The convergent validity of three surveys as alternative sources of health information to the 2011 UK Census

Joanna Taylor, Liz Twigg and Graham Moon

Abstract

Censuses have traditionally been a key source of localised information on the state of a nation's health. Many countries are now adopting alternative approaches to the traditional census, placing such information at risk. The purpose of this paper is to inform debate about whether existing social surveys could provide an adequate 'base' for alternative model-based small area estimates of health data in a post traditional census era. Using a case study of 2011 UK Census questions on self-assessed health and limiting long term illness, we examine the extent to which the results from three large-scale surveys – the Health Survey for England, the Crime Survey for England and Wales and the Integrated Household Survey – conform to census output. Particularly in the case of limiting long term illness, the question wording renders comparisons difficult. However, with the exception of the general health question from the Health Survey for England all three surveys meet tests for convergent validity.

Short report

Small area health information highlights localised need for health services and community based care provision. As Luck, Chang, Brown & Lumpkin (2006, 979) argue "*it can be a powerful vehicle for improving the health of a community by both highlighting the existence of problems and opportunities for improvement. It can also guide local action in support of*

policy change". National censuses have traditionally been one of the main sources of small-area health information. In the UK numerous academic publications attest to the importance of census health data as a source for small area studies of health inequalities (with examples including Barnett et al., 2001; Boyle, Gatrell, & Duke-Williams, 1999; Cairns, Curtis, & Bambra, 2012; Congdon, 2006; Haynes & Gale, 2000). This situation is replicated in other countries with census health questions.

As of January 2014 a total of 227 countries or areas have taken or will be taking a census between 2005 and 2014 (United Nations, 2014). Of the 79 censuses analysed by the United Nations (2010) the majority included questions on mortality (37%) and/or disability status (66%). A significant proportion of censuses now adopt alternative approaches to a traditional census based on full field enumeration, through the use of administrative records, a rolling census and/or survey supplements. Of the 121 countries surveyed 11 per cent reported using alternative methodologies prior to 2005 and a further 15 per cent have introduced new methodologies more recently (United Nations, 2013). Countries such as New Zealand and the United Kingdom are currently investigating options for future censuses. In the UK case the Office for National Statistics (the national statistical institute for the UK) launched its "*Beyond 2011*" programme reviewing the options for the future production of population statistics in April 2011. A census of the UK population has been taken every decade since 1841 (with the exception of 1941 and an additional census in 1966) (Stillwell et al., 2013) predominantly using a paper census form. March 2014 saw the publication of the final recommendation from the National Statistician and Chief Executive of the UK Statistics Authority – an online census of all households and communal establishments in England and Wales in 2021. She also recommended an increased use of administrative data and surveys in order to improve annual statistics between censuses as well as enhance the statistics from the

2021 Census, stating that this approach will "*offer a springboard to the greater use of administrative data and annual surveys in the future*" (Matheson, 2014, 11).

However, previous work by the Beyond 2011 programme demonstrated how any future increased reliance on annual surveys would be potentially challenging for the continued provision of small area data. Even if a new compulsory survey interviewed four per cent of the population annually, at least three years' data would be required to produce direct estimates for the small area geographies currently available via the traditional census (ONS, 2013a). Small area synthetic estimation could circumnavigate this problem by using statistical models that predict the probability of a 'target variable' using national surveys, but adjusting that prediction to take account of local area characteristics.

The purpose of this paper is to inform the debate as to whether existing rather than specially commissioned social surveys could provide an adequate 'base' for such estimation techniques. We, focus on the UK 2011 Census questions on general health and limiting long term illness (LLTI) and begin by outlining three candidate surveys before moving onto describe their coverage of the two specific health questions. A methods section explains how we test for convergent validity between the census and the surveys. To conclude we explore the broader implications of our findings for the synthetic estimation of health status based on existing social surveys.

The surveys

Three surveys are considered – the Health Survey for England (HSfE), the Crime Survey for England and Wales (CSEW) and the Integrated Household Survey (IHS). These were chosen to exemplify a specialist health survey, a specialist survey on a non-health related issue and a larger-scale general household survey. We focus on the 2011 runs of these surveys.

