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Do greener areas promote more equitable child health?

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ABSTRACT

Several recent studies have suggested that people in socioeconomically disadvantaged circumstances may benefit more from local green space ('equigenesis'). This study provides a test of this hypothesis in children aged 0–13 years old. Results from multilevel models suggest the odds of sub-optimal general health were 14% lower among children in areas containing ≥21.5% green space compared to those with <10%. Higher parent-reported quality green space was associated with 18% lower odds of sub-optimal child health. However, no effect modification of the association between child health and area disadvantage across strata of green space quantity or quality was observed.

1. Introduction

Field experiments in a variety of settings show that exposure to green and natural surroundings promote favourable health responses (Hartig et al., 2003; Park et al., 2010; Roe et al., 2013). A rapidly growing number of epidemiological studies suggest these benefits can manifest at the population-level (Gascon et al., 2015; Hartig et al., 2014; James et al., 2015). Although there are fewer studies of green space with respect to children, reflecting the field of environmental health more broadly (Gascon et al., 2016), many of the potentially causal mechanisms linking green space exposure with a range of health benefits in adults can also apply to children. These can be summarised in three broadly defined and inter-related categories. The first category refers to the potential for green space to partially or fully restore abilities depleted through some form of adverse exposure. This may be, for example, a life event that is the source of psychosocial stress, such as the break-up of a previously steady relationship (Van Den Berg et al., 2010). For children, other sources of stress may also apply, from those of which they are direct targets (e.g., bullying) to experiencing events that exert stress (e.g. witnessing of parental arguments). The main hypotheses underpinning this category are 'stress reduction theory' (Ulrich et al., 1991) and 'attention restoration' (Kaplan and Kaplan, 1989). Many studies have reported findings to suggest that mental wellbeing among children growing up in greener neighbourhoods is more favourable in comparison to peers in areas that are less green (Amoly et al., 2014; Feng and Astell-Burt, 2017; Flouri et al., 2014; Markevych et al., 2014).

Aside from contact with nature having benefits for overall psychological wellbeing per se, green spaces are also considered to exert a quasi-gravitational pull for active outdoor recreation. The health benefits of keeping physically active are well known and guidelines on recommended participation have been established (Haskell et al., 2007). Prior work suggests more green space nearby translates into more physically active children (Cohen et al., 2007; Roemmich et al., 2006). However, the strength of this mechanism may not be universally experienced by all population groups (Sanders et al., 2015c) and a greener neighbourhood may be a cue for more physical active lifestyles that may only partially occur within a green space (Wheeler et al., 2010). Some studies in adults report evidence to suggest that greater levels of social cohesion within the community may be another link between green space and health (Dadvand et al., 2016; de Vries et al., 2013), but again the evidence is not unequivocal (Triguero-Mas et al., 2015) and is particularly thin with respect to child-focussed studies. These types of immersive contact with nature may also have other health benefits, such as an increased exposure to microbial biodiversity (e.g., through gardening) potentially strengthening the immune system (Kuo, 2015). Finally health gains may be accrued merely through the presence of green spaces in the neighbourhood without any formal contact required. This may be due to potential reductions in air pollution concentrations (Hirabayashi and Nowak, 2016; Nowak

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et al., 2014), amelioration of 'heat-island' effects (Bowler et al., 2010) and acoustic (and potential psychoacoustic) buffering of the effects of noise (Van Renterghem and Botteldooren, 2016).

While studies with increasingly sophisticated data and analytical techniques seek to interrogate which of the mechanisms are more important for particular outcomes, another outstanding question that epidemiologists have only recently begun to tackle in earnest is will urban greening be an intervention that promotes better health equally for all people (Astell-Burt et al., 2014)? Or will there be differential returns on investment for some groups compared to others? An important application of this question is with regards to health inequity between affluent and disadvantaged communities. The presence of green space may disproportionately benefit people in disadvantaged circumstances because they tend to have more to gain health-wise, in comparison to those in more affluent surroundings who are usually already healthier in part due greater quantity and command over resources, higher levels of autonomy and more control over their time (Marmot, 2006; Wilkinson and Marmot, 2003). The population-level impact would be to 'level-up' the life chances of people in disadvantaged areas and promote greater health equity overall. This process has been labelled 'equigenesis' (Mitchell, 2013). Or do affluent groups benefit more from local green spaces because of the aforementioned advantages that may, for example, translate into having greater ability to choose to visit green spaces during hours of the day that are sociable, timed with formal physical activities or simply deemed to be safe. If the latter scenario is evident then socioeconomic inequities in health could be exacerbated by urban greening strategies in ways that are not dissimilar to other interventions that have widened health inequities (Capewell and Graham, 2010).

