Wales Centre for Health
Canolfan Iechyd Cymru

National Public Health Service for Wales
Gwasanaeth Iechyd Cyhoeddus Cenedlaethol Cymru

Briefing paper on LSOA Townsend deprivation scores calculated from unadjusted Census data

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Date: 31/01/08 | **Version:** 1c

Status: Draft

Intended Audience: Public Health Information professionals

Purpose and Summary of Document: This paper gives information on the production of lower super output area (LSOA) Townsend scores from unadjusted Census data, and on the methodology and data sources used. It documents an investigation into the calculation of the Index for England and Wales, including a comparison of results when using different overcrowding variables, and between scores using adjusted and unadjusted Census data.

Publication/Distribution: Publication on website/dissemination to PHOs

Version History:

Version	Change	By	Date
1a	First draft	Andrea Gartner (WCfH)	21/01/08
1b	Minor additions & amendments	Nathan Lester	24/01/08
1c	Minor corrections	Andrea Gartner (WCfH)	28/01/08

1 Introduction

The Townsend deprivation index (Townsend, Phillimore & Beattie, 1988) is well-known and widely used in health research, particularly in academic research (Galobardes *et al.*, 2007). Gordon (1999) also considers the Index to be valid and reliable. In public health departments and government organisations other deprivation measures such as the IMD (England) and WIMD (Wales) are often used instead, but some organisations, such as the National Public Health Service for Wales (NPHS), prefer to use the Townsend index. This is because the Index focuses on a tight definition of deprivation, that is material deprivation, and may be calculated consistently over time using the same variables and calculation methodology (using the decennial census). Indices of multiple deprivation such as the IMD and the WIMD have not been consistent in this way.

Townsend scores are usually calculated from published Census data, which in 2001 were subject to random small cell adjustment by the Office for National Statistics (ONS) in order to prevent disclosure of personal information, and are not available for the exact age groups specified in the methodology described by Townsend, Phillimore and Beattie (1988). As part of an MPH research project with the ONS, it was possible to obtain unadjusted lower super output area (LSOA) Census data to calculate more accurate scores for both Wales and England at the ONS offices. In the process of calculating these it became apparent that there were also two different sources of data used for the calculation. An investigation into these differences was undertaken to provide the most accurate score possible and to make recommendations on the methodology.

2 Purpose of this paper

This paper gives information on the production of the scores along with the methodology and data sources used. It documents the modest investigation into the calculation of the Index for England and Wales, including a comparison of results when using different sources.

3 Calculation method

The method used was adapted from Townsend, Phillimore & Beattie (1988). The Index uses four equally weighted variables to calculate the scores as follows:

Variable 1: % economically active residents aged 16-59/64 who are unemployed (excluding students)

Variable 2: % private households who do not possess a car or van

Variable 3: % private households not owner occupied

Variable 4: % private households overcrowded (more than one person per room)

Variables 1 and 4 are log transformed to normalise their distributions (y=ln(x+1)). As a next step, the z-score technique is applied (e.g. z-score1 = (Variable1 – Mean(Variable1))/Standard deviation(Variable 1)). The final score is the sum of the four z-scores.

Note that for Variable 1 the Census data was supplied for the age groups prescribed in the original method, i.e. 16-64 years for males and 16-59 years for females. At LSOA level, published Census data on unemployment aggregates to the 16-74 age group. It was also possible to exclude the full-time students from the unemployed and economically active population counts. However, published data groups students with the rest of the population preventing their exclusion from the calculation.

4 Two data sources for overcrowding

There are two sources of Census data for the overcrowding variable:

a) The previous definition of more than one person per habitable room (>1ppr) (available from Univariate Table 58)

b) A new 2001 Census variable "occupancy rating" (available from Key Statistics Table 19), which is described as a more sophisticated method to establish overcrowding

It was found that the Public Health Observatories in England were using the occupancy rating for their Townsend scores, albeit for other geographies. The NPHS had used the previous definition (>1ppr) which also existed in the 1991 Census. Conversations with colleagues from SWPHO and ERPHO revealed that the occupancy rating was used because the initial 2001 Census release in 2003 did not contain the variable ">1 ppr". These figures for overcrowding were very different, and the occupancy rating overall defined nearly 4 times more households as overcrowded compared to the variable ">1 ppr". Dr. Paul Norman (University of Leeds) recommended that the variable ">1ppr" should be used, as the "occupancy rating skewed the results even more towards urban deprivation".