The 2011 sweep of the HSfE, commissioned by the Health and Social Care Information Centre, was the 21st annual survey and interviewed 8,610 adults and 2,007 children living in private households and achieved a core household response rate of 66 per cent (NatCen Social Research, 2012; NatCen Social Research and UCL, 2013)[i]. The survey covers public health trends, the proportions of people who have specific health conditions and the prevalence of risk factors associated with these health conditions.

The CSEW (ONS, 2013b)[1] , until recently was known as the British Crime Survey, was first conducted in 1982, however, since 2001/02 it has been conducted continuously with the survey asking adults living in private households about their experiences of crime in the year preceding the interview as well their views on crime and criminal justice issues. It also includes questions on health status as part of its generic demographics module. The 2011/12 sweep achieved a sample size of 45,930 with a response rate of 75 per cent (TNS BMRB, 2012).

The 2011/12 IHS is comprised of a core suite of questions from three ONS household surveys – the Annual Population Survey (which itself combines results from the Labour Force Survey (LFS) and the English, Welsh and Scottish LFS boosts), the Living Costs and Food Survey and up until December 2011 the General Lifestyles Survey – and currently represents the biggest pool of UK social data after the census. It encompassed 350,000 respondents and covered themes such as education, migration, housing and employment as well as health (ONS, 2012b).

General health

A question on general health was first asked in the 2001 Census. The question has helped inform the Department of Health and (former) NHS Primary Care Trusts decisions on the allocation of health resources at local and national level with data on general health being found to be a strong predictor of the higher utilisation of health service resources (ONS, 2010). The question has also been used to facilitate research on a broad range of topics including area level health resilience (Cairns, Curtis, & Bambra, 2012) and patterns of worklessness (Bambra & Popham, 2010). The wording of the 2011 Census question on general health was: "*how good is your health in general*?" with the possible answers being "*very good*", "*good*", "*fair*", "*bad*" and "*very bad*". This is the recommended harmonised question wording for use in (government) surveys (ONS, 2011a) and is copied exactly by all three surveys under investigation in this paper, albeit with different topics preceding and following.

ONS (2011a) states that the general health five point scale can be dichotomised with "*very good*" and "*good*" being classified as "*good health*" and the remainder being grouped together as "*poor health*". ONS's justification for including "*fair*" in the poor health category emanates from evidence from the 2005 and 2006 General Lifestyles Surveys which found that more than half of those who described their general health as fair also reported an LLTI compared with less than ten per cent of those who said their health was either very good or good (Smith & White, 2009). On the basis of this evidence, we focus below on a dichotomous categorisation of general health.

Limiting long-term illness

A limiting long-term illness question has been included in the census since 1991 with data from this question historically being used by the Department for Health in their formula for funding local health services. The information has also been used to allocate health resources within local jurisdictions and for policy development and monitoring, in relation to the assessment of progress towards better population health, the reduction of health inequalities, and improving access to services (ONS, 2010). Academic research using census LLTI data has included work by Barnett et al., (2001), Boyle, Gatrell & Duke-Williams (1999) and Spencer, Blackburn & Read (2010).

Unlike the general health question, questions on LLTI differ between our chosen sources, sometimes markedly (Table 1). A harmonised question was only introduced as a primary standard by the Office for National Statistics in August 2011, after the design period of the surveys and the census (ONS, 2011b). Earlier versions of the harmonised question (which included the term "*disability*") were classified as secondary standards meaning that they only applied to a selected group of surveys. A particular difference between our sources is that the census question specifically tells respondents to include LLTI problems relating to old age. With the exception of an optional prompt on the CSEW this is not the case with our surveys.

