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Are children living on dead-end streets more active? Near-home street patterns and school-going children's time spent outdoors in Dhaka, Bangladesh

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ABSTRACT

This study aimed to investigate relationships between near-home street patterns and children's time spent outdoors (TSO). Participants were 60 ($n = 60$) school-age Dhaka children, 7–11 years old (16 girls and 44 boys) selected by a two-phase cluster sampling method. Data were collected from September 2010 to June 2011 by visiting each of 60 children's homes. Children's mean TSOs (in minutes) were reported by parents' face-to-face interviews, and near-home street pattern data were collected by systematic direct observations. The researchers also collected data on seven socio-demographic variables and three neighborhood built-environment variables. A backward selection based multiple linear regression was used to examine association between children's TSO and near-home street patterns. Results (adjusted $R^2 = 0.66$ for weekdays and 0.68 for weekend) suggested that children's TSO were significantly associated with near-home street type: dead-end instead of through streets (28 min on weekdays, $p < 0.01$ and 66 min on weekend, $p < 0.01$). The width of the street, level of its branching and availability of an open space or playground near the house are also positively associated with TSO. Near-home street features significantly contribute to TSO in school-going children of Dhaka.

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1. Introduction

Increasing physical activity in youth is considered crucial for public health (Southward et al., 2012). Time spent outdoors (TSO) is an important determinant of children's physical activity (Cleland et al., 2008; Sallis et al., 1993, 2000; Schaefer et al., 2014; Van der Horst et al., 2007). TSO is often considered a potential surrogate measure of children's physical activity (Burdette et al., 2004) and can be critical for achieving the minimum of 60 min of moderate-to-vigorous physical activity (MVPA) daily for youth, recommended by the World Health Organization (2010). Beyond physical activity, increased TSO is also reported as a strategy to reduce the risk of developing myopia in children and adolescents (He et al., 2015; Rose et al., 2008; Sherwin et al., 2012). Several studies expressed concern about the decrease of children's TSO in developed countries (Cleland et al., 2010; Gray, 2011; Hofferth, 2009). However, little is known about children's TSO in developing countries, where children's diminishing outdoor time is equally critical (Luo and Hu, 2002).

Rapid urbanization is often described as one of the key factors behind the global trend of physical inactivity (WHO, 2010b). Rapid urbanization in developing countries typically overburdens the ability of local governments to provide essential services (Alberti and Susskind, 1996). UN-Habitat studies (2014) have also demonstrated that, in many cases, there are no proper mechanisms to ensure the creation, protection, and maintenance of public open spaces in developing countries. Moreover, encroachment of existing public open space is also commonplace, which exacerbates the problem. Dhaka, one of the most densely populated cities in the developing world, suffers from these typical crises of lack of public open space. High population density, inadequate infrastructure, economic pressure on land, poor urban management (Afroz, 2009), encroachment, and antisocial occurrences (Nilufar, 2000) all contribute to shrinking of open spaces in Dhaka. The developed areas under the Dhaka City Corporation (DCC) jurisdiction had only 14.5% open space (SENES, 2007), and during the time span of 11 years (from 1992 to 2003), the land area occupied by vegetation in greater Dhaka diminished to only 5.5% from 13.6% (Dewan and Yamaguchi, 2009). How this cityscape of diminishing accessible public open space and urban green has affected the TSO of its children is not well documented. However, one study (Islam, 2009) conducted with 109 school-going Dhaka

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children showed that almost 34% of children spent no time outdoors during regular school days. Given the unprecedented urbanization of the mega cities in developing nations, children's TSO needs further investigation. Dhaka is the 16th largest city by population (Worldatlas, 2016) and one of the fastest growing cities in the world (Demographia, 2016) and thus provides a unique setting for research on children's TSO.

Previous studies identified several socio-demographic correlates of children's TSO. Gender (Islam et al., 2014; Prezza and Pacilli, 2007; Rissotto and Giuliani, 2006) and age (Hofferth and Sandberg, 2001) of children were consistently reported as significant determinants of TSO, showing that boys spent more time outdoors than girls, and older children enjoyed longer TSO than younger ones. Parents' income (Brodersen et al., 2005; Ferreira et al., 2007), education (Tranter and Pawson, 2001), parental encouragement and supervision (Cleland et al., 2010), and parental perception of safety (Molnar et al., 2004; Prezza and Pacilli, 2007; Wilson et al., 2004) were also found to be associated with children's TSO. Immediate neighborhood characteristics were also reported to be associated with children's TSO (Giuliani et al., 1997; Moore, 1990). Lack of recreational infrastructure (Davison and Lawson, 2006) or accessible open space near home (Kytä, 2002) reduced children's TSO. Shorter home–school distance was found to be positively associated with children's TSO (Cohen et al., 2006; van Oel, 2009). Few studies found associations between children's outdoor activities and design characteristics of the residential buildings they lived in (Prezza et al., 2001; Saegert, 1982). Research also demonstrated that children who lived above the first floor play outside less than those on the ground or first floor (Conway and Adams, 1977).

