Improving Mental Health through the Regeneration of Deprived Neighborhoods: A Natural Experiment

Running head: Improving mental health through regeneration

James White 1,2 Senior Lecturer in Public Health
Giles Greene 3 Lecturer
Daniel Farewell 3 Senior Lecturer
Frank Dunstan 3 Professor of Medical Statistics
Sarah Rodgers 4 Associate Professor
Ronan A Lyons 4 Clinical Professor of Public Health
Ioan Humphreys 5 Research Assistant
Ann John 4 Associate Clinical Professor
Chris Webster 6 Professor of Urban Planning
Ceri J Phillips 5 Professor of Health Economics
David Fone 3 Professor of Health Sciences Research

1 Centre for Trials Research, College of Biomedical and Life Sciences, Cardiff University, Cardiff. CF14 4YS. Wales, United Kingdom.

2 Centre for the Development and Evaluation of Complex Interventions for Public Health Improvement (DECIPHer), College of Biomedical and Life Sciences, Cardiff University, Cardiff. CF14 4YS. Wales, United Kingdom.
3 Institute of Primary Care & Public Health, School of Medicine, Neuadd Meirionnydd, Cardiff University, Heath Park, Cardiff. CF14 4YS. Wales, United Kingdom.

4 Farr Institute, Swansea University Medical School, Swansea. SA2 8PP. Wales, United Kingdom.

5 Swansea Centre for Health Economics, College of Human and Health Sciences, Swansea University, Singleton Park, Swansea. SA2 8PP. Wales, United Kingdom.

6 The University of Hong Kong, Faculty of Architecture, Department of Urban Planning and Design, Pokfulam, Hong Kong.

Correspondence to: Dr James White
7th floor Neaudd Merinionydd,
Centre for Trials Research,
College of Biomedical and Life Sciences,
Cardiff University,
Cardiff.
CF14 4YS.
Wales, United Kingdom.
Email: whitej11@cf.ac.uk
Tel: +44 (0) 29 20 687054
Fax: +44 (0) 29 20 687236

Key words: Mental Health, Quasi-Experimental Studies, Inequalities, Neighborhood, Propensity Score
Abbreviations: UK, United Kingdom; SAIL, Secure Anonymized Information Linkage; LSOA, lower super output areas; WIMD, Welsh Index of Multiple Deprivation; MHI-5: Mental Health Inventory.
ABSTRACT

Neighborhood-level interventions provide an opportunity to better understand the impact of neighborhoods on health. In 2001, the Welsh Government, United Kingdom, funded Communities First, a program of neighborhood regeneration delivered to the 100 most deprived of the 881 electoral wards in Wales. In this study, the authors examined the association between neighborhood regeneration and mental health. Information on regeneration activities in 35 intervention areas (n=4,197 subjects) and 75 control areas (n=6,695 subjects) were linked to data on mental health from a cohort study with assessments in 2001 (before regeneration) and 2008 (after regeneration). Propensity score matching was used to estimate the change in mental health in intervention versus control neighborhoods. Baseline differences between intervention and control areas were of a similar magnitude as produced by paired randomization of neighborhoods. Regeneration was associated with an improvement in the mental health of residents in intervention areas compared to control neighborhoods (β coefficient = 1.54, 95% confidence interval: 0.50, 2.59), suggesting a reduction in socioeconomic inequalities in mental health. There was a dose response relationship between length of residence in regeneration neighborhoods and improvements in mental health (P-for-trend = 0.05). These results show the targeted regeneration of deprived neighborhoods can improve mental health.

Keywords: mental health; environment; neighborhood; residence characteristics; non-randomized controlled trials; causality; inequalities.
A series of studies has shown that poor mental health is more common in residents of low quality housing (1, 2), less desirable neighborhoods (e.g. litter, graffiti, few street lights) (3, 4), and socioeconomically deprived areas (5, 6). The support for these associations has not been universal with all showing marked attenuation after accounting for individual- or household-level measures of socioeconomic disadvantage (1-6). If the association between poor mental health and the quality of the neighborhood environment was causal, it would suggest that regeneration could help to reduce inequalities in mental health.