Table 1 Questionnaire wording for LLTI

Source	Question(s) on LLTI
2011 Census	Are your day-today activities limited because of a health problem or disability which has lasted, or is expected to the last, at least 12 months? Include problems relating to old age. 1. Yes, limited a lot 2. Yes, limited a little 3. No
CSEW	Do you have any of the following long-standing physical or mental health conditions or disabilities that have lasted or are expected to last 12 months or more? IF NECESSARY: Please include those that are due to old age 1. Blindness, deafness or other communication impairment 2. Mobility impairment, such as difficulty walking 3. Learning difficulty or disability, such as Down's syndrome 4. Mental health condition, such as depression 5. Long-term illness, such as Multiple Sclerosis or cancer 6. Other long-standing health condition or disability 7. None of these Does/do your health condition(s) or disability/disabilities mean that your day to day activities are limited? Would you say you are… 1. Severely limited 2. Limited but not severely 3. Or not limited at all?
HSfE	Do you have any long-standing illness, disability or infirmity? By long-standing I mean anything that has troubled you over a period of time, or that is likely to affect you over a period of time? 1. Yes 2. No Does this illness or disability/do any of these illnesses or disabilities limit your activities in any way? 1. Yes 2. No
IHS (APS component)	Do you have any health problems or disabilities that you expect will last for more than a year? 1. Yes 2. No
(Other components' question wording same as HSfE)	Do these health problems or disabilities, when taken singly or together, substantially limit your ability to carry out normal day to day activities? If you are receiving medication or treatment, please consider what the situation would be without the medication or treatment. 1. Yes 2. No

Some of the surveys employ a dichotomous coding frame whereas others cover the extent of limitation. Research conducted by ONS (2011b) found no evidence to suggest that combining the "*little*" and "*a lot*" categories into a dichotomous measure artificially inflated the

prevalence compared with using "*yes*" or "*no*" response categories. Other differences such as the inclusion of more emotive language such as "*troubled you*" in the HSfE (Goddard, 1990) or the word "*infirmity*", which for some respondents is synonymous with old age (Sturgis et al., 2001), have been hypothesised to affect respondents' answers. The IHS includes two different types of questions depending on the source survey. Respondents from either the Living Costs of Food Survey or the General Lifestyles Survey were asked the same questions as the HSfE. However, the Annual Population Survey questions are markedly different as respondents are prompted to consider what the situation would be without medication or treatment (where applicable). The official guidance states that because of the significant differences in the wording of these questions, the differences cannot be bridged between the different sources of the IHS and consequently the data are not made available to external researchers (ONS, 2012c)

Two other 2011 UK Census questions cover, at least in part, health related issues. The first asks about individuals' caring responsibilities for others with long-term physical or mental ill-health/disability and/or problems related to old age. Out of the three surveys covered in this short paper only the HSfE included such a question. The other census question which touches on ill health asks respondents about their employment in the last seven days with one of the options being long-term sick or disabled. None of the employment status questions included in the surveys were comparable. For example the IHS uses a seven day reference period for employment followed by a four week reference period for unemployment and inactivity. For these reasons the focus for this report is on the two health questions which were covered by at least two of the surveys.

Methods

To test for convergent validity of data on general health and LLTI from the three surveys against the 2011 Census we adopted the methodology outlined by Scarborough, Allender, Rayner & Goldacre (2009) for validating synthetic estimates of the prevalence of risk factors for coronary heart disease against alternative direct survey estimates. We plot survey based estimates (x axis) against an external measurement (in this case the census) of the same target variable (y axis) at the smallest common geography (regions, which before April 2011 were known as Government Office Regions) across all three surveys. Although there will be some scatter, due to confidence intervals around the survey estimates, in order to achieve convergent validity the scatter should be around the line $x = y$. In other words a regression line should have a gradient close to one and an intercept around zero. Scarborough Allender, Rayner & Goldacre (2009, 598) stated that "*the external measurement is not required to be a gold standard*", however, because the UK Census questions have almost complete coverage of the population (with the undercount being compensated for in the published figures using the Census Coverage Survey (ONS, 2012a)) it is argued that the census represents a near gold standard (Holt, Diamond, & Cruddas, 2001) to compare against the survey estimates.

It is worth noting at this juncture that although we conduct our tests for convergent validity at the regional level (as the smallest common geography across the three surveys) any small area synthetic estimates of health information would be needed at a much finer or more localised level. However, we contend that if convergent validity is not achieved at the course geography of regions it suggests that the surveys would not provide an adequate base for neighbourhood synthetic estimates, especially given the fact that any statistical model's regional residuals are often incorporated into the synthetic estimation process.

