

## “Kids Get in Shape with Nature”: A Systematic Review Exploring the Impact of Green Spaces on Childhood Obesity

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**Summary** Green and blue spaces (GABS) are vital components of sustainable and healthy communities. Evidence suggest that GABS positively affect population health and wellbeing. However, few studies examine GABS influence on childhood obesity. This systematic review investigates the impact of GABS on childhood obesity particularly on children’s physical activity and eating behavior. The search protocol identified 544 studies from PubMed, Medline, PsycINFO, CINAHL, and Web of Science. A two-tier screening process document using the PRISMA flow diagram identified 16 studies which underwent quality analysis using the National Heart, Lung, and Blood Institute (NHLBI) and Critical Appraisal Skills Programme (CASP) tools. Data were interpreted using thematic analysis and narrative synthesis. Selected studies show varying sociodemographic characteristics of sampled populations located in urban and rural settings. The influence of GABS on children’s physical activity and eating behaviour depends on the type, location, proximity, density, facilities, and activity types that interplay with gender, ethnicity, and parent-child relationship. The review demonstrates the significant effect of GABS on children’s physical activity and eating behaviour. GABS provide children with safe venues for socialisation and long, intensive, and enjoyable physical activity; and influence children’s perceptions on vegetable consumption supporting healthier eating behaviour. These spaces have the potential to eradicate childhood obesity if policy, social, economic, environmental, and organisational considerations are addressed.

**Key Words** physical activity, eating behaviour, child obesity, nutritional assessment, environmental health

There is a broad range of obesity prevention strategies (1) and these include nature and built environments such as green and blue spaces (GABS) which are integral parts of public spaces. GABS provide opportunities for physical activity and health promoting behaviours (2, 3). Ecological models for health show that features of sustainable built environments such as urban design, transportation systems, and open places (e. g. pedestrian spaces, closer distance to open and recreational spaces, and density of healthy food environments) (4–8) influence engagement to physical activity (9, 10).

GABS coexist in natural and built environments (11). Green spaces are components of green infrastructure such as parks, playgrounds, vegetation, green roofs, facades, urban meadows, greenways, riverside greeneries, lakeside trails, community gardens, woodlands, and wildlife reserves (11). Blue spaces are visible water surfaces such as lakes, rivers, canals, streams, coastal waters, and waterfronts (12). The health-enhancing features of these spaces provide venues for relaxation, stress alleviation, social and environmental connection, mental health improvement, strengthening of cognitive and immune function, and physical activity (11). GABS

also aid in behavioural improvement of children (13); have indirect effects on mortality due to cardiovascular diseases (14); have impact on human wellbeing (2); and influence engagement to physical activity and successful weight management (3, 15, 16). Despite these benefits (17), there is an inadequacy of GABS in most communities thereby compromising active lifestyle (18). This calls for the development of GABS to facilitate engagement to physical activity contributing to childhood obesity prevention (19, 20).

The rising global demand for GABS and interest on its health and wellbeing effects drive the implementation of this systematic review by investigating the impact of access to GABS on children’s physical activity and dietary behaviour.

### METHODOLOGY

The main researchers followed a predeveloped systematic review protocol by implementing literature search, screening, data extraction, quality assessment, analysis, and synthesis.

*Literature search.* Studies following randomised controlled trial, cohort, cross-sectional, before-after, and qualitative research designs were systematically collected from PubMed, Medline, PsycINFO, CINAHL, and Web of Science in June 2018 using combined keywords.

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Literature was limited to research involving children (<18 y old) and published in English between 2010 and 2018.

The PICO framework was used to determine the following keywords. *Population*: child, pupils, boys, girls, and school children. *Interventions*: urban green space, greenspace, parks, forests, nature, environment, green infrastructure, trees, wildlife, open spaces, walkable areas, neighbourhood characteristics, vegetations, built environment, vegetable gardens, blue space, bluespace, water parks, rivers, seas, surf areas, harbours, swimming pools, diving areas, boating areas, fishing areas, ponds, waterfalls, ports, marinas, canals, lakes, fountains, and aquariums. *Outcomes*: physical activity, fitness, exercise, play, active lifestyle, walking, running, bicycle, childhood obesity, child adiposity, overweight, weight loss, BMI-for-age, food choice, diet, and eating behaviour.