Large regeneration projects are common in the United Kingdom (UK); examples include New Deal for Communities (7) and Go Well (8); in the United States the Empowerment Zones (9); and in mainland Europe URBAN (10). Policymakers often target deprived neighborhoods for regeneration with the expectation that inequalities will reduce and population health will improve, since housing and neighborhoods of low quality (1-3), as well as the wider social, economic and environmental determinants of poor health, are concentrated in the most deprived areas (4-6). The hypothesized mechanisms through which regeneration might improve mental health includes improving physical health through housing improvements (11), increasing social capital and support through establishing community groups (12), enhancing feelings of control and empowerment, and reducing crime by enhancing neighborhood security (13).
There have been few studies on targeted neighborhood regeneration and mental health. Of the controlled evaluations to date, the New Deal for Communities project, an area-wide regeneration scheme in England, UK, found regeneration was not associated with change in mental health when compared to randomly sampled residents from non-contiguous comparator areas (14, 15), or to Health Survey for England participants with a similar level of area-level deprivation (16). In the smaller Single Regeneration Budget, based in Manchester, UK, no difference in mental health scores were found between residents of intervention and neighboring control wards (17). In contrast, the Go Well regeneration program in Glasgow, Scotland, UK, found that residents of areas receiving housing improvements reported an improvement in mental health in comparison to residents in control areas (18). The improvement was also greater for the residents of areas that received >£10,000 investment per household than <£5,000, suggesting a relatively high threshold in the investment required to narrow inequalities (19). These studies, however, lack detailed assessments of individual- and household-level socioeconomic disadvantage, such that it is unclear whether intervention and comparison groups were adequately matched on socioeconomic factors that are closely associated with poor mental health.

‘Communities First’ is an area-wide regeneration program delivered to deprived neighborhoods in Wales, UK (19). We exploited an opportunity to evaluate a natural experiment using data on neighborhoods which did and did not receive regeneration linked to an electronic record-linked prospective cohort, the Caerphilly Health and Social Needs Electronic Cohort Study (eCATALyST) (20). Previous analyses of the eCATALyST found Communities First was delivered in an area with substantial socioeconomic inequalities in mental health (5). We therefore used propensity score
matching to reduce the imbalance in socioeconomic disadvantage across intervention
and control areas brought about by non-random targeted allocation (20). We tested the
hypothesis that the Communities First regeneration program would be associated with
a reduction in mental health inequalities.

METHODS

The protocol for this prospective controlled quasi-experimental study or natural
experiment has been published (21). We linked data from three sources for this study:
regeneration data from Caerphilly County Borough Council, the eCATAlyST study
(22), and the Secure Anonymized Information Linkage (SAIL) databank (23). The
eCATAlyST study received ethical approval for the baseline population survey 2001
from the former Gwent Local Research Ethics Committee (REF: JW/CC/00/59(a))
and for the follow-up survey in 2008 from the South East Wales Research Ethics
Committee Panel C (ref 08/WSE03/25). The linking of datasets received approval
from the SAIL Information Governance Review Panel (IGRP) (Ref: 0266 CF) at
Swansea University.

Setting

Caerphilly County Borough, located in south-east Wales, UK, is a local government
unitary authority with a 2001 census population of 169 519, rising to 179 941 in the
latest mid-year estimate for 2014. In 2001, the year in which the Communities First
regeneration program was initiated, there were 22 local authorities in Wales, 881
electoral wards, and 1896 lower super output areas (LSOAs) defined by the UK Census. Employment in Caerphilly County Borough was historically dominated by the coal industry. By 2001, the borough had a higher rate of unemployment (5.4 vs 8.5%), a higher percentage of public housing than the Welsh average (17.1 vs 13.7%); ranking fourth out of 22 local authorities in Wales on the proportion of LSOAs in the 10% most deprived on the 2000 Welsh Index of Multiple Deprivation (WIMD).