Few studies have examined the relationship between street design characteristics and children's outdoor activities. Because residential streets are a key component of the built environment, they must be examined as a predictor of children's TSO. Some studies have found a positive relationship between street connectivity and children's biking or walking to school (Braza et al., 2004; Falb et al., 2007). Others have found increased connectivity associated with lower rates of walking or riding to destinations (Timperio et al., 2004). Only one previous study, in the context of a developing country (Islam et al., 2014), found that Dhaka children's average time outdoors on weekdays was likely to be higher when the streets in front of their residences were dead-end streets instead of through streets. Lack of previous studies suggests the need for further investigation into the role of the closest street in front of the child's home in TSO.

2. Methods

2.1. Participants

School going Dhaka children, 7–11 years old (16 girls and 44 boys), and parents volunteered for the study. This is the age range when children are developmentally capable and more likely to roam outdoors than in earlier periods of childhood (Moore, 1990; O'Brien et al., 2000; Prezza and Pacilli, 2007). The study adopted a two-phase, cluster, random sampling method. Because there was no available Dhaka database of individual children 7–11 years old, instead of random sampling, the first phase of sampling started with random selection of schools from an existing list of all Dhaka schools retrieved from the Bangladesh Bureau of Educational Information and Statistics (BANBEIS, 2009). The author visited four schools randomly selected from the list. Permission to visit the schools was obtained from the Directorate General (DG) of the Ministry of Education of the Government of the People's Republic of Bangladesh. The author visited four classrooms (one classroom per school) and gave a slide presentation on a multimedia projector to brief children about the objectives and possible outcomes of the research, in language suitable for children. After the presentation, the author asked the children whether they wish to participate in the study. One hundred percent of the children gave their assent (verbally) to

participate. The author also distributed written informed-consent forms to all children of each of the four classrooms. Children were instructed to take the forms home to their parents and bring signed consent forms back to their class teachers. Incomplete or unsigned consent forms were rejected and not considered for inclusion. Fifteen children per classroom (totaling 60 children) were randomly selected from a sample frame of 177 completed and signed consent forms (Fig. 1) of children from the four schools. For data collection, the author visited each of the 60 children's homes by scheduling appointments with parents over the phone. These visits took place on the weekends (Fridays and Saturdays in Bangladesh) and school holidays.

During each visit to a child's home, the author followed this protocol for data collection.

1. The author explained the research to the parent(s) in the presence of the child.
2. The author then administered a parent interview with a structured questionnaire. Initially, it was planned that both parents would participate in the survey separately, but due to conservative values in many households, the mothers denied participation and data from one parent was considered for the final analysis.
3. After the interview, the parent and the child identified the child's route to school on a Google Earth satellite map (Fig. 2).
4. The child, with parent's permission, then led the author to his/her outdoor destination(s) (if any) where he/she spent recreational time daily/frequently.
5. During the child-led field trip, the author interviewed the child with a structured questionnaire.
6. The author also collected built-environment data (e.g., by measuring the width of the near-home street with a measuring tape and the child's help).
7. If agreed, the author collected parents' consent for the test-retest interview in a separate consent form.
8. Parents who agreed and signed the consent were called via phone one week from the day of the site visit and were again asked questions regarding their children's TSO. This data was used to calculate test-retest reliability of the questionnaire instrument.

2.2. Measures

Parents reported start and end times of children being outdoors for each of the seven days of a typical school week. The researcher calculated TSO for each day from the start and end outdoor times. Average value of the reported TSOs for the five weekdays (Sunday–Thursday) was calculated to measure weekdays TSO of children. Similarly, the average value of weekend TSO was calculated. The structured interview was also used to collect child data regarding seven socio-demographic variables: gender, age, number of siblings, eldest among siblings, household monthly income, and whether the child walk to school (Table 1). The study included four design characteristics of the near-home street: street type, street width, street level, and number of street crossings along the school journey. During the child-led field trip, the child showed the outdoor destination near home where he/she frequently visited for play/recreational activities. Such destination was not always a park or playground but, rather, a variety of open spaces identified as playgrounds by the participating children. Other built-environment data were collected by systematic direct observations. The variables of the study, their definitions, data collection methods, and units of measurement are described in Table 1.

2.3. Statistical analyses

Multiple linear regression was used to examine relationship between children's TSO and their near-home street type (dead-end or through street). Analyses were controlled for built-environment variables, socio-demographic characteristics of the participants and other

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