Most evidence in this regard is from adults, with supportive findings from some studies of mortality (Lachowycz and Jones, 2014; Mitchell and Popham, 2008), chronic health conditions (Brown et al., 2016; Maas et al., 2009), mental health (McEachan et al., 2015; Mitchell et al., 2015) and self-rated health (Maas et al., 2006; Wheeler et al., 2015). Not all published studies in adult populations have been supportive, however (Sugiyama et al., 2016). A smaller number of studies have been published suggesting that more neighbourhood green space is differentially associated with healthier birthweight among babies in socioeconomically disadvantaged circumstances (Dadvand et al., 2012, 2014). The potential for green space to narrow socioeconomic inequities in child health, aside from birth outcomes, has not been investigated. Yet children are widely considered to be more sensitive to environmental exposures and their impacts on health due to this being a key developmental period in the lifecourse (Gascon et al., 2016). The exposures that children come into contact with can have major implications for their health and for the magnitude of health inequities several decades later (Kuh and Ben-Schlomo, 2004). Although the hypothesised causal mechanisms are ostensibly the same for both adults and children, any assumption that the evidence of probable health benefits of green space among translates directly from one age group to another would be naïve. For example, contact with green space for children is not only determined by the quantity available locally, but also whether their parent(s) or guardian(s) consider those green spaces to be of good quality. This is an important gap to address in order to support urban planning policies and practices which help to shape healthier, fairer societies from the ground up (Jackson et al., 2013).

Accordingly, this paper examines associations between child general health in relation to an objective measure of green space quantity and a subjective measure of parent-reported green space quality using an established nationally representative source of data in Australia. This analysis is then taken forward to assess the potential for effect measure modification of the association between child general health and area disadvantage across strata of green space quantity and quality.

2. Methods

2.1. Data

Data for this study was obtained from the Longitudinal Study of Australian Children (Sanson et al., 2002). In 2004, a cohort of 5107 children born between March and February 2004 and another cohort of 4983 children born between March and February 2000 were recruited from the Medicare enrolment database. This is the most comprehensive data of Australia's population and supported attempts to create a nationally representative sample. Only one child per family was included in the sample selection process. The sampling was conducted using a geographically clustered design based upon postcodes to make data collections via face-to-face interviews cost-effective. This clustered design was stratified across states and territories and resulted in an average of 40 children per postcode in the larger Australian states and 20 children per postcode in the smaller states and territories (Soloff et al., 2005). Face-to-face interviews were then conducted every two years thereafter on the parents and/or guardians of the children in the sample, with usually the biological mother performing the role of 'parent 1′ (i.e. primary spokesperson). The 'Statistical Area 2′ (SA2) area identifier, developed by the Australian Bureau of Statistics to be a proxy representation for local community at approximately 10,000 residents on average (Australian Bureau of Statistics, 2011), was linked by the data custodian to all children in the sample according to their address at the time of each face-to-face interview (i.e. incorporating residential mobility).

2.2. Sample

In this paper, data for all 10,090 children tracked from wave 1–5 in both cohorts were pooled, resulting in 44,329 observations after taking into account sample attrition over time. A total of 96 observations were omitted due to missing outcome data and a further 75 observations were omitted due to missing area identifier. The final analytical sample was 44,158 observations nesting within 10,088 children, who in turn were clustered within 1853 SA2s.

2.3. General health outcome

The outcome variable in this study was the general health of the child as reported by parent 1. A single-item question worded "in general, how would you say the study child's current health is?" was asked at every wave of data collection. The question was taken from the Child Health Questionnaire (Waters et al., 2000) with the following potential responses "excellent", "very good", "good", "fair" or "poor". In line with previous work (Nicholson et al., 2012), a binary indicator was constructed to differentiate between "excellent" and "very good" responses and "good", "fair" and "poor" responses. In effect, the outcome variable distinguishes between children considered by their parent to be in sub-optimal in contrast with optimal general health.

2.4. Area disadvantage

In this paper the Australian Bureau of Statistics indicator of area disadvantage – the 'Socio Economic Index For Areas' (SEIFA) relative index of disadvantage – was linked to every participant by the data custodian. This composite indicator taking into account a range of variables including unemployment, educational attainment and income is the established means for measuring socioeconomic disadvantage within communities across Australia (Trewin, 2001). For this paper, area disadvantage was expressed in tertiles based upon the study sample.