) which proposes that individuals with less income often have worse health than individuals with higher income due to negative upward social comparisons (Kondo et al., 2008; Runciman, 1966) which can result in frustration, shame, stress (Kondo et al., 2008) and subsequently ill health.

The literature comparing the materialist and psychosocial effects of an individual's income on their health has mostly used actual income to represent the materialist hypothesis. This is normally contrasted with the psychosocial hypothesis as represented by the Yitzhaki Index (Yitzhaki, 1979). This function represents the average difference between an individual's income and the income of all individuals with higher income within the same reference group. Studies using the Yitzhaki Index to assess the psychosocial hypothesis have yielded mixed results, with many studies finding the Yitzhaki Index relates to health (for example, Eibner and Evans, 2005; Eibner et al., 2004; Kondo et al., 2008; Subramanyam et al., 2009; Yngwe et al., 2012; Yngwe et al., 2005; Yngwe et al., 2003), while many others (for example Gravelle and Sutton, 2009; Jones and Wildman, 2008; Li and Zhu, 2006; Lorgelly and Lindley,

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2008; Wildman, 2003) find no or only weak evidence for an association (see Adjaye-Gbewonyo and Kawachi, 2012, for a review of empirical studies published between 2000 and 2010 that test the effect of Yitzhaki Index on health measures). The mixed findings have been attributed to a number of different factors, such as the use of different outcome measures, countries, size and choice of reference groups, statistical methods, different time lags between income and health measures, as well as the presence of a threshold effect of income differences on health (Kondo et al., 2009).

Meanwhile, a new line of evidence (Boyce et al., 2010; Daly et al., 2015; Hounkpatin et al., 2015; Wood et al., 2012a) has consistently suggested that it is the rank (ordinal position) of an individual's income that is psychosocially important for their health. For example, Daly et al. (2015) compared the effects of income and income rank on self-rated health, obesity, and allostatic load, and they found that income rank was significantly associated with each health measure in two British populations, even after controlling for the effects of actual income. Moreover, when controlling for income rank, actual income no longer related to health, suggesting that income only relates to health through acting as a proxy for income rank. This parallels findings with mental health and depressive symptoms as the outcome (Elgar et al., 2013; Hounkpatin et al., 2015; Wetherall, Daly, Robb, Wood, & O'Connor, 2015; Wood et al., 2012a) as well as findings from a study by Subramanyam et al. (2009) which indicated that percentile income rank significantly predicted self-rated health in a US population after controlling for actual income. The income rank specification is consistent with the psychosocial hypothesis but differs from the Yitzhaki Index in that it proposes that health is not necessarily related to the *magnitude* of the difference, but rather the position of income on the income distribution within a comparison group.

The first motivation of the *income rank hypothesis* was from primate studies indicating that low ranking animals in conflict with more dominant members of the same species experience high levels of stress (Sapolsky, 2004; Shivley et al., 1997) as evidenced by decreased levels of serotonin in their serum (Raleigh et al., 1983; Yeh et al., 1996). Reduced secretion of serotonin is believed to have allowed the subordinate animal to behave in a hyper vigilant and withdrawn manner so as to increase their chances of survival under hostile conditions. Humans continue to display similar reactions in response to cognitions associated with low social rank (Gilbert, 2006; Price et al., 1994). While these hard-wired responses to low rank were adaptive under evolutionary conditions, such reactions may adversely affect health in modern day, particularly if prolonged (Gilbert, 2006; P. J. Taylor, Gooding, Wood and Tarrier, 2011).

The second motivation for the rank hypothesis was from cognitive science findings that people always judge relative magnitude based on rank position rather than any other specification (Stewart et al., 2006). Judgements normally rely on heuristics, rules of thumb that balance cognitive processing cost with accuracy (Kahneman and Tversky, 1979, 2000). It has been suggested that when making relative judgements (such as one's income position relative to others) people first bring a distribution of similar stimuli to mind (e.g., other individual's income) from memory or salient features of the environment, sequentially compare the target (e.g., one's income) with each of the other stimuli in the set (e.g., the incomes of others), and simply keep track of the number of stimuli higher than the target stimuli (that is, one's rank within the income distribution). This ranking process provides a balance between the low cognitive costs (and low informational value) of making non-relative judgements and the high cognitive costs (but high informational value) of calculating both rank position and relative distance (as with the Yitzhaki Index), whilst still capturing most of the relevant information through taking into account the main features of the distribution (e.g., skew). This model has been shown to predict judgements of personality (Wood et al., 2012c), fairness of sentencing (Aldrovandi et al., 2013), indebtedness (Aldrovandi et al., 2015), willingness to pay for food (Aldrovandi et al., 2015), educational satisfaction (Brown et al., 2015), emotion (Melrose et al., 2013; Wood et al., 2011), alcohol use (M. J. Taylor, Vlaev, Maltby, Brown and Wood, in press; Wood et al., 2012b), pain (Watkinson et al., 2013) and health benefits of exercise (Maltby et al., 2012).

If people have an evolutionary sensitivity to rank position and judge their social position based on rank position, using the Yitzhaki Index - which measures rank plus the magnitude of income difference - may erroneously lead to a rejection of the psychosocial hypothesis. For example, when using the Yitzhaki Index a psychosocial effect of income may not be apparent for a comparison group of individuals with similar incomes as income differences will only be minimal. However, a psychosocial effect would be observed for the same group of individuals when using a pure rank specification. We are unaware of any previous studies in adults that have directly contrasted the health effects of the Yitzhaki Index and income rank specifications. Although a study by Elgar et al. (2013) indicated that rank affluence (within region) better predicted psychosomatic symptoms in an adolescent sample than actual family affluence or Yitzhaki Index, it is not clear whether such findings might extend to an adult population and to objectively as well as subjectively measured health outcomes. In the present study, we directly compare the effects of Yitzhaki Index and income rank on two health measures, self-rated health and allostatic load, using data from two nationally representative but culturally different adult samples. Due to co-linearity issues associated with predicting health jointly from income and income rank or Yitzhaki Index (Gravelle and Sutton, 2009), we primarily compare the predictive fit of each of the income-related predictors. We hypothesised that: (H1) A model using income rank will better predict both self-rated and objective health than one that uses the Yitzhaki Index, suggesting that income rank is the better representation of psychosocial position, and (H2) use of income rank would provide more consistent support for the psychosocial hypothesis across measures and datasets than the Yitzhaki Index.

2. Methods

2.1. Participants and procedure

The analysis was performed on two separate datasets: the English Longitudinal Study of Ageing (ELSA) and the Longitudinal Internet Studies for the Social Sciences (LISS) panel.

2.1.1. ELSA

ELSA is a nationally representative sample of non-institutionalized individuals aged 50 years and older and living in England. The ELSA sample was drawn from households who participated in the Health Survey for England (HSE) during 1998, 1999, and 2001. Participants were asked to complete questionnaires about their socio-demographics and health every two years. During Wave 2 (2004), Wave 4 (2008), and Wave 6 (2012), participants who gave consent were also visited by a nurse for assessment of objective measures of health such as blood pressure, lung function and anthropometric indices. Seventy-eight percent of the initial sample (9,432 out of 12,100 participants) completed questionnaires at Wave 2 (2004) and 7,666 participants (63.35% of the initial sample) additionally underwent clinical assessment by a nurse. Eleven thousand and fifty participants completed questionnaires during Wave 4, and 10,601 participants completed