Although the Communities First program was allocated at the electoral ward level (average population 5,500), we used LSOAs (average population 1,630) as our measure of small-area geography, as they are smaller, more homogeneous, and nested within wards.

The intervention

Communities First is a Welsh Government program of area-wide regeneration. It is targeted at the 100 most deprived of the 881 electoral wards in Wales, according to the 2000 WIMD, a small-area based measure of deprivation based on residents’ income, employment status, education, housing, health and geographical access to services (24). An extra 46 wards were added in 2005 following a change in rankings when the WIMD was updated. In 2001, each of the 22 local authorities in Wales was funded to establish community multi-agency partnership boards which included residents of Communities First areas, the police, National Health Service, local authorities and housing providers. Partnership boards liaised with residents to identify what regeneration activities were needed. Once a candidate project was identified, a wider consultation with residents was held; if residents agreed the project was a priority, an application was made to a potential funder, such as a charity, local
government, or private industry. In some cases funding was provided by the partnership board (25). Communities First is on-going, although re-organized in 2012, when the ranking of wards changed following publication of the 2011 WIMD.

We classified the projects delivered into 48 different types of intervention nested within six domains of regeneration. We used text descriptions and the geographical location to classify regeneration activities according to a scheme informed by a similar intervention, the New Deal for Communities (26). Examples of funded activities in the six domains included those to address community needs on: 1) crime: installing street lighting; 2) education: teaching assistants; 3) health: provision of sport equipment; 4) housing and physical environment: conduct housing maintenance and repairs, redevelopment of waste land; 5) vocational training and business support: provide computer skills training to the unemployed; and, 6) community: build community facilities (see Web Appendix 1 shows the full classification scheme and more examples).

**Data sources**

*The Caerphilly Health & Social Needs Electronic Cohort Study (eCATALyST).*

The eCATALyST study is a prospective cohort study of adult residents of Caerphilly County Borough, Wales, UK (22). Briefly, in 2001 a stratified random sample of 22,236 individuals aged 18 and over resulted in 10,892 respondents to a baseline postal questionnaire survey. In 2008 the survey was repeated, sampling the 9,551 participants who still resided in the borough. Of these, 4,426 provided a valid mental
health score. The pattern of response in 2001 and 2008 showed an under-representation of younger age groups, particularly men, but no discernable bias by 1991 Townsend area-level deprivation scores (22).

_Caerphilly County Borough Council_. Council records were used to identify the LSOAs within Caerphilly County Borough that received Communities First funding (intervention areas) and those LSOAs which did not (control areas) between 2001 and 2008.

_The Secure Anonymized Information Linkage (SAIL) databank_. SAIL is a privacy protecting environment that enables multiple datasets to be pseudonymised then brought together for analysis. It contains the Welsh Demographic Service (a list of the addresses of all patients registered with free to use general medical practices in Wales between 1998 and 2012) and clinical data (23). The date of every update for each individual’s record is held. The Welsh Demographic Service was used to track migration and calculate length of residence from 31st May 2001 to 1st January 2009, the dates of the eCATALyST surveys. We also used data held in SAIL on mental health symptoms, diagnoses and treatments recorded in 11 of the 29 general medical practices in Caerphilly County Borough to impute missing eCATALyST data.

**Variables**

_Mental Health_. Mental health was assessed using the Mental Health Inventory (MHI-5) included in the Short Form-36 version 2 scale (27), measured in the 2001 and 2008 waves of eCATALyST. The validity and reliability of the MHI-5 are well established
in general population samples (27), and it is effective at screening for mood and anxiety disorders identified using Diagnostic Interview Schedules (28). Respondents can achieve a total score within a range of 5 to 25, which we transformed to a 0 to 100 scale (29). The primary outcome was change in mental health score (wave 2 – wave 1) with positive values indicating an improvement in mental health.

