Health & Place 46 (2017) 101–106

Contents lists available at ScienceDirect

Health & Place

journal homepage: www.elsevier.com/locate/healthplace

What is the association between healthy weight in 4–5-year-old children and spatial access to purposefully constructed play areas?

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ABSTRACT

Background: Childhood obesity is a global issue. Understanding associated factors is essential in designing interventions to reduce its prevalence. There are knowledge gaps concerning the leptogenic potential of play areas for very young children and particularly whether there is an association between levels of childhood obesity and play area quality.

Methods: A cross-sectional observational study was conducted to investigate whether spatial access to play areas had an association with healthy weight status of 4–5-year-old children. Data from the English National Childhood Measurement Programme 2012/13 was used to measure healthy weight status and a geographic information system was used to calculate (a) the number of purposefully constructed play areas within 1 km (density), and (b) the distance to nearest play area (proximity), from child's residential postcode. A play area quality score was included in predictive models. Multilevel modelling was used to adjust for the clustering of observations by school. Adjustment was also made for the effects of gender and deprivation.

Results: 77% of children had a healthy weight status (≥2nd and < 85th centile). In a fully adjusted multilevel model there was no statistically significant association between healthy weight status and density or proximity measures, with or without inclusion of a play area quality score, or when accounting for the effects of gender and deprivation.

Conclusions: Among 4–5-year-old children attending school, there was no association between healthy weight status and spatial access to play areas. Reasons may include under-utilisation of play areas by reception age children, their minimal leptogenic influence or non-spatial influences affecting play area choice.

1. Background

Associations between childhood obesity and adult obesity in an individual's life-course, and the co-morbid conditions linked to both are well documented (Albright, 2008). Childhood overweight and obesity is recognised by the World Health Organisation as a serious global problem with an estimated 41 million children under the age of 5 years affected worldwide (World Health Organisation, 2016). In England, all school children have their weight measured as part of the National Childhood Measurement Programme (NCMP) during their first year of school attendance (age 4–5 years) and again at age 10–11 years. Prevalence of childhood obesity has increased in England with approximately a fifth of 4–5-year-old children and a third of 10–11-year-old children currently overweight or obese (Health and Social Care Information Centre, 2015). Understanding factors associated with childhood obesity is paramount in designing interventions that may reduce its prevalence within the population.

In this context, research on childhood obesity has often focused on the influences of the food environment, both at home, school and in the community (Papas et al., 2007). Fewer studies have looked specifically at the association of physical activity and/or childhood obesity and even fewer at the association with access to purposefully constructed play areas or playgrounds. Such environmental assets might be expected to lead to increased physical activity in children (Sallis et al., 2000) and be a protective factor against developing childhood obesity. The WHO highlights the importance of adequately provisioned public spaces to allow children to be physically active (World Health Organisation, 2016). Public play areas are generally free to use, and modern design and manufacturing have been able to enhance their appeal and play value. Play areas also benefit children by being fun and interactive (Potwarka et al., 2008) and stimulate social development and locomotor skills (Quigg et al., 2012).

To date the limited, largely North American, evidence base on the leptogenic influence of play areas has set out mixed conclusions with

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http://dx.doi.org/10.1016/j.healthplace.2017.05.012
Received 31 October 2016; Received in revised form 3 May 2017; Accepted 10 May 2017
1353-8292/

some studies pointing to a positive influence on healthy weight among children (Potwarka et al., 2008; Veugelers et al., 2008; Singh et al., 2010) and others showing no association (Burdette and Whitaker, 2004; Lovasi et al., 2011). There have been obvious differences in the methodological approaches, geographies, populations and sample sizes studied which may have given rise to these mixed results. Spatial access to play areas is commonly divided into measures of density, such as number of play areas within a specified distance or within a neighbourhood, and measures of proximity, such as distance between residence and nearest play area. Some studies utilised geographic information systems (GIS) to objectively measure these spatial variables (Burdette and Whitaker, 2004; Roemmich et al., 2006; Potwarka et al., 2008; Potestio et al., 2009; Quigg et al., 2010; Lovasi et al., 2011, 2013). Other studies have relied on subjective parental reports of accessibility (Veugelers et al., 2008; Jones et al., 2009; Singh et al., 2010; Alexander et al., 2013; Fan and Jin, 2013; Tappe et al., 2013). Play area appeal is also likely to be influenced by the location, play value, and maintenance of the facility which, combined, create a measure of quality. This is the first study to account for quality in testing for an association between spatial access to play areas and weight status among young children.

A major issue with past childhood studies has been the diverse age range of included children. Some studies have focused on children (Burdette and Whitaker, 2004; Potestio et al., 2009; Lovasi et al., 2011, 2013) (≤10 years), others on adolescents (Veugelers et al., 2008; Singh, Siahpush and Kogan, 2010; Fan and Jin, 2013) (≥10 and < 19); some have combined both in the same analysis (Potwarka et al., 2008; Alexander et al., 2013). Although wide age groups make findings more generalisable to a population, they may not be applicable to specific age groups. Different age groups are likely to have different associations between weight status and spatial access to play areas. In addition, play areas will vary in their appeal and suitability to different age groups. Burdette and Whitaker (2004) and Lovasi et al., (2011, 2013) are among the few studies to focus specifically on children aged 3–5 years old.

