



Do psychosocial factors moderate the association between neighborhood walkability and adolescents' physical activity?

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ABSTRACT

Ecological models emphasize the interaction between individuals and their environment. Furthermore, they posit that environmental variables influence physical activity (PA) not only directly but also indirectly through their interaction with other factors. This study explored if the association between neighborhood walkability and adolescents' PA is moderated by psychosocial factors using data from the Belgian Environmental PA Study in Youth (BEPAS-Y). BEPAS-Y recruited adolescents from 32 neighborhoods differing in objectively determined neighborhood walkability and income. Between 2008 and 2009, 637 adolescents (13–15 years; 49.4% boys) completed a survey measuring socio-demographic and psychosocial factors and wore an accelerometer for seven days. Multilevel-regression analyses revealed that for adolescents living in low-income neighborhoods, the association between neighborhood walkability and PA is moderated by perceived barriers and perceived benefits toward PA. Neighborhood walkability was positively associated with PA among adolescents, living in low-income neighborhoods, who perceived many barriers and few benefits, while for adolescents who perceived few barriers and many benefits, the PA level was high, irrespective of neighborhood walkability. For adolescents, living in high-income neighborhoods, none of the psychosocial attributes moderated the association between neighborhood walkability and PA. These findings provide some support for the predicted interactions posited by ecological models. Improving neighborhood walkability might increase PA-levels of adolescents living in low-income neighborhoods, with less positive psychosocial profiles, or in other words; those who are most difficult to reach through PA interventions. However, in order to increase PA in large populations, interventions focusing solely on improving neighborhood walkability may not have the desired effect.

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Introduction

Despite the strong evidence on the protective effects of regular physical activity (PA) on the development of obesity and many chronic diseases (Jimenez-Pavon, Kelly, & Reilly, 2010; Kokkinos, 2008; Vuori, 2007; Warburton, Nicol, & Bredin, 2006), a large proportion of school-aged youth is insufficiently active (Ekelund, Tomkinson, & Armstrong, 2011). The development of effective interventions for the promotion of PA among youth has therefore become a public health priority in most developed countries (World Health Organization, 2004). Consequently, a growing body of research intended to identify on which factors to focus when developing PA interventions (Ferreira et al., 2007; Van Der Horst, Paw, Twisk, & Van Mechelen, 2007).

Several studies have employed the theoretical perspectives of individually-oriented models (e.g. the health belief model, the theory of reasoned action, the theory of planned behavior, the social cognitive theory, the social learning theory) focusing primarily on personal and psychosocial factors, to investigate the correlates of PA in youth (Glanz, Rimer, & Lewis, 2002). This research identified the contribution of demographic, psychological and social factors to explain PA (Hsu et al., 2011; Sallis, Prochaska, & Taylor, 2000; Van Der Horst et al., 2007; Voorhees et al., 2005). From these studies, the following psychosocial factors emerged as consistent correlates of adolescents' PA: modeling, social norm, social support from family and friends, self-efficacy, perceived benefits toward PA and perceived barriers toward PA (De Bourdeaudhuij & Sallis, 2002; Sallis et al., 2000).

However, while many personal and psychosocial factors have been found to be associated with PA, previous research testing individually-oriented models and theories, explained at best

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a proportion of 20–40 percent of variance in PA. Consequently, the majority of variance in PA remains unexplained (Spence, Courneya, Blanchard, & Wilson, 2000). Furthermore, the long term effects of individually-oriented interventions to promote PA tend to be limited (Spence & Lee, 2003). These kinds of interventions seem to affect the behavior initially, but other factors such as physical environmental factors may cause a return to the original unhealthy behavior after the intervention is complete. Consequently, this has led to a shift from individually-oriented models to ecological models that emphasize the dynamic interaction between the individual and factors at multiple levels, which include intrapersonal factors, sociocultural factors, physical environmental factors and policies (Sallis, Owen, Fisher, & Glanz, 2008).

Within this line of research, empirical evidence documenting on the role of neighborhood walkability (i.e. land use mix, street connectivity and residential density of a neighborhood) (Frank, Schmid, Sallis, Chapman, & Saelens, 2005; Leslie, 2006) to explain adolescents' PA is accumulating (Ding, Sallis, Kerr, Lee, & Rosenberg, 2011). For adolescents, the local neighborhood environment is a key setting for PA (Davison & Lawson, 2006). Adolescents are often dependent on adult rules concerning travel and destination choices and are not licensed to use motor vehicles under the age of 16. Consequently, adolescents may be influenced strongly by their own local neighborhood. However, in contrast to the consistent results in adults, the current empirical evidence considering the association between neighborhood walkability and PA among young people is inconsistent. A recent review by Ding et al. (2011) concluded that in only 20 percent of the studies among adolescents, objectively determined neighborhood walkability and objectively determined PA had a significant positive association. In the other 80 percent of the studies, no association could be established. Within this field of research, the use of objective data to determine neighborhood walkability as well as PA is recommended to avoid differences in reporting bias and to guarantee comparability across countries (Ball et al., 2008; Reilly et al., 2008). Neighborhood walkability can be objectively assessed through Geographic Information Systems (GIS) databases and motion detectors such as accelerometers and pedometers can capture PA objectively (Corder, Brage, & Ekelund, 2007).