Demographic and socioeconomic variables. The eCATAlyST database contained a number of individual, household and area-level demographic and socio-economic variables (5). These included age in 10-year bands, sex, Registrar General social class (I&II (most advantaged), IIINM, IIIM, IV&V, Other), employment status (employed, unemployed, full-time student/government training scheme, looking after home or children full-time/long-term carer, permanently unable to work due to illness or disability, retired), housing tenure (owner-occupier, or not owner-occupier), council tax valuation band of property values (Lowest value: A, B, C, D, E, F-H: Highest value) (30), poverty (defined as a gross household income < £10 000 per annum which equated to 60% of median income after housing costs in 2001: the UK definition of household poverty), the 2005 Welsh Index of Multiple Deprivation (WIMD) at the LSOA level (31), marital status (married/ cohabiting, single, divorced, and widowed), smoking status (daily, occasional, quit, never smoked), tertiles of the sum of the Neighbourhood Cohesion scale at the individual and LSOA-level, assessing levels of social interaction, trust and reciprocity within neighborhoods (32), and physical health, assessed using the Physical Component Summary score of the Short Form-36 (range 0 to 100) (27).
**Statistical analysis**

Unless specifically indicated, all analyses were intention to treat and pre-planned in accordance with our published protocol (21). We assessed whether there were interactions between the allocation status and age groups and sex and found these were not statistically significant. We therefore pooled data for men and women and across age groups.

We estimated the effectiveness of regeneration on inequalities in mental health by matching residents in 35 intervention LSOAs to residents in 75 control LSOAs based on their propensity scores using information from the 2001 eCATAlyST survey (all 4,197 intervention group participants were matched to the same number of control group participants, n=4,197). The variables included in the calculation of the propensity score were employment status, housing tenure, council tax band, poverty and marital status (see Web Appendix 2 for details).

To investigate the different types of interventions, we fitted models in which the binary term for allocation status was replaced with a categorical term for the six domains of regeneration (with control areas as the reference category).

**Missing data.** eCATAlyST data were weighted to allow for the unequal electoral ward sampling probability and survey non-response as a function of age, sex and 1991 Townsend deprivation scores, the latest available measure of area-level deprivation in the Welsh Demographic Service for the whole sampling frame (20). Data on
allocation status and covariates were available for 4,426 people who had a mental health score. We used Read codes, a system of clinical coding used in general medical practices in the UK, on mental health symptoms, diagnoses and treatments as auxiliary data to impute missing post-intervention covariate and outcome data in the eCATAlyST database (see Web Appendix 3).

Of the 6,466 participants who did not provide complete data in the 2008 eCATAlyST survey, 1,504 (22.5%) had a Read code for a symptom, diagnosis or treatment for a mood or anxiety disorder recorded in general practice. A variable with the absence (coded as 0) or presence (≥1 coded as 1) of a relevant Read code across all years (2001–2008) for all participants was derived. The prediction model comprised all eCATAlyST covariates including the presence or absence of any mental health Read codes. We imputed the raw scores for all eCATAlyST covariates using multiple imputation by chained equations to generate 20 imputed datasets (each had a final n = 10,892), accounting for the hierarchical structure of the dataset (individuals nested within LSOAs). Web Figure 1 shows the data sources, number of participants linked and data imputed.

Sensitivity analysis. We performed several sensitivity analyses. First, we ran our analysis in a complete sample of 4,426 participants without any missing data. Second, we replaced a binary term for allocation with tertiles for the frequency of different types of regeneration activities. Third, we examined whether the intention to treat principle had led the association between regeneration and mental health to be underestimated by repeating models replacing allocation with duration of residence in
an intervention area categorized into quartiles. Fourth, we examined the impact of population migration by including a term in models for whether a participant had moved. Fifth, we repeated the analysis adjusting for covariates included in the propensity score to examine their effect on changes in mental health. All analyses were performed with Stata version 13 (StataCorp LP, College Station, Texas), MLwiN version 2.32 (Centre for Multilevel Modelling, Bristol, United Kingdom) and R (R Foundation for Statistical Computing, Vienna, Austria). The type I error probability was set to 0.05 for all analyses. The reporting of this study conforms to the Transparent Reporting of Evaluations with Nonrandomized Designs statement (available at http://aje.oxfordjournals.org/) (33).

