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Urban Regeneration and Mental Health: Investigating the Effects of an Area-Based Intervention Using a Modified Intention to Treat Analysis with Alternative Outcome Measures

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ABSTRACT

A quasi-experimental study of the mental health impacts of regeneration was carried out across fifteen communities in Glasgow, UK, grouped into five and then four types of intervention area. Regression modelling was undertaken to examine the effects of living in each type of area upon mental health (MCS-12 and SF-12 MH) and mental wellbeing (WEMWBS). Living in regeneration areas had no impacts on mental health or wellbeing, possibly due to incomplete implementation. Positive impacts from living in areas of housing improvement were not extended in areas of high-rise housing. Areas surrounding regeneration areas exhibited gains in mental health and wellbeing, contrary to notions of negative spillover. Moving between areas had negative effects, especially for those moving beyond the study areas. Changes in mental wellbeing appear less substantial compared with changes in mental health.

Keywords: mental health; mental wellbeing; urban regeneration; area-based interventions.

1. Introduction

Area-based interventions focusing on improving physical, social and economic environments in disadvantaged communities are a regular feature of urban policy (Couch et al., 2013). Policy-makers and evaluators are increasingly interested in the health impacts of these programmes (Russell and Killoran, 2000). This is partly for 'intuitive' or theoretical reasons, whereby 'initiatives that aim to improve social, economic and environmental conditions will lead to population health improvements' (Popay 2001, p.1), in accord with theories of the wider determinants of health (Dahlgren and Whitehead, 2007). Policy-makers also wish to see regeneration having longer-term rather than temporary effects (Fyfe, 2009) and to move away from a predominant focus on the physical environment alone to become more sustainable and 'holistic' (Campbell, 2011). However, a review of regeneration evaluations over a twenty-five-year period from 1980 reported that health outcomes rarely featured, and when they did, the effects on self-rated health and mortality were negative or marginally positive (Evans et al., 2003; Thomson et al., 2006). A review of systematic reviews on aspects of the wider determinants of health reported that housing improvement works were associated with improved social outcomes such as reduced fear of crime or increased social participation, but that area-based environmental changes were highly variable in their health impacts (Bambra et al., 2010). The most recent rapid review of studies of regeneration and health also concluded that, whilst housing improvements were likely to lead to small improvements in health, particularly mental health, more generally 'the evidence that regeneration programmes improve health or socio-economic outcomes is mixed' (McCartney et al. 2017, p.76).

There are, however, expectations of improvements in mental health following housing-led area regeneration as studied here (Evans et al., 2003; McGregor, 2010), through one or more of several pathways. Improvements to existing housing can: reduce feelings of stress and helplessness from enforced overcrowding (due to unusable rooms) and ongoing disrepair and improved intra-household relationships (Basham et al., 2004; Gilbertson et al., 2012); increase feelings of safety from enhanced security measures, and lift occupants' mood as a result of lighter, refreshed buildings and improved visual amenity (Curl et al., 2015); and lower financial stress through reduced fuel bills (Novoa et al., 2017). Demolition of tower blocks, relocation to new-build lower-rise houses, and redevelopment of neighbourhoods can: remove the stress of overcrowding (particularly prevalent in low-demand tower blocks) and reduce anxieties from noise and antisocial behaviour in high-rise buildings (Gibson et al., 2011); improve feelings of control and status from living in a new, modern house (Kearns et al., 2000); and increase access to outdoor space and higher-quality neighbourhoods that support social interaction and belonging (Jones-Rounds et al., 2014).

An understanding of why and how area regeneration programmes may impact upon mental health and wellbeing stems from the theory of the social or wider determinants of health (Dahlgren and Whitehead 2007). These wider determinants affect whether people have resources to achieve goals, meet needs and deal with change (Dennis 2004) and are said to be 'powerful in shaping health and health inequalities' (Marmot et al. 2010, p.60). Public Health England (2019, p.1) concur that there is a 'strong and persistent link between social inequalities and disparities in health outcomes' and identify seven domains of the wider determinants of health: the natural and built environment, which includes a range of factors such as housing, food and transport; work and the labour market; vulnerability, which covers issues such as loneliness and homelessness; income; crime; education; and Marmot indicators. The latter refers to the Marmot Review of health inequalities, which covered five

domains of the social determinants of health: early years; education; work; income; and communities, which encompasses housing, green space and the social gradient between areas (Marmot et al. 2019).