Results

The HSfE tended to overestimate both the percentages reporting poor health and those stating they had an LLTI for most regions compared with the census (Figures 1 and 2[ii]). However, it should be noted that because the confidence intervals for the survey data were relatively wide, due to a relatively small sample size, most of the 2011 Census figures fell within the surveys' confidence intervals. The CSEW estimates of poor health were similarly very close to those from the 2011 Census. On the other hand, the CSEW underestimated the proportion of people with an LLTI for all regions except the West Midlands. Previous analysis of the General Household Survey suggested that respondents who are asked about their specific illness before they are asked whether the illness limited their activities (as is the case for the CSEW) might give lower estimates of any limiting and long lasting health conditions or illnesses (Foster, Wilmot, & Dobbs, 1990). The authors hypothesised that some respondents may be reluctant to state that the illness limits their activities to an interviewer if the interviewer already knows the nature of their illness. In the case of the IHS results are restricted to the general health question because the data on LLTI are unavailable. By virtue of the IHS's large sample size the confidence intervals are relatively tight and therefore the census figures fall outside these intervals for all regions except the South West, West Midlands and Wales.

INSERT FIGURE 1 AROUND HERE

Figure 1 95 % confidence intervals for the three surveys versus the 2011 Census for percentage of adults with poor health

INSERT FIGURE 2 AROUND HERE

Figure 2 95 % confidence intervals for the three surveys versus the 2011 Census for percentage of adults with an LLTI

Table 2 and Figure 3 details the results of the Scarborough, Allender, Rayner & Goldacre (2009) test for convergent validity. Of the five permutations the only one which does not meet their criteria of a regression line with a gradient close to one and an intercept around zero is HSfE's measure of general health where the gradient is significantly different from one. Strong correlations between the survey estimates and the census were found for all permutations with the strongest from the CSEW.

Table 2 Surveys versus the census at the region level

	Intercept	Lower CI	Upper CI	Contains zero?	Gradient	Lower CI	Upper CI	Contains one?	$\rho^{(c)}$
General health									
2011 HSfE	0.09	-0.01	0.19	✓	0.57	0.16	0.98	×	0.75 *
2011/12 CSEW	0.02	-0.02	0.06	✓	0.90	0.71	1.08	✓	0.99**
2011/12 IHS	-0.02	-0.06	0.03	✓	1.01	0.84	1.19	✓	0.93**
LLTI									
2011 HSfE	0.01	-0.06	0.09	✓	0.85	0.51	1.20	✓	0.88**
2011/12 CSEW	0.03	-0.01	0.07	✓	0.95	0.75	1.16	✓	0.93**

a. * and ** indicates correlation significant at the 0.05 and 0.01 levels respectively.
b. CIs represent 95 per cent confidence intervals.
c. ρ indicates Spearman's rank correlation.

INSERT FIGURE 3 AROUND HERE

Figure 3 Scatter plots of the survey estimates against the 2011 Census at the regional level

Discussion

Small area estimation using survey data may offer a census replacement strategy for neighbourhood level statistics on topics, such as health, not necessarily covered by administrative data, both in the UK and internationally. The question posed at the beginning of this paper was whether the three surveys under investigation could be used as the base to

generate such estimates. With the exception of the general health question from the HSfE all three surveys met tests for convergent validity. However, as Figures 1 and 2 illustrate there were differences between the 2011 Census and the corresponding survey estimates – the 'worst' being the East of England where four out of the five survey measures were statistically significantly different to the census compared with just one significant difference for the South West.