RESULTS

There were 1,500 funded regeneration projects in Caerphilly County Borough during the seven year follow-up (2001 to 2008) at a cost of £82,857,180. Of these projects, over one-half (59.1%; £16,489,716) were classified as community-based projects, with the remaining classified as improvements in housing and the physical environment (22.3%; £55,670,516), projects in educational settings (8.0%; £5,534,839), health improvement (4.7%; £1,321,639), interventions to reduce crime (4.2%; £1,742,129), and the provision of vocational training or business support (1.7%; £2,098,341).

Of the 10,892 participants, 4,197 (38.5%) were located in 35 intervention LSOAs and 6,695 in 75 control LSOAs (see Web Figure 2). The mean length of residence during
the study period was 58.8 months (standard deviation = 17.0, range 0.2 to 91.0). 208 (5.0%) intervention and 160 (2.4%) control residents moved between 2001 and 2008. People with missing eCATAlyST post-intervention data in 2008 were more likely to be older, have a semi-routine or routine occupation, disabled, living in poverty, married and a daily smoker, but less likely to be a homeowner (all \( P \)-values <0.05).

As would be expected for an intervention delivered on the basis of area-level deprivation, the largest differences between the intervention and control groups were found for employment status, housing tenure, council tax valuation band, and poverty status (Table 1). After matching, the absolute standardized differences were less than 10% for all variables entered into the propensity score, indicating an acceptable match (Table 2) (34).

The descriptive data showed a reduction in the mental health of all participants over the study period. The mean intervention group mental health (MHI-5) score reduced by 0.4 points, with a corresponding mean reduction of 0.2 points in the control group (Table 1). After propensity score matching, targeted regeneration was associated with an improvement in the mental health of intervention compared to control group residents (\( \beta \) coefficient = 1.54; 95% confidence interval: 0.50, 2.59), suggesting that regeneration narrowed mental health inequalities.

The results of the sensitivity analyses are shown in Web Appendix 4. We found essentially the same pattern of results in our complete case and imputed samples.
(Appendix 4, Table 1). We found similar effect sizes but no significant differences when type of intervention was examined (Appendix 4, Table 2). We found evidence of a dose-response association across suggesting the longer the duration of residence in an intervention area the greater the improvement in mental health ($P$ for trend = 0.05, Appendix 4, Table 3). The change in mental health was comparable in the models which did and did not exclude migrants from intervention and control areas (Appendix 4, Table 4). In the covariate adjusted analysis, being an owner occupier, sick or disabled, or retired was associated with an improvement in mental health (Appendix 4, Table 5).

DISCUSSION

We estimated the impact of regeneration on mental health in a natural experiment by linking data from a regeneration program delivered to deprived communities to a prospective cohort study that collected data both pre- and post-intervention. We found that the targeted regeneration of deprived neighborhoods narrowed inequalities in mental health, and some evidence for a dose-response association between length of residence in a regeneration area during the study period and improvements in mental health.

In propensity score matched analyses, regeneration in neighborhoods that had the greatest concentration of socioeconomic disadvantage, was associated with a small improvement in the mental health of intervention compared to control area residents; thus inequalities in mental health narrowed. The effect size was equivalent to one out
of every three intervention group residents increasing their response on the MHI-5 scale by one category (e.g. from most to all of the time), or 7% of a standard deviation on the MHI-5 scale. This narrowing of inequality was found at relatively low cost with the average cost of a community project at £18,590 and housing project being £166,180. The results contrast most of the prospective controlled evaluations that found no association between regeneration in deprived neighborhoods and changes in mental health (14 - 17), but replicate the narrowing of mental health inequalities found in the Go Well regeneration project (19). These inconsistencies may be attributed to differences in the effectiveness of regeneration, sampling of areas or residents, or our use of propensity score matching.