Urban regeneration is an approach to area change that seeks to narrow the gap, or 'disparities', between the most deprived areas and other places by acting upon the wider determinants of health, as far as that is possible within a single locality. It does this by seeking to improve the physical (natural and built), services (public and private sector provision), social and economic environments (including economic development, labour market interventions, and domestic costs). We have added the psychosocial environment to the usual list of influential environments for a number of reasons in relation to mental health and wellbeing. It comprises several elements that influence how residents see themselves in the social world and how they feel about themselves as a result (Kearns et al. 2012a). Housing and neighbourhoods are partly positional goods with comparative qualities that can affect how people experience the social gradient and perceive their relative position in society with mental health consequences (Bianchi 2011; Foye et al. 2018; Kearns et al. 2013). Regeneration can alter the quality and appearance of homes and neighbourhoods with potential effects upon residents' mood, whilst the changes brought about in and of themselves may enhance feelings of status and control, particularly if communities have been arguing for change for some time. Lastly, the process through which regeneration is delivered, if done in consultation with the community can affect residents' sense of empowerment (Baba et al. 2017). In line with the theory of wider determinants and resources for health improvement, regeneration, by acting upon these five environments, can boost a number of capitals available to individuals and communities, with consequences for mental health and wellbeing. These capitals include fixed and environmental capital, human capital, economic capital, cultural capital and social capital (Kearns et al. 2009). This three-step pathway to mental health and wellbeing is depicted in Figure 1.

Some recent regeneration studies have accepted the general premise that regeneration can impact upon mental health and wellbeing, and answered the call for more experimental and longitudinal research on health outcomes (Popay, 2001). Of five studies of different regeneration programmes in the UK, three found no significant improvement in mental health in the intervention group (Critchley et al., 2004; Huxley et al., 2004; Stafford et al., 2014; Walthery et al., 2015), with two finding mental health gains (substantive in only one case) (Blackman and Harvey, 2001; White et al., 2017). Of two European studies, one reported a positive change in mental health for women only (Jongeneel-Grimen et al., 2016), and the other reported stability in mental health for the intervention group versus deterioration in the comparison group (Mehdipanah et al., 2014). Existing studies therefore offer no clear consensus on regeneration's mental health impacts.

There are two areas of uncertainty and variability in such studies. First, the nature of the intervention itself can be problematic, being difficult to describe, comprising a mixture of projects that are not always pre-defined or delivered according to plan (Bond et al., 2013). Indeed, one of the difficulties facing the recent rapid review of evidence in this area was that the interventions studied were not sufficiently similar or clear to enable conclusions to be drawn regarding impacts (McCartney et al. 2017). Relying on the implementer's description of the intervention may miss out some activities and lead to misclassification (White et al., 2017). Some programmes are not implemented as planned, for example, due to unforeseen circumstances or budget cuts, causing 'holistic regeneration' to be less

than comprehensive (Breese, 2008), and others are intentionally flexible. Yet most existing studies proceed on the basis that what is initially planned as area regeneration is subsequently enacted, even though lack of effect may be partly due to inadequate implementation (Haines et al., 2004). This is even more likely where regeneration relies upon partnership working to deliver outputs (Mayo, 1997).