*Screening and data extraction.* Selected studies were screened between June and July 2018. The two-staged screening included title and abstract review vis-à-vis research aims, objectives, inclusion, and exclusion criteria. Sifted studies were subjected to full review and final studies underwent data extraction using a bespoke online data form based from the Cochrane Handbook for Systematic Review of Interventions (CHSRI).

*Quality assessment.* The NHLBI and CASP tools were used to assess quality of studies and discount effects of bias. Rating scales were based from quality score categories developed by Rashid et al., using low (0–4 points), reasonable quality (5–8 points), and high (9–12 points) (21) ratings.

*Analysis and synthesis.* Thematic analysis and narrative synthesis were employed due to data heterogeneity. Data were scrutinised through inductive coding, descriptive theme development, and analytical themes formulation.

## RESULTS

A total of 544 studies were gathered from Web of Science ( $n=310$ ), PsycINFO ( $n=137$ ), Medline ( $n=61$ ), PubMed ( $n=23$ ), and CINAHL ( $n=13$ ) after deduplication. There were 539 studies on green spaces and five studies on blue spaces. Sixteen studies on green spaces were selected whilst blue space studies were excluded because these did not satisfy the eligibility criteria. Quality assessment results showed nine studies having reasonable quality and seven having good quality.

### *Characteristics of selected studies*

Studies used qualitative (22), before-after (23–27), cross-sectional (28–35), prospective cohort (36), and randomised cross-over (37) research designs. All focused on the influence of green spaces on physical activity and eating behaviour. Sampled populations were less than 18 y old and recruited from schools, and urban and rural communities in New Zealand, UK, USA, The Netherlands, Canada, Turkey, and Germany.

Most green spaces were characterised by neighbourhood-built environments (23, 28, 36), types, and features (24, 25). Green spaces include parks, sport fields,

playgrounds, recreational and community centres, nature reserves, school fields, open picnic areas, and shelters (26, 29, 30, 37). Three studies focused on location and accessibility of green spaces in urban settings (31–33); whilst one study concentrated on parks and neighbourhood facilities (34). Two studies used interactive green spaces such as Park Hop (a scavenger-hunt-type activity) (35), and school gardening (22). Another study used structured green space playtime activities such as playground sports and nature-based orienteering (27). Intervention durations range between 6 and 16 d; to 1 and 10 mo; whilst some did not report duration.

Measured outcomes were children's physical activity characterised by intensity, frequency, duration, and distance (23–28, 30, 31, 34, 36, 37). Fair et al. and Quigg et al. centralised on intensity and proportion of children engaging to intensive physical activity (33, 35). Alexander et al. and Schalkwijk et al. discussed levels of childhood obesity (29, 36), whilst Ward et al. focused on body mass index and waist-to-hip ratio (26). One study assessed children's vegetable consumption experience (22). Other related outcomes are park usage and distance (25); green space size; park visit frequency; influence of demographic characteristics on physical activity (23, 31); and parental influence (32) and perceptions on safety, quality, and enjoyment (35).

### *Thematic analysis*

Exposures and outcomes were used in forming coding units and frameworks to create descriptive and analytical themes. Generated descriptive themes are type; location; facilities; features; gender, ethnicity, and age; and social and parental influences. Analytical themes are community-based green spaces; school-based green spaces; features and facilities of green spaces; and socio-demographic influences on green space use.

## DISCUSSION

### *Community-based green spaces*

Community parks, sports fields, nature reserves, recreational parks, and playgrounds provide significant outcomes on engagement, intensity, and duration of physical activity amongst children (25, 26, 33, 35). Children exposure to sport fields and nature reserves monitored in a seven-day period demonstrated a suggestive relationship between green space exposure and proportion of time spent in moderate to vigorous physical activity (MVPA) (26). This is similar to Quigg et al. study where 2% of children's time spent on physical activity occurred in city parks and playgrounds (33). Amongst obese children, MVPA occurred in city parks with playgrounds during non-school days which is similar to Wheeler et al. study (25). Ward et al. also claim that although some school children have low exposure to green spaces, this still has positive effect on MVPA (26). Additionally, Fair et al. observed that total engagement time of children in physical activity ranges between 98.62 and 99.2 min in community recreational parks (35). This is higher than the 60-min recommendation of WHO for 5–17 y old children (38).

This suggests that children engage to longer MVPA in community-based green spaces.

#### *School-based green spaces*

Children's exposure to school fields, playgrounds (33, 37), and school vegetable gardens (22) has positive effect on duration and engagement to physical activity and eating behaviour.