**Strengths and limitations.** The main strength of this study was the availability of detailed pre- and post-intervention assessments of socioeconomic disadvantage on residents who participated in a prospective cohort study. The SAIL system facilitated enabled clinical records, migration and duration of residence to be assessed. Our use of propensity score matching allowed us to account for the baseline differences in mental health scores by balancing several characteristics of participants (such as employment status) and households (poverty status) between intervention and control areas. Another concern was selective migration (35), but we found little difference in estimates for those who had and had not moved out of intervention areas.

The main limitation of this study was that a direct measure of individual exposure could not be captured by the data. Although this is common to most evaluations of neighborhood-level interventions, not all residents will have been exposed and
residents of control neighborhoods may have been exposed as people cross boundaries. This would act to under-estimate the effect size. A further limitation was loss to follow-up. Although the study had sufficient power to detect a difference across intervention and control areas (21), it is likely the sub-group analysis into the type of regeneration activities was underpowered; increasing risk of a type II error. The use of auxiliary information on mental health symptoms, diagnoses and treatments meant that for 22.5% of participants with missing cohort data, relevant information on mental health was available from general practice to improve the imputation model.

The information on intervention sub-type relied heavily on the accuracy of Caerphilly County Borough Council records, and it is possible that not all funded activities, or those funded through another source were recorded. Our reliance on text descriptions of projects meant that the intervention type could have been misclassified, which could have biased the sub-group analysis towards the null. A general limitation with propensity score analysis is that it can only balance confounders included in the model; thus our estimates may have been different if other important variables had been included. The estimates derived from propensity scores can be comparable to those from adjustment in regression (36), particularly when using propensity scores as a covariate, but less so when matching participants as we did.

This study has wider implications for the methods used to evaluate non-randomized targeted interventions. Given the billions spent in the United States ($), UK (£) and Europe (€) on area-wide regeneration, and paucity of evidence on effectiveness,
randomized allocation of areas may be both the fairest means of allocation and enable robust evaluation to inform decisions on continued support or disinvestment (7 - 10). We found propensity score matching was able to balance intervention and control groups for known confounding factors in an area with socioeconomic inequalities in mental health. Future studies should compare effect size estimates from propensity score matched analyses to those from randomized trials to examine the value of this analytical approach.

The Communities First regeneration program we evaluated is unique in that community residents, rather than local councils or governments, identified areas to be regenerated. The policy implication of this finding is that targeted regeneration, directed by the residents of deprived urban communities, may help to reduce inequalities in mental health.
Acknowledgements

Author affiliations: South East Wales Trials Unit (SEWTU), Cardiff University, Cardiff, Wales, United Kingdom (James White); Centre for the Development and Evaluation of Complex Interventions for Public Health Improvement (DECIPHer), Cardiff University, Cardiff, Wales, United Kingdom (James White); Institute of Primary Care & Public Health, Cardiff University, Wales, United Kingdom (Giles Greene, Daniel Farewell, Frank Dunstan, David Fone); Farr Institute, College of Medicine, Swansea University, Swansea. SA2 8PP. Wales, United Kingdom (Sarah Rodgers, Ronan A Lyons, Ann John); Swansea Centre for Health Economics, Swansea University, Swansea. Wales, United Kingdom (Ioan Humphreys, Ceri J Phillips); The University of Hong Kong, Department of Urban Planning and Design, Pokfulam, Hong Kong (Chris Webster).

Grants and/or financial support: This project is funded by the National Institute for Social Care and Health Research (NISCHR) program (project reference RFS-12-05). This work is undertaken with the support of The Centre for the Development and Evaluation of Complex Interventions for Public Health Improvement (DECIPHer), a UKCRC Public Health Research Centre of Excellence. Joint funding (MR/KO232331/1) from the British Heart Foundation, Cancer Research UK, Economic and Social Research Council, Medical Research Council, the Welsh Government and the Wellcome Trust, under the auspices of the UK Clinical Research Collaboration, is gratefully acknowledged. This work is also supported by the Farr Institute of Health Informatics Research. The Farr Institute is supported by a consortium of ten UK research organizations: Arthritis Research UK, the British Heart Foundation, Cancer Research UK, the Economic and Social Research Council,
the Engineering and Physical Sciences Research Council, the Medical Research Council, the National Institute of Health Research, the National Institute for Social Care and Health Research (Welsh Government) and the Chief Scientist Office (Scottish Government Health Directorates).