There may be merits in developmental evaluation, whereby a fixed-state programme is not assumed, but rather 'ongoing adaptation' and 'inconsistency of interventions' are acknowledged (Patton, 2006). One way of doing this would be to consider implementing a version of 'modified intention to treat' (MITT) analysis alongside the usual 'intention to treat' (ITT) form. This could allow for significant changes to the nature of the area regeneration programme to be taken into account at the analysis stage, for example, through reclassification of the interventions. Such an approach would not present the same biases as deviation from ITT analyses in clinical trials, which prevent the original ITT analysis being conducted, or the deviations going unreported (Abraha et al., 2015). In the evaluation of a natural experiment like area regeneration, a MITT analysis could reflect changes in the intervention, or its withdrawal altogether from some areas, with this being done alongside the original ITT analysis to assess the effects of adaptation.

The second issue is that of the outcome measures used in mental health evaluations of regeneration. Although McCartney et al. (2017) reported that evidence for health impacts was more consistent where clinical scales were used rather than self-rated health, even here there is variation between studies. The two most common scales used in regeneration studies are the Mental Health Inventory (MHI-5), included as part of the SF-36 survey tool (Berwick et al., 1991), and the General Health Questionnaire (GHQ-12) (Goldberg and Hillier, 1979). The MHI-5 is said to screen for mood and anxiety disorders, and in regeneration studies has been converted into an index (0-100) (Jogeneel-Grimen et al., 2016; White et al., 2017) or used with two or more items indicating poor mental health (Stafford et al., 2014). The GHQ-12 is said to indicate symptoms of mental distress and to screen for mental disorders, and has been used in regeneration studies with minima of two (Huxley et al., 2004), three (Mehdipanah et al., 2014) and five (Stafford et al., 2014) items out of twelve taken to indicate poor mental health. One study used a bespoke list of six indicators of psychological distress with a threshold of one item to define mental health problems (Blackman and Harvey, 2001). Thus, there is variation and inconsistency in outcomes, with none of the studies using more than one measure of mental health to test whether the outcome used affects the reported impacts of the intervention.

Moreover, there has been little consideration of the differences between mental illness, or absence thereof (as measured by the predominant scales used in this field), and mental health or wellbeing. In some cases this is due to a binary, psychiatric perspective which assumes that if people are not mentally ill then they are mentally healthy (Keyes, 2005), although in what follows we use a continuous mental health score rather than adopting a cut-off for caseness. However, research suggests that wellbeing —comprising positive emotions, feelings and functioning— does not have the same correlates as mental disorders or symptoms, so the two should not be conflated (Patalay and Fitzsimmons, 2016; Westerhof and Keyes, 2010). Furthermore, regeneration studies have not considered whether the effects of the residential environment upon mental health (including its physical, social and economic elements) extend beyond the experience of distress and disorders, as screened by the commonly used scales, to also include positive affect and functioning, as captured in

the concept of mental wellbeing (NHS, 2019). As well as reducing the prevalence of mental health problems, regeneration might provide psychosocial benefits that influence aspects of wellbeing, such as feelings of control, status and self-esteem (Kearns et al., 2012).

The aims of this study were to assess the impact of living through area regeneration upon residents' mental health, in order to add to a sparse evidence base in the UK and Europe, and to address two other issues. First, what can be learnt from undertaking a MITT analysis alongside the usual ITT analysis? Second, does regeneration have different effects upon conventional measures of mental health and a measure of mental wellbeing? In addressing these aims and objectives, we test the following hypotheses:

- Areas of more extensive, wholesale regeneration will be associated with greater impacts upon mental health and wellbeing due to the programme's ability to tackle more of the relevant environmental contexts.
- The effects of area regeneration will be more evident with the use of a modified classification of intervention areas that better reflects the reality of programme delivery on the ground.
- Regeneration will have greater effects upon mental wellbeing than upon mental health due to the inclusion in the former of a wider range of items measuring elements of affect and functioning, with more scope to respond to the breadth of regeneration interventions.