5 Comparison of unadjusted and adjusted scores for Wales

Figure 1 for Wales and Figure 2 for England each show a Bland-Altman plot (Bland & Altman, 1986) with the differences in score between those from adjusted and unadjusted data plotted by the average of the two scores for each LSOA. It shows that differences between the two scores decrease with increasing average deprivation score. It therefore appears that the areas with the higher deprivation scores are less affected by the use of adjusted or unadjusted data for its calculation. This is likely to be due to the proportionately larger impact of random small cell adjustment, particularly in the unemployed or overcrowding variables, in the least deprived areas where counts will be relatively small. The frequencies in Table 1 below show that 80 LSOAs in Wales have moved up one quintile in the new

scores (unadjusted) compared to previous scores (adjusted) and 82 LSOAs have moved down a quintile, whilst 1734 have stayed the same. Table 2 shows that for England 958 LSOAs have moved up one quintile in the new scores (unadjusted) compared to previous scores (adjusted) and 958 LSOAs have moved down a quintile, whilst 30566 have stayed the same. Any analysis focusing mainly on the most deprived quintiles may therefore not be greatly affected by the choice of scores from either adjusted or unadjusted data.

Figure 1 Bland-Altman plot of score differences (between scores using unadjusted and adjusted data) by average score, LSOAs in Wales

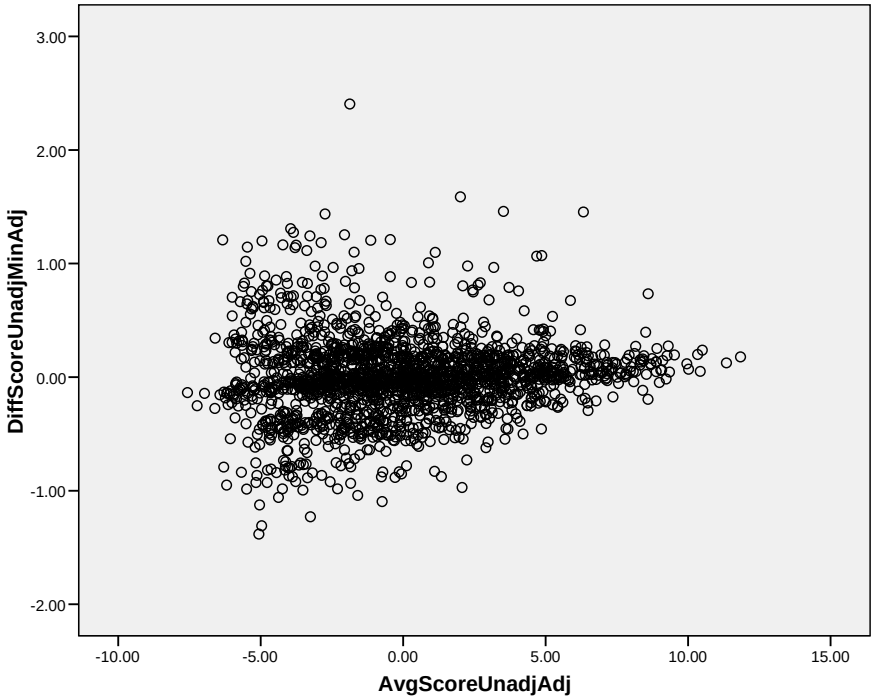

Table 1: Frequencies of differences in Townsend score quintiles (unadjusted – adjusted), LSOAs in Wales

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	-1	82	4.3	4.3	4.3
	0	1734	91.5	91.5	95.8
	1	80	4.2	4.2	100.0
	Total	1896	100.0	100.0	

Figure 2: Bland-Altman plot of score differences (between scores using unadjusted and adjusted data) by average score, LSOAs in England