All funders had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Conflict of interest: none declared.
References


Table 1. Characteristics of residents of intervention and control Lower Super Output Areas before (2001) and after (2008) the introduction of Communities First, Caerphilly County Borough, Wales, UK

<table>
<thead>
<tr>
<th>Variables</th>
<th>Intervention LSOAs (n = 4197)</th>
<th>Control LSOAs (n = 6695)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mental health b, c</td>
<td>22.3 (66.6)</td>
<td>19.9 (66.2)</td>
</tr>
<tr>
<td>Physical health c</td>
<td>13.3 (44.7)</td>
<td>12.2 (43.7)</td>
</tr>
<tr>
<td>Social cohesion d</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1083 25.8</td>
<td>1152 27.5</td>
</tr>
<tr>
<td>Medium</td>
<td>1537 36.6</td>
<td>1319 31.4</td>
</tr>
<tr>
<td>High</td>
<td>1577 37.6</td>
<td>1726 41.1</td>
</tr>
<tr>
<td>Social class e</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I&amp;II</td>
<td>755 18.0</td>
<td>967 23.0</td>
</tr>
<tr>
<td>III non-manual</td>
<td>772 18.4</td>
<td>777 18.5</td>
</tr>
<tr>
<td>III manual</td>
<td>961 22.9</td>
<td>932 22.2</td>
</tr>
<tr>
<td>IV&amp;V</td>
<td>1343 32.0</td>
<td>1398 33.3</td>
</tr>
<tr>
<td>Other</td>
<td>366 8.7</td>
<td>123 2.9</td>
</tr>
<tr>
<td>Employment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>1953 46.5</td>
<td>1799 42.9</td>
</tr>
<tr>
<td>Unemployed</td>
<td>135 3.2</td>
<td>115 2.7</td>
</tr>
<tr>
<td>Student</td>
<td>62 1.5</td>
<td>25 0.6</td>
</tr>
<tr>
<td>At home or carer</td>
<td>406 9.7</td>
<td>284 6.8</td>
</tr>
<tr>
<td>Permanently sick or disabled</td>
<td>719 17.1</td>
<td>586 14.0</td>
</tr>
<tr>
<td>Retired</td>
<td>922 22.0</td>
<td>1388 33.1</td>
</tr>
<tr>
<td>Not an owner occupier</td>
<td>1081 25.8</td>
<td>1151 27.4</td>
</tr>
<tr>
<td>Council tax valuation band</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A lowest property value</td>
<td>1891 45.1</td>
<td>1728 41.2</td>
</tr>
<tr>
<td>B</td>
<td>1568 37.4</td>
<td>1481 35.3</td>
</tr>
<tr>
<td>C</td>
<td>376 9.0</td>
<td>508 12.1</td>
</tr>
<tr>
<td>D</td>
<td>196 4.7</td>
<td>214 5.1</td>
</tr>
<tr>
<td>E</td>
<td>125 3.0</td>
<td>196 4.7</td>
</tr>
<tr>
<td>F-H highest</td>
<td>41</td>
<td>1.0</td>
</tr>
<tr>
<td>In poverty</td>
<td>2466</td>
<td>58.8</td>
</tr>
<tr>
<td>Smoking status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daily</td>
<td>1160</td>
<td>27.6</td>
</tr>
<tr>
<td>Occasional</td>
<td>217</td>
<td>5.2</td>
</tr>
<tr>
<td>Quit</td>
<td>979</td>
<td>23.3</td>
</tr>
<tr>
<td>Never smoked</td>
<td>1841</td>
<td>43.9</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married/cohabiting</td>
<td>2808</td>
<td>66.9</td>
</tr>
<tr>
<td>Single</td>
<td>678</td>
<td>16.2</td>
</tr>
<tr>
<td>Divorced or separated</td>
<td>404</td>
<td>9.6</td>
</tr>
<tr>
<td>Widowed</td>
<td>307</td>
<td>7.3</td>
</tr>
</tbody>
</table>

*a 2008 (post intervention) minus 2001 (pre intervention) change in mean or %.