2. Methods

2.1. Study context and design

The study was undertaken in Glasgow, a postindustrial city with poor health and 'excess mortality' (Walsh et al., 2013). Following the transfer of the local authority's housing stock to an independent social landlord in 2003, a housing improvement and regeneration programme commenced in 2005 in order to raise housing quality and create a sustainable housing system within the city (Gibb 2003). Fifteen communities were selected for area regeneration and redevelopment, with other social housing estates targeted for housing improvement works and/or the addition of new build private housing (Glasgow City Council, 2007). Around 50,000 dwellings were to be improved and nearly 20,000 demolished (Glasgow Housing Association, 2010). Planned to last ten years, the area regeneration is still underway, with completion expected sometime over the next ten years. Many areas received additional interventions comprising a mixture of environmental improvements, community facilities, community engagement and development work, and projects related to crime and safety, tenancy support, financial advice and health-related activities.

Fifteen study areas were selected, divided into five Intervention Area Types (IATs), classified in consultation with the regeneration agencies. These ranged from large regeneration areas, where the entire housing stock was to be demolished and new social and private housing built as a replacement, to areas where limited housing improvement works were to be accompanied by some new private housing. This original IAT classification of areas forms the basis of our ITT analysis. However, things did not proceed as planned: delays with area regeneration have meant that, following demolition, redevelopment is only partially completed in the larger regeneration areas; in some other areas where partial demolition was to occur, the housing stock was improved in its entirety; due to the financial crash of 2008, private development of tenure mixing on some estates has not occurred. Thus, we

have produced a Modified Intervention Area Type (MIAT) classification of the study areas as the basis for our MITT analysis. Figure 2 describes the two types of area classification and indicates how the study areas transfer from the original to the modified categories. All study areas were among the 15% most deprived area in Scotland, which are routinely targeted by policy. We also include a category for those not living in one of the original study areas, as some people had moved since the study began, most due to clearance, but others for voluntary reasons.

Interview surveys were conducted with adult householders in the study areas on four occasions (2006, 2008, 2011 and 2015). In the regeneration study areas, all residential addresses were selected, with addresses selected randomly in the other areas (Egan et al., 2010). The survey response rates were 50.3%, 47.5%, 45.4% and 47.0%, respectively. Retrospective matching of names, personal characteristics and addresses was used to identify the longitudinal cohort of adults interviewed on more than one occasion. A longitudinal sample of 1,674 cases was derived whereby an interview in 2015 (T2) was matched to their earliest previous interview (T1). Of the analytical sample (all of whom were interviewed at Wave 4) 41.3% were interviewed for the first time at Wave 1, 35.1% at Wave 2 and 23.6% at Wave 3.

2.2. Dependent variables

For mental health, we used two measures derived from the SF-12v2 questionnaire, validated for measuring health-related quality of life (Ware et al., 2005). The Mental Health Component Score (MCS-12) is based on questions relating to vitality, social functioning, role-emotional and mental health in the previous 4 weeks, and is scored from 0-100, with higher values indicating better mental health. Many of these items ask about the extent to which activities are constrained by mental health issues; since the mental health of people in deprived areas can be affected by restricted opportunities (Huxley et al, 2004), we did not want to rely solely on a measure that assumes activities are available and undertaken. Thus, we also used the narrower Mental Health Scale (SF-12 MH), which is based on two questions about how often the respondent has felt (i) calm and peaceful and (ii) downhearted and depressed, and is also scored from 0 to 100. For mental wellbeing, we used the Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS), which covers positive affect, positive functioning and relationships with others during the previous two weeks (Tennant et al., 2007). It is scored from 14-70, with higher values indicating greater mental wellbeing.

2.3. Independent variables

The main independent variables of interest are the two area classifications: IAT and MIAT, assigned at T2. For both, we used the classification with the least intensive regeneration activity as the reference, peripheral estates and low-rise housing improvement areas, respectively); there are no deprived areas without intervention that would be suitable as a comparison/control group. We included baseline covariates to control for potential confounding, including: age in years; gender; long-standing illness; smoking status; ethnicity; respondent's employment status; workless household; household structure; and housing tenure. To account for residential mobility, a variable was included to indicate whether the respondent had moved between area types during the course of the study.