We found important differences in wording between the 2011 Census and the surveys analysed in this report for the LLTI question(s). For example, the Annual Population Survey asks respondents to consider what the situation would be without medication or treatment, therefore in many instances turning the question into one about the efficiency of treatment. This is a fundamental difference which at the time of the 2011 Census, limited the utility of ONS's largest survey as a potential census replacement strategy via small area estimation for generating local data on LLTI.[iii]

Nonetheless we must sound some notes of caution. All three surveys included the same general health question wording as the census but collected the information in different ways. The householder is responsible for ensuring that the census questionnaire is completed whereas the surveys are completed by the individual. Furthermore the census is a paper self-completion form whereas the surveys were interviewer administered. The context of the survey may also matter, with those focusing on health generating higher estimates – something that our analysis supports. It is also worth stating at this juncture that the analyses presented here are limited to large scale geographical differences between survey and census results as the rationale for the paper was to investigate the suitability of existing surveys as a base for small area estimates as a potential census replacement strategy for localised health

information. It is reported elsewhere how responses to health questions also vary by socio-demographic characteristics. For example, Altman and Gulley (2009) found that older respondents as well as those with low income or low educational qualifications were less likely to answer different questions to ascertain disability prevalence differently. Furthermore, Calnan (1987) reported that those with higher levels of education were able to produce more elaborated definitions of health which could lead to systematic differences between social groups in their understanding of a question on general health (Sturgis et al., 2001).

The focus of the UK Beyond 2011 programme was the option of a new compulsory survey, arguably, to the exclusion of considering the sizeable resource of existing social surveys. The majority of the measures met the test for convergent validity and although it was acknowledged in the recent consultation document on the future of the census that "*any change would lead to some discontinuities from statistics produced previously*" (ONS, 2013a, 11), the geographical differences between the census and survey estimates (taking into account the latter's confidence intervals) make it difficult to advocate that the existing surveys, in their current format, could provide an adequate base for small area estimates of the census health questions. Alternatively if, in the future, a compulsory survey were to be introduced to supplement annual population statistics from administrative sources, the research presented here again highlights the imperative importance of the question wording to ensure continuity with past small area data on health.