*b Values are expressed as a mean (standard deviation).

*c MHI-5 = Mental health inventory had a range of 5 to 25 and was transformed to a 0 to 100 scale using a standard linear transformation (27).

*d Cut points on social cohesion scale: Low = 0-16, medium = 17-31, high = 32-40.

*e Social class = Registrar General Social Classes, I = Professional occupations, II = Managerial and technical occupations, IINM = Skilled, non-manual occupations, IIM = Skilled manual occupations, IV = Partly unskilled, V = Unskilled occupations, SC other = Others including students, homemakers or the unemployed.

f Marital status at baseline was retrospectively assessed for 2001 in 2008.

LSOA, lower super output areas.
Table 2. Comparison of Baseline Demographic and Socio-economic Characteristics of Residents of Intervention and Control Lower Super Output Areas Before (2001) and After (2008) Propensity Score Matching, Caerphilly County Borough, Wales, UK

<table>
<thead>
<tr>
<th>Variables</th>
<th>Before matching (n = 10 892)</th>
<th>After matching (n = 8 394)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intervention (n = 4197)</td>
<td>Control (n = 6695)</td>
</tr>
<tr>
<td>Employment status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>1953 46.5</td>
<td>3728 55.7</td>
</tr>
<tr>
<td>Unemployed</td>
<td>135 3.2</td>
<td>169 2.5</td>
</tr>
<tr>
<td>Student</td>
<td>62 1.5</td>
<td>133 2.0</td>
</tr>
<tr>
<td>At home or carer</td>
<td>406 9.7</td>
<td>447 6.7</td>
</tr>
<tr>
<td>Permanently sick or disabled</td>
<td>719 17.1</td>
<td>710 10.6</td>
</tr>
<tr>
<td>Retired</td>
<td>922 22.0</td>
<td>1508 22.5</td>
</tr>
<tr>
<td>Tenure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not an owner occupier</td>
<td>1081 25.8</td>
<td>985 14.7</td>
</tr>
<tr>
<td>Council tax band</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A lowest property value</td>
<td>1891 45.1</td>
<td>688 10.3</td>
</tr>
<tr>
<td>B</td>
<td>1568 37.4</td>
<td>2874 42.9</td>
</tr>
<tr>
<td>C</td>
<td>376 9.0</td>
<td>1535 22.9</td>
</tr>
<tr>
<td>D</td>
<td>196 4.7</td>
<td>821 12.3</td>
</tr>
<tr>
<td>E</td>
<td>125 3.0</td>
<td>483 7.2</td>
</tr>
<tr>
<td>F-H highest</td>
<td>41 1.0</td>
<td>294 4.4</td>
</tr>
<tr>
<td>Poverty status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In poverty</td>
<td>2466 58.8</td>
<td>2939 43.9</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married/cohabiting</td>
<td>2808 66.9</td>
<td>4874 72.8</td>
</tr>
<tr>
<td>Single</td>
<td>678 16.2</td>
<td>910 13.6</td>
</tr>
<tr>
<td>Divorced or separated</td>
<td>404 9.6</td>
<td>490 7.3</td>
</tr>
<tr>
<td>Widowed</td>
<td>307 7.3</td>
<td>421 6.3</td>
</tr>
</tbody>
</table>
Standardized difference calculated as

\[ d = \frac{100 \times (\bar{x}_{\text{treatment}} - \bar{x}_{\text{control}})}{\sqrt{\frac{s^2_{\text{treatment}} + s^2_{\text{control}}}{2}}} \]