Also in another study, the Belgian Environmental PA Study in Youth (BEPAS-Y), the association between objectively determined neighborhood walkability and PA in 13–15 year old Belgian adolescents was investigated (De Meester et al., 2012). The results of this study revealed that only for adolescents living in low-income neighborhoods, GIS-based neighborhood walkability was positively associated with accelerometer-based PA. Among adolescents living in high-income neighborhoods, no association between neighborhood walkability and PA was found. From these results, it appears that the direction and strength of the association between neighborhood walkability and adolescents' PA level may depend on neighborhood income. This is in line with the theoretical conceptualization of neighborhoods by Bernard et al. (2007) stating that the impact of resources offered in the neighborhood may be diminished or reinforced by the socio-economic status of the residents. According to Dahlgren and Whitehead (2006) the importance of structural interventions (e.g. neighborhood-level interventions) may be far greater among low-income groups than among high-income groups. This underlines the importance to being perceptive of disparities across socio-economic groups in this field of research.

Thus, although the local neighborhood has been acknowledged as a key setting for PA among adolescents (Davison & Lawson, 2006), the results concerning the relationship between neighborhood walkability and PA are inconclusive, the relationship is not well understood and strong support is lacking (Ding et al., 2011).

However, based on the results of adult studies, many researchers have emphasized the importance of designing neighborhoods characterized by high-walkability in order to increase PA in large populations (Heath et al., 2006). After all, physical environmental changes in a neighborhood will affect all residents living in the targeted neighborhood. However, before these kinds of interventions can be developed, it is important to understand the impact of neighborhood walkability among different population subgroups.

According to the ecological approach, research focusing on only one level, such as walkability and income on neighborhood level, without the integration of other factors on other levels (e.g. psychosocial factors on the individual level), may underestimate the accumulation of influences that affect PA (Sallis et al., 2008). After all, ecological models posit that environmental variables not only directly, but also indirectly influence PA through their interaction with other factors such as psychosocial factors (Sallis et al., 2008). Specifically, healthy behaviors are thought to be maximized if environments support healthful choices and when individuals are motivated and educated to make those choices (Ottawa Charter for Health Promotion, 1986; Sallis et al., 2008). This core principle of the ecological models was supported by the results of the study of Frank, Saelens, Powell, and Chapman (2007) that showed that adults living in walkable environments and preferring walkability had higher levels of physical activity.

Given the importance of certain psychosocial factors to explain PA (i.e. modeling, social norm, social support from family and friends, self-efficacy, perceived benefits toward PA and perceived barriers toward PA); the moderating role of these factors in the association between neighborhood walkability and adolescents' PA certainly needs more attention. In agreement with the ecological approach, it could be hypothesized that a walkable neighborhood cumulated with a positive psychosocial profile would result in a higher level of physical activity. Within the current empirical evidence, arising from previous work conducted to corroborate the theoretical perspectives of the ecological models, only a few studies provide information about the direction of the moderating effect of these psychosocial factors on the association between the physical environmental factors and physical activity. One study among young adults, investigated the moderating effect of self-efficacy on the association between perceived physical environmental factors (neighborhood safety and access to PA facilities) and active transportation. The findings showed that young adults with low-efficacy were more likely to be influenced by environmental barriers (Deforche, Van Dyck, Verloigne, & De Bourdeauduij, 2010). To our knowledge, no previous studies have examined the potential moderating effects of psychosocial factors on the association between objectively determined neighborhood walkability and adolescents' PA. Among adults however, there is some evidence that confirmed the moderating role of psychosocial factors on the relationship between GIS-based neighborhood walkability and PA. A Belgian study found that living in a high-walkable neighborhood was associated with taking more steps, especially in adults with a preference for passive transport and/or a low intention to walk or cycle (Van Dyck, Deforche, Cardon, & De Bourdeaudhuij, 2009).

The results of the study of Deforche et al. (2010) and the study of Van Dyck et al. (2009) support the perspective of the ecological models that emphasizes the role of other factors, including psychosocial and demographic factors, when investigating the association between neighborhood walkability and PA. In these two studies, self-efficacy, preference for passive transport and intention to walk or cycle (i.e. psychosocial attributes) were found to moderate the association between neighborhood walkability and PA. However, the results of both studies do not support the core principle of the ecological models stating that a supportive

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