Most past studies used a BMI-centile calculation from height and weight measurements to categorise obesity. Studies differ in whether these have been measured by trained professionals (Burdette and Whitaker, 2004; Roemmich et al., 2006, 2007; Veugelers et al., 2008; Jones et al., 2009; Potestio et al., 2009; Quigg et al., 2010; Lovasi et al., 2011, 2013) or reported by parents (Potwarka et al., 2008; Singh et al., 2010; Alexander et al., 2013; Fan and Jin, 2013). Parental reporting of weight, more so than height, has been shown to be inaccurate in this age group compared to measurements by trained professionals (Dubois and Girad, 2007).

On the basis of this brief review of current knowledge, the present study aims to investigate the association between objectively measured healthy weight status in 4–5-year-old children attending school, and spatial access to purposefully constructed play areas whilst adjusting for the effects of gender, deprivation, and play area quality.

2. Methods

Ethical approval was granted by the Faculty of Medicine Ethics Committee of the University of Southampton.

A cross-sectional design was used. Anthropometric measurements were obtained from the National Childhood Measurement Programme (NCMP) 2012/13 dataset for reception aged children (4–5 years), living in Southampton. The dataset contains a Body Mass Index (BMI) centile score for each individual. Healthy weight is defined as a BMI-centile between the 2nd and less than the 85th (overweight BMI-centile ≥85th and < 95th, obesity BMI-centile ≥95th). Variables from the NCMP dataset used in this project were postcode, gender, ethnicity, deprivation score, and BMI-centile. All reception year aged children living in Southampton who had data collected as part of the NCMP in 2012/13 and where that data was complete were included in the study. Participation rate was 93.4% with 195 children having pre-measurement opt out by parents. A total of 2763 records were available for analysis and 18 records were excluded due to residential postcodes outside Southampton. A further 33 records of children classified as underweight (BMI-centile < 2) were removed. This left 2712 children for inclusion.

2.1. Play area data

Southampton City Council provided geo-referenced vector map data (as polygon ‘shapefiles’) for play areas within the city (updated 2013) and the Index of Multiple Deprivation IMD (2010) score measured at lower super output area level. Play areas were included if they were on Southampton City Council's play area database and met the definition of being ‘a *designated play space in a defined area, containing at least one purposefully constructed item of play equipment*’. There were 82 play areas meeting this definition. Play area quality was subjectively assessed using Play England's ‘Playable Space Quality Assessment Tool’ (Inspire, 2009). This is a recognised tool for producing a numerical quality rating based on location, play value and maintenance of a play area (Dover District Council, 2011; Jenkins et al., 2015). Location scores included factors such as observing evidence of use, accessibility, safety, lighting and security. Play value scores included factors such as degree of enticement of equipment, and whether the equipment catered for children of different ages and abilities. Care and maintenance scores included observations of state of repair, health and safety, and presence of litter bins. The tool includes clear guidance for scoring on each category. A single quality assessment was made during a two-week period in June 2014 by RP.

2.2. Data management

Children in the NCMP data were geocoded to residential postcode centroid using the Code Point dataset from Ordnance Survey. A Geographic Information System (MapInfo Professional v11.5 (Pitney, 2012)) was used to calculate (a) Number of play areas within a Euclidean 1 km buffer of residential postcode centroid (a density measure) and (b) the Euclidean distance from residential postcode centroid to the nearest play area (a proximity measure). A play area was counted if (a) any part of its polygon intersected the 1 km buffer or (b) any part of its polygon was nearest to a postcode centroid of a child. A 1 km buffer distance of 1 km was chosen representing a typical walking time of 10–15 min. Existing studies use buffer sizes ranging from 0.4 to 1 km (Potwarka et al., 2008; Lovasi et al., 2013). Euclidean distances have been found to be highly correlated with network distances in urban areas and their computation is easier (Shahid and Bertazzon, 2009; Boscoe et al., 2012).

2.3. Statistical analysis

Stata/IC version 13.1 (Statacorp, 2013) was used for statistical analysis. Summary statistics were generated for weight status by gender, number of play areas within 1 km, near distances to play areas and respective play area quality scores. Random intercept multilevel logistic regression was used to adjust for clustering of healthy weight status by school. Children attending the same school may share weight status similarities due to unmeasured factors specific to within schools due to the clustered data collection process as part of NCMP. Multilevel analysis with schools as clusters can account for these effects. Model one was used to predict healthy weight for play area density and proximity. Model two was an adjusted model predicting healthy weight for play area density and proximity and accounting for the effects of play area quality, gender and IMD quintile. The ethnicity data collected by the NCMP was unreliable (36% of records were ‘unstated’) and therefore no adjustment was made for the effects of ethnicity except in a sensitivity analysis.

Both distance to nearest play area and play area count within 1 km