2.4. Analysis

The mean and standard errors of the outcome variables and sociodemographic covariates were examined at the two times. The main analyses consist of two regression models for each of the three outcomes. First, a random effects (RE) model of the following form was used for each outcome variable within the panel data-set:

$$Y_{ij} = \mu + T_j + X_{ij} + \varepsilon_{ij}$$

where Y_{ij} represents the outcome of the i^{th} individual living in the j^{th} treatment area, and μ is the average outcome of all the longitudinal cases. T_j represents the effect of living in an area of a particular regeneration type (IAT or MIAT), X_{ij} represents individual characteristics of i^{th} individual living in the j^{th} treatment area. This model allows us to capture the effect of regeneration and other area types as well as individual variation in sociodemographic variables. Second, an ordinary least squares regression (OLS) was applied which uses the differences in mental health and wellbeing outcomes across time as the dependent variables.

2.5. Ethical approval

The study received ethical approval from the NHS Scotland, Scotland A Research Ethics Committee (05/MRE10/89). Written informed consent was obtained from all participants.

3. Results

Table 1 shows the composition of the samples at the two time points. The majority of participants (64%) were female and white British/Irish (89%). Age, retirement and the presence of older-person households inevitably increased over time in the samples, as did the prevalence of long-standing illness. Employment and home ownership were relatively low, at between a fifth and a quarter of participants, reflecting the deprived nature of the study communities. Mental health improved over time on the narrower SF-12 MH scale, whereas changes in the broader mental health score (MCS-12) and in mental wellbeing (WEMWBS) were not statistically significant. In separate analyses to investigate the effects of attrition in the sample, we compared the characteristics of those participants retained from T1 to T2, with those who were not. The retained cases were more likely to be female, middle-aged (30-64 years), working, and to have given a more positive response on one of the four mental health questions comprising the MCS-12 scale. In the case of each of these items, the difference in response between the retained and 'lost' sample was <4%.

3.1 Intention-to-treat analysis

Using the original IAT categorisation of areas, most of the significant effects are in the change-over-time OLS models (Table 2). Those living in the Wider Surrounding Areas (WSAs) and Housing Improvement Areas (HIAs) experience positive change over time in all three outcome measures: for WSAs +4.122 MCS-12 ($P < 0.01$), +7.395 SF-12 MH ($P < 0.01$) and + 1.707 WEMWBS (borderline, $P < 0.10$); for HIAs +1.938 ($P < 0.05$), +3.854 ($P < 0.05$) and +1.953 ($P < 0.05$), respectively. Living in a non-study area is associated with a negative change in all three outcomes [-4.582 MCS-12 ($P < 0.01$), -7.277 SF-12 MH ($P < 0.01$) and -2.473 WEMWBS ($P < 0.10$)]. In the RE models, moving between area categories is associated with lower mental health (-2.145 MH; $P < 0.10$) and lower mental wellbeing (-

1.237 WEMWBS; $P < 0.05$). The two types of regeneration area (TRA and LRA) are not associated with the mental health and wellbeing outcomes themselves (RE), nor with change in the outcomes (OLS).

From the RE regression results in particular, we see that two sociodemographic factors have a negative effect upon all three outcome measures: having a long-term illness and not working. Three other factors have negative effects upon the two mental health measures but not mental wellbeing: being a smoker, and being in an adult-only household or a single-parent household. Being white British/Irish was negatively associated with both mental health (SF-12 MH) and mental wellbeing. Employment had mixed effects, being positive for mental health (SF-12 MH) but negative for mental wellbeing. Being male was positive for all three outcome measures, and being an owner-occupier was positive for mental health (MCS-12 and SF-12 MH) but not mental wellbeing.

In the OLS models for change in the outcome variables over time, controlling for baseline, only one sociodemographic factor was associated with change in mental health or mental wellbeing, namely ethnicity. White non-British and non-white British respondents experienced a reduction in mental health over time (MCS-12 and SF-12 MH, respectively). The baseline outcome measures are interesting as the effects are significant but in opposite directions in the two types of model. Positive coefficients in the RE model show that those with a higher baseline mental health or mental wellbeing score continue to have higher scores. However, the negative coefficients in the OLS models indicate that those with higher baseline mental health or mental wellbeing gain less over time, i.e., those with lower baseline scores increase the most.