Two children groups who separately played in school fields with trees and bushes and in playgrounds surrounded by school buildings within two weeks engaged more frequently and longer in MVPA in natural and built environments (37). Contrastingly, less time was spent in MVPA in nature-based orienteering compared to sports-based activities in playgrounds using playing equipment (27). However, only fit children engaged in playground sports whilst obese children participated in nature-based orienteering (27). This suggests that altering play environment is imperative to increase intensity of physical activity and obese children prefer more interactive but less strenuous green space activities (27, 37). Wood et al. also claim that children who played in natural environments do not acquire additive effect on self-esteem (37), whilst Barton et al. claim otherwise (27). Positive changes in children's eating behaviour who participated in school gardening was also observed in a Dutch study (22). After harvest period, improvement on children's perceptions on vegetables characterised by their ownership, enthusiasm, and involvement in vegetable production, preparation, and consumption were observed.

#### *Features and facilities of green spaces*

Five studies focused on features and facilities of green spaces such as proximity (31), density and foliage (28, 36), neighbourhood environment (28, 30, 36), and types of activities (30). Akpınar observed that closer distance of residences to urban green spaces results to increased frequency of children's engagement to physical activity (31). Remote green spaces are also associated to longer child screen time resulting to physical inactivity amongst girls (31). Schalkwijk et al. also underscored that children are likely to become obese if they live in communities lacking of green space foliage and density (36). This is similar to another study demonstrating that access to abundant green spaces affect levels of engagement to MVPA (28). Evidence also suggest that communities with high mobility index provide children with opportunities for physical activity resulting to MVPA; however, this is influenced and controlled by parental perceptions on child safety (28). Bocarro et al. also noted that the abundance of facilities in playgrounds, courts, and open spaces are substantial in increasing children's physical activity levels (58). For instance, park zones and courts are associated to MVPA, whilst picnic areas are associated to low intensity physical activity (34). Green spaces are also expected to provide activities which are either informal or formal, and structured or unstructured. Bocarro et al. highlight that formal park activities decrease boys' engagement to physical activity; however, if formal activities are coupled with recreational facilities, levels of physical

activity increase, especially amongst girls (30).

#### *Sociodemographic influences on green space use*

Green space use amongst children is influenced by demographic aspects such as gender (23, 24, 30, 34, 37), age (30, 31, 34), and ethnicity (29); and social and parental/familial factors (30, 32, 34–36). Girls are more associated with low engagement and low level of physical activity in green spaces especially those who are less deprived (34) and habitually use motorised transport (23). However, girls have significant increase in physical activity when this is undertaken in fields (37) with abundant facilities even during formal play (30). Boys spend more time in MVPA and engage more when environments are wider and with abundant sport fields and facilities (23). Thus, ample and gender-sensitive playing facilities in green spaces are recommended. Frequency of physical activity of children aged 1–12 y old are higher in green spaces, whilst duration of children aged 7–12 y old are longer (31). Younger children are also more active, however, when the type of play is formalised and organised, this level decreases especially in younger boys. Though evidence is limited, a possible relationship between park use and ethnicity was observed amongst obese non-Hispanic Black children (29). Moreover, children of parents with low educational attainment and have less access to green spaces are likely to be obese (36). Contrastingly, children of parents with low educational attainment are associated with high frequency of physical activity; and those children whose parents experience high levels of deprivation have low frequency of physical activity (32). Adult presence and participation in children's play is also associated to lower engagement of children; and this is more evident amongst girls, adolescents, and younger children (30, 32, 34). However, if parents integrate themselves in children's play and activities, this increases children's frequency and duration of physical activity (32) given that safety, quality, and enjoyment are ensured to parents and carers (35, 36).

## CONCLUSION

This systematic review critically analyzes and synthesizes evidence on the impact of green spaces about the underlying factors of childhood obesity (i.e. physical activity and eating behavior). Features of green spaces (i.e. proximity, density, foliage, facilities, and types of activities) affect how children access, engage, and utilise these spaces considering their sociodemographic profiles (i.e. age, gender, and social relationship with carers and peers). Better-quality and child-friendly green spaces influence children's intensity, duration, and exposure on physical activity as well as eating behaviour. These spaces can help prevent childhood obesity in developing countries provided that safe, clean, and conducive green spaces are available and accessible in residential and school environments, and societal influencers are supportive of active outdoor play. Further studies on the impact of blue spaces on childhood obesity is highly recommended.

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No conflicts of interest to be declared.

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