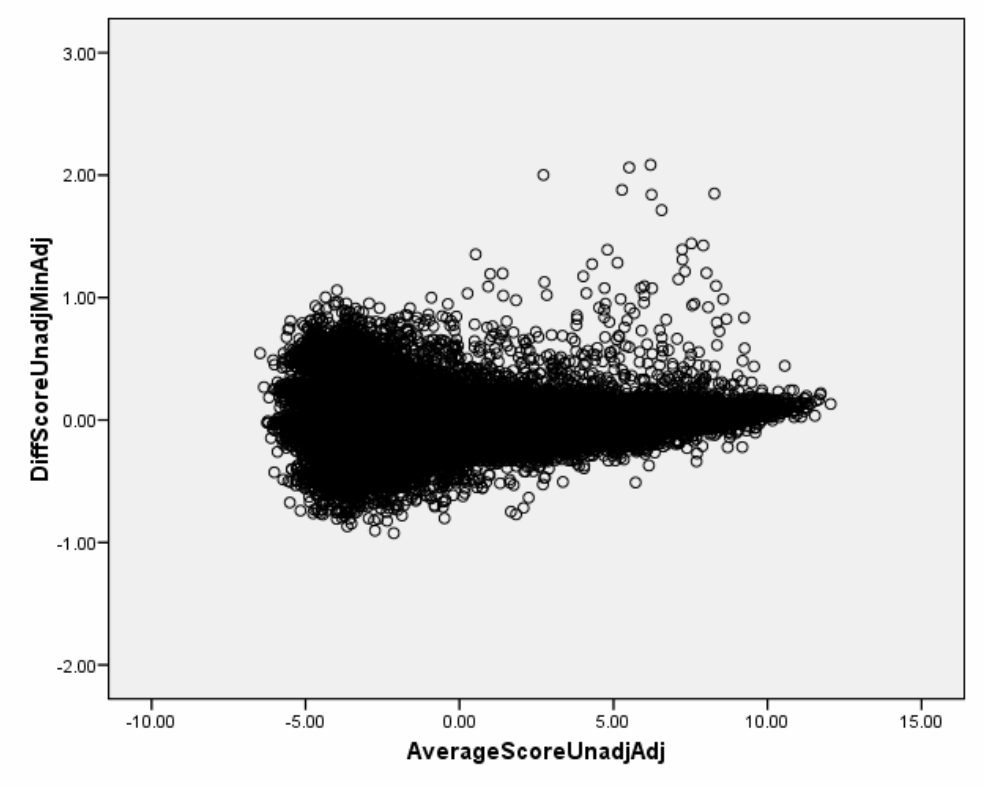

Table 2: Frequencies of differences in Townsend score quintiles (unadjusted – adjusted), LSOAs in England

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	-1	958	2.9	2.9	2.9
	0	30566	94.1	94.1	97.1
	1	958	2.9	2.9	100.0
	Total	32482	100.0	100.0	

6 Comparison of scores using different overcrowding measures

This section compares the scores when using the two difference overcrowding measures, both using unadjusted Census data. Figure 3 for Wales and figure 4 for England each show a Bland-Altman plot of score differences by average scores. Scores have, overall, been lower for those using the >1ppr overcrowding variable compared to the occupancy rating. Differences in scores appear to be larger for LSOAs with higher score averages, therefore suggesting that the choice of overcrowding indicator is likely to have a bigger impact in more deprived areas. Table 3 for Wales and Table 4 for England show the frequencies of differences in allocated quintile, and only 78.7% of LSOAs in Wales, and 82.7% of LSOAs in England have been allocated the same quintile. These differences in quintile coupled with the larger differences at the more deprived end of the scores suggest that there may be substantial differences in analysis depending on choice of scores. As mentioned in Section 4, the use of occupancy ratings was chosen by SWPHO and ERPHO since the established data variable for overcrowding was not available at the time. Problems of potential overestimate of overcrowding using the occupancy rating, and subsequent changes to Townsend index scores suggest that the established measure of more than one person per room should be used.

Figure 3: Bland-Altman plot of score differences (between scores using >1ppr and occupancy rating) by average score for LSOAs in Wales