3.2 Modified intention-to-treat analysis

Table 3 gives the equivalent MIAT results. All sociodemographic variables have similar effects to previously, as expected. The altered area-type reference category includes some of the HIAs that had positive effects in the ITT analysis; thus, in the OLS models, the positive effects of WSAs are still present, but slightly reduced [+3.135 MCS-12 ($P < 0.01$), +5.368 SF-12 MH ($P < 0.01$)], and the magnitude of the negative effects of living in a non-study area increased [-5.201 MCS-12 ($P < 0.01$), -8.031 SF-12 MH ($P < 0.01$), -2.646 WEMWBS ($P < 0.05$)]. Moving between area categories again has a negative effect on mental wellbeing (-1.500; $P < 0.05$) but not on mental health. The modified regeneration area category continues to have no effect on the outcomes. The High-Rise Housing Improvement Area category, where estates of tower blocks are subject to improvement works, also had no effect on the outcomes.

4. Discussion

We set out to examine the impacts upon mental health of living in areas subject to area-based regeneration interventions of different kinds over the medium-term (nine years). This would provide a new kind of evidence of regeneration's effects by matching area-based interventions to area-based longitudinal research. What is more, the study includes residents of all kinds, irrespective of their receipt of any particular package of works or services, on the assumption that all residents can potentially benefit to some degree from a mixture of house- and household-specific measures as well as from area-based actions.

With respect to our main research objective, we found no evidence of mental health impacts from living in regeneration areas in Glasgow that have been subject to large-scale redevelopment over a ten-year period, contrary to our first hypothesis. However, this is consistent with earlier reviews of the evidence and with most of the recent studies in the UK (Critchley et al., 2004; Huxley et al., 2004; Stafford et al., 2014; Thomson et al., 2006). However, there was a positive effect associated with living in areas undergoing housing improvements, mainly to social-rented stock. This concurs with a study of similar activity in Manchester (Blackman and Harvey, 2001). Our findings are an important addition to the evidence base because they come from a relatively large study carried out over a longer period than others. To date, reviews have concluded that housing improvements are most likely to have health impacts where they target those in most need, in the poorest housing, on lowest incomes, or with existing health conditions (McCartney et al., 2017; Thomson et al., 2013). However, our results also suggest that area-based housing improvements may have impacts over and above the effects that property-specific works have upon individuals, although this would need to be confirmed in future studies.

The study provides indicative support for the argument that the ‘process of regeneration’ may be important for health outcomes (Popay, 2001). The duration and certainty of regeneration may be of primary importance, although these are factors that merit specific examination in future studies (see below). In the regeneration areas, redevelopment is unfinished so that after a decade of activity, residents are still living in an incomplete environment with much of the planned housing and amenities still undelivered by the time of the fourth survey. Moreover, the end-point is still some time away, and in the case of the larger TRAs not even defined. In these circumstances, there is no detectable impact upon the mental health of residents, in contrast to the HIAs, where the planned housing improvements are complete and a positive effect on mental health is identified.

Second, regeneration often involves relocating residents, with ‘forced relocation’ seen as having negative social effects (Goetz, 2002). Many studies of regeneration have not investigated the impacts on those who move as well as those who stay, something called for by reviewers (McCartney et al., 2017). In our study, movement between area categories has a small negative effect on mental health and wellbeing, but there are notably larger negative effects of not living in a study area; these are people who have relocated to different parts of the city, with two-in-five considering they lived ‘a long way’ from their origin neighbourhood (Kearns and Mason, 2013). Previous research, also in Scotland, did not find any effect of rehousing on mental health across an intervention group as a whole, possibly due to low power and/or a short one-year follow-up (Thomson et al., 2007). However, positive effects have been shown where psychosocial benefits of status and control were enhanced by the move (Kearns et al., 2011). Key factors differentiating these earlier studies from the current study may be the extent to which residents could choose whether or where they moved, and the distances involved, the argument being that less choice and higher distances tend to produce negative outcomes (Goetz, 2002; Kearns and Mason 2013; Kleinhans, 2003). The recent rapid review also concluded that the effects of rehousing on mental health were dependent upon the impacts of moving on individuals’ social networks and rent levels (McCartney et al., 2017), which have not been assessed here.