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Figure 1

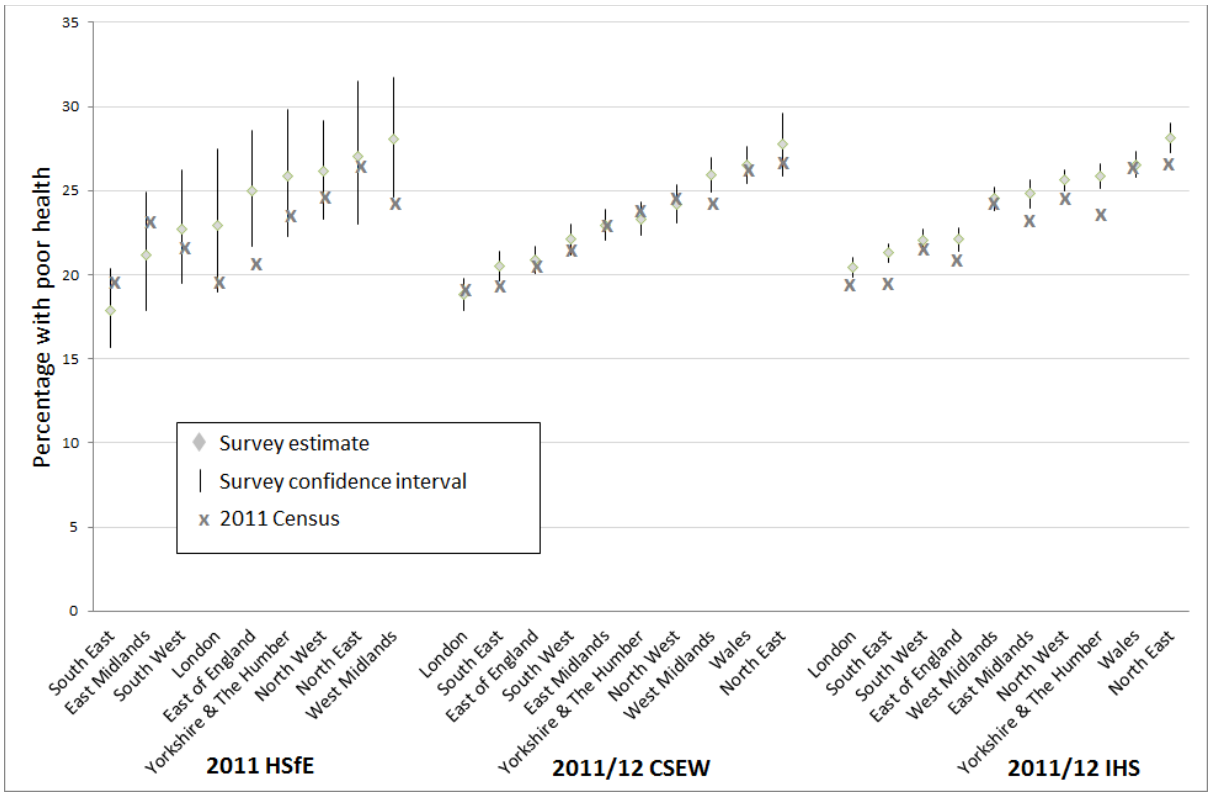


Figure 2

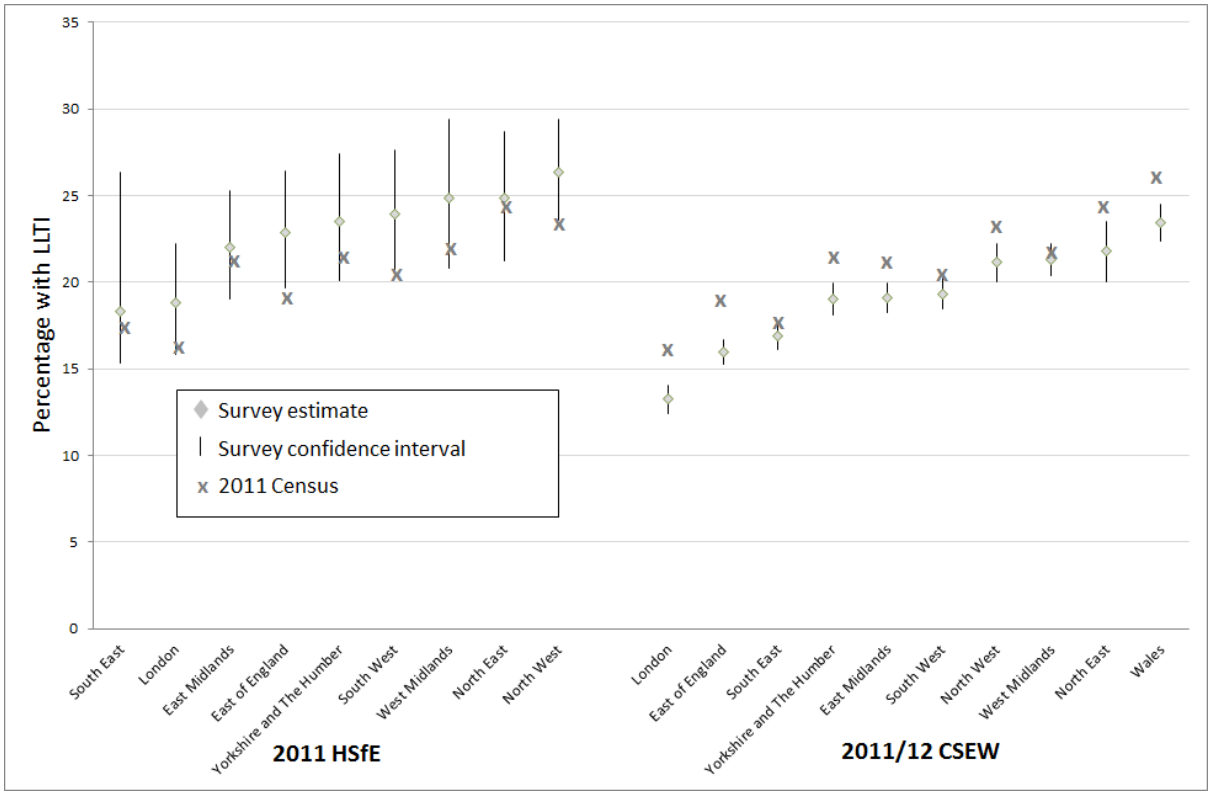
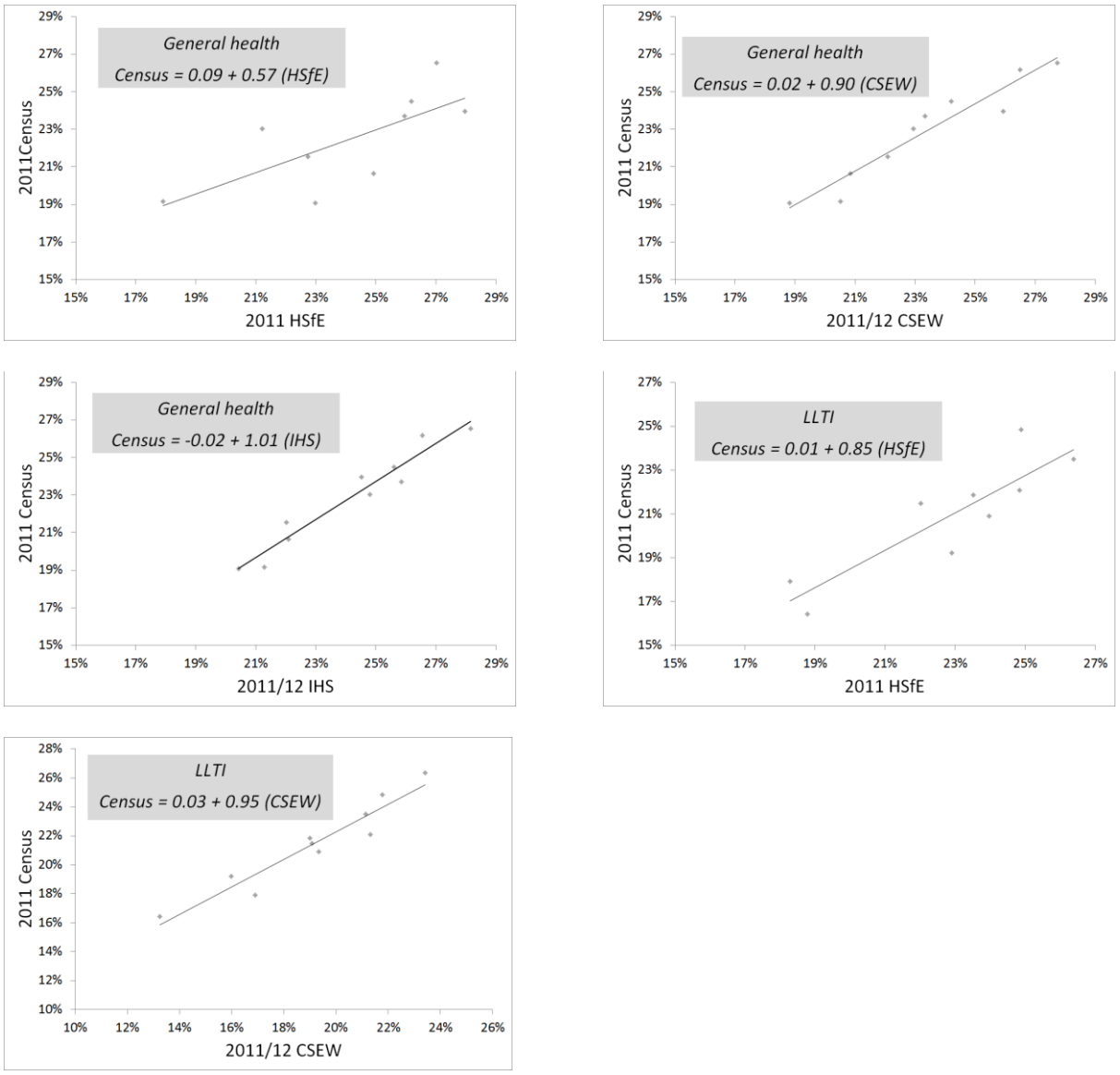


Figure 3



[i] The original data creators, depositors or copyright holders, the funders of the data collections and the UK Data Archive bear no responsibility for their further analysis or interpretation.

[ii] All figures based on adults aged 16 or over living in private households. The census figures exclude those living in communal establishments to reflect the sampling strategy of the surveys.

[iii] In April 2013 the APS adopted the harmonised LLTI question (ONS, 2013c).