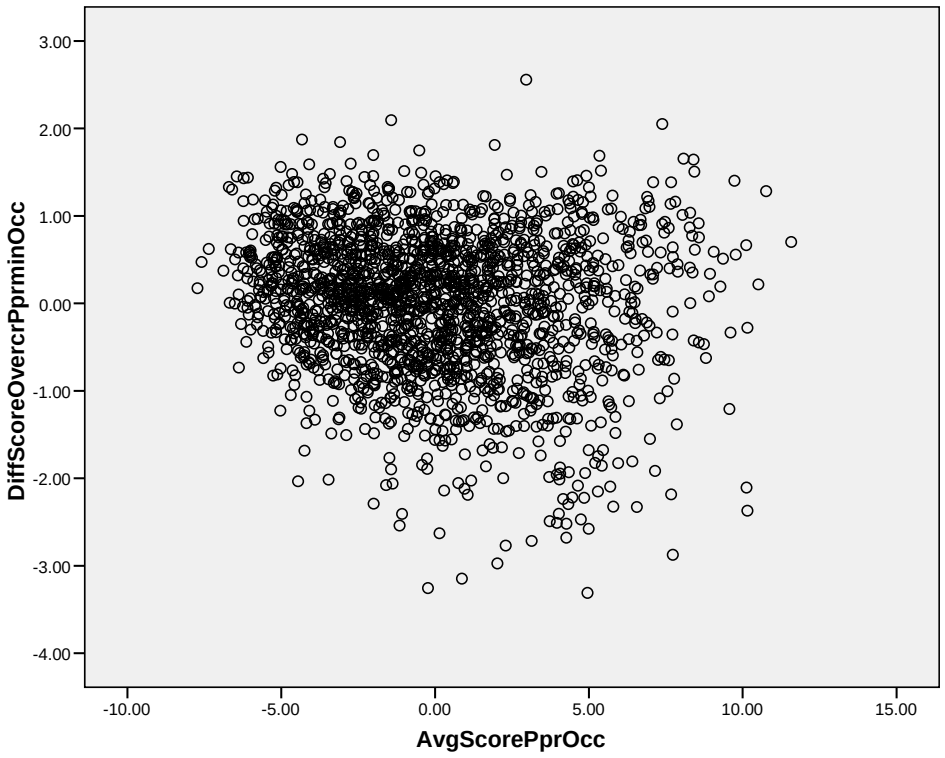

Table 3: Frequencies of differences in quintile between using different overcrowding measures for LSOAs in Wales

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	-2	3	.2	.2	.2
	-1	197	10.4	10.4	10.5
	0	1493	78.7	78.7	89.3
	1	203	10.7	10.7	100.0
	Total	1896	100.0	100.0	

Figure 4: Bland-Altman plot of score differences (between scores using >1ppr and occupancy rating) by average score for LSOAs in England

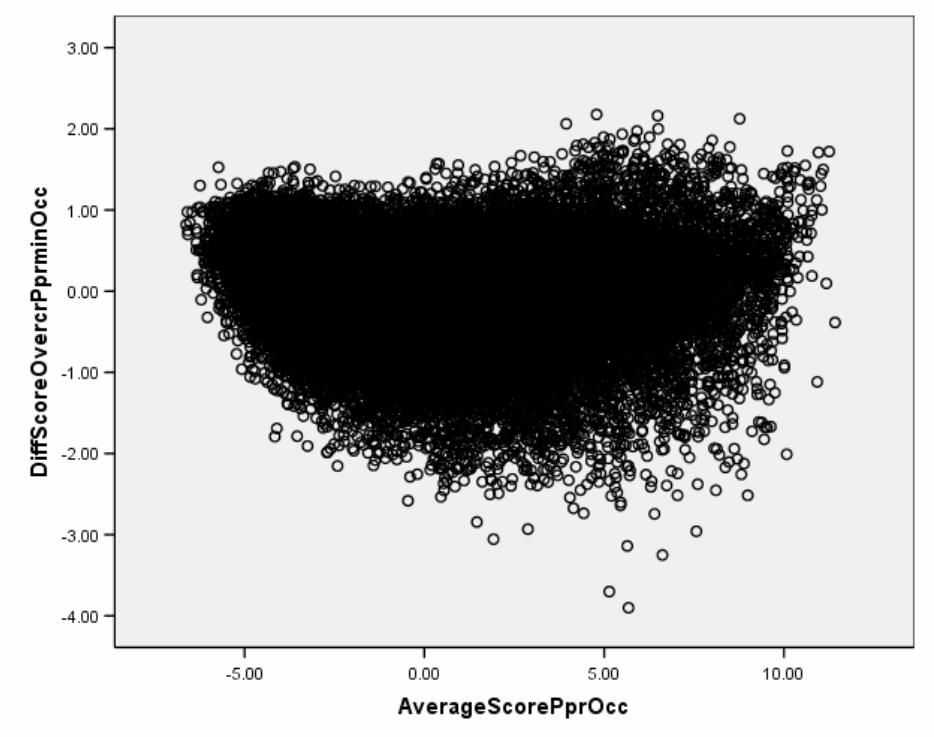

Table 4: Frequencies of differences in quintile between using different overcrowding measures for LSOAs in England

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	-2	9	.0	.0	.0
	-1	2802	8.6	8.6	8.7
	0	26851	82.7	82.7	91.3
	1	2820	8.7	8.7	100.0
	Total	32482	100.0	100.0	

7 Recommendations

As discussed in section 6, there were sizable differences between the scores using the different overcrowding measures, and the previous definition of more than one person per room (>1ppr) should be used. The released scores are based on these. Differences between the scores from unadjusted and those from adjusted data are unlikely to have any great effect on any analysis that focuses on the most deprived quintile. But as the scores from unadjusted data also include the correct age bands for unemployment, they are more accurate, and the use of the newly calculated scores is therefore recommended.

The new scores from unadjusted data have been calculated for Wales separately, for England separately, and for Wales and England combined. These have been checked by staff at the Office for National Statistics before the scores only were released for distribution. These are not an "official" ONS or Wales Centre for Health product, but the scores can be freely distributed to colleagues and are published on the WCfH website Wales Centre for Health - Observatory Publications.

Finally, it is recommended that representations are made to the ONS to allow the calculation of the Townsend index using the prescribed method based on unadjusted data when 2011 Census data become available.

8 References

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