Lastly, the results showing positive effects for the areas surrounding the larger regeneration areas, which are in receipt of relocated residents and a limited amount of new housing, indicate a number of things: that shorter-distance moves may be positive for mental health and wellbeing, echoing findings from earlier eras of relocation where longer distances resulted in feelings of loss of community (Young and Willmott, 1957); that 'negative spillover effects' are not an inevitable corollary of regeneration (Kleinhans and Varaday, 2011); and that social compositional changes brought about by regeneration, in this case an increased presence of ethnic minority residents relocated from tower blocks (Lawson and Kearns, 2017), are not necessarily negative, as is often assumed (McCartney et al., 2017), and indeed may be positive where a community lacked cohesion previously (Kearns and Whitley, 2018).

Regarding our two subsidiary questions, we found the following. By removing the study area that did not receive any redevelopment works from the Local Regeneration Area category, the MITT analysis confirmed the absence of any regeneration area effect upon mental health for the Regeneration Area category of intervention, which was not in accord with our second hypothesis. However, the reconfiguration in the MITT analysis also revealed that additional positive effects of housing improvements were not evident in areas of high-rise dwellings when these were identified as a separate category. Although this finding may not be unexpected given what is known about poorer mental health and residential outcomes for residents in high-rise dwellings (Evans 2003; Kearns et al., 2012), the contextual effects of area-based housing improvements discussed above might have been expected to particularly apply to estates of high-density tower blocks. The fact that we have not found that here is important new evidence, since past studies of regeneration were not able to distinguish between areas of low-rise and high-rise housing.

Although it may be the case that health impacts from regeneration are more likely to be recorded in studies using objective measures including clinical scales (McCartney et al., 2017), we suggested earlier that the commonly used scales varied in their use, and in their appropriateness for deprived populations. It has been previously remarked that the predominant scale used in many studies, the SF-36 mental component score, may be insensitive for detecting population level health changes (Thomson et al., 2007; Ziebland, 1995). A comparison of different outcome measures in our study shows a number of things regarding the effects of area type on the various mental health and wellbeing scales, which can be seen by looking at the size of effects in the ITT and MITT OLS models in comparison with the T1 standard deviation for each scale. First, looking at the two mental health scales, the effects of area types are greater in proportional terms on the MCS-12 score than on the SF-12 MH scale. This may be due to the latter having a higher initial score and larger standard error, i.e., partly an artefact of the scales being differently constructed as continuous measures. Another potential explanation is that the MCS-12 score includes more variables that measure mental health impacts upon activities, such as questions about accomplishments, social activities and work, whereas the SF-12 MH scale only includes two items about affect (feeling calm and feeling depressed), and it may be that activities are more susceptible to change in deprived areas due to interventions, than mood. This is an issue worthy of further consideration in future research.

We also found, contrary to our third hypothesis, that any effects of area types upon mental wellbeing are smaller than those upon mental health, particularly when considered in relation to their respective

standard deviation at T1. Typically, significant effects of area types on the two mental health scales are equivalent to changes over time of between one third and one half a standard deviation of the relevant scale, whereas area effects upon the mental wellbeing scale are between one tenth and one quarter of a standard deviation. This is important because the Scottish Government has adopted the WEMWBS scale as a national outcome to which all policies contribute. However, our results indicate that area-based programmes and policy initiatives for disadvantaged communities may be ineffective in boosting average mental wellbeing. The possibility that this is due to the nature of the scale itself is supported by the fact that nationally there has been no movement of this indicator over the past decade (Scottish Government, 2019), so that small improvements in mental wellbeing as measured by WEMWBS may be nonetheless be of some importance given this background.

The fact that smaller changes were reported for WEMWBS is in accord with our previous remarks about the SF-12 MH scale, since WEMWBS also contains many items about mood or affect, as well as items about functioning, which prompts some further observations. First, with fourteen items of a diverse nature, there may be a tendency for movements in different directions on various items to cancel each other out to some extent, so that the overall effect on the scale, in one direction or the other, is reduced, as possibly indicated by the static national trends noted above. A previous review of the responsiveness of the WEMWBS scale which looked at studies of mental health interventions involving selected or self-selected individuals reported improvements for a minority of adults across the studies (13-46%) (Maheswaran et al., 2012). Thus, it is not surprising that we find relatively small changes in WEMWBS for a general population subject to area interventions which are not focused on mental health, nor targeted at individuals. Second, some of the items within WEMWBS, such as those on confidence, cheerfulness or optimism, may reflect personality traits more than current conditions, and thus be less susceptible to change as a result of area-based interventions.

Lastly, the smaller, and in the case of the larger regeneration areas - absent, impacts on WEMWBS may be due to the fact that regeneration does not act sufficiently upon those factors that influence mental wellbeing. Based upon earlier findings, there are at least two environments (see Fig. 1) where interventions may not be of the scale, intensity or consistency over time to improve conditions sufficiently in order for area regeneration to impact substantially upon mental wellbeing. One is the neighbourhood physical environment, where quality and a sense of progress or positive trajectory are strongly associated with mental wellbeing (Bond et al., 2012), but where investment is often lower than for housing. The other is the psychosocial environment, which corresponds closely with the content of the WEMWBS scale, since both involve assessing oneself in relation to others. Here, important elements, such as collective influence over key decisions, perceived area reputation, and relative status and standard of living compared with other areas, are significantly associated with mental wellbeing (Kearns et al., 2012a and 2013), but are aspects of deprived areas that are often not addressed within regeneration programmes or are notoriously hard to tackle (e.g., see Robertson, 2013 on area reputations).

4.1 Limitations

The response rate to our surveys was under 50%, which is in line with declining response rates in recent years and lower response rates in Glasgow than in other districts (Scottish Government, 2010 and 2013). However, the response rate does increase the likelihood that our surveys did not capture

the views of less-inclined or hard-to-reach groups, who are likely to be more present in deprived areas. Our study design utilised deprived areas with a lower intensity of intervention as the contrast to regeneration areas, which may lead to underestimation of the effects of regeneration. However, it is hard to find deprived areas in Scotland that are not subject to special policy measures, making the identification of 'control' areas problematic. There will be unobserved factors influencing mental health that are not captured by the survey, and if these are correlated with some of the explanatory variables included, the estimates will be biased. It is also likely that residents with the worst mental health were hard to reach and not captured by the survey. The outcome variables are self-reported and subject to potential bias such as response style (Villar, 2011). Our study, like others in this field, is unable to attribute changes in outcomes to particular area regeneration components (Gibson et al., 2011) due to the complexity of the interventions themselves, the under-reporting of their individual elements, and unknown variation in their implementation (Thomson and Thomas, 2015). The total interval covered by the present study is ten years, being the original timetable for regeneration, but this typical period is increasingly insufficient for the complete delivery of such programmes. In future research there is a case for a longer study time, along with a design intended to examine how the effects on mental health and wellbeing change as duration extends and/or certainty of delivery changes, assuming that a way to measure the latter is capable of being developed. Ideally, future research would include study areas with different intended delivery periods so that the effects of duration could be properly assessed.

5. Conclusion

Future studies of mental health and wellbeing impacts from regeneration should consider how to incorporate the variability and uncertainty of interventions into their study designs, for example through the selection of study areas and adaptation of their classification, alongside flexibility in the analytical strategy. The suitability of various mental health and wellbeing measures for particular contexts requires further exploration if they are to continue to be used to investigate the impacts of area-based interventions in deprived communities.

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