Correlates of physical activity among overweight and obese populations: A review of the literature

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Abstract The dose-response association between physical activity (PA) and obesity is well-established; however, the correlates of PA among overweight and obese populations require clarification. Therefore, the purpose of this study was to review the correlates of PA among overweight and obese populations. Literature searches were conducted for English and Japanese-language published articles, between Jan 2000 and Dec 2010, using “PubMed”, “Medline”, “Psycinfo” and the “Japan Medical Abstract Society”. A total of nine eligible articles were included in the analysis: five studies compared the PA correlates between normal-weight and overweight/obese populations; and four studies examined PA correlates in overweight/obese populations. Consistent correlates of PA among overweight and obese populations were age, self-efficacy, social support, perceived good access to facilities, and seeing people being active in the neighborhood. For obesity prevention, particularly in non-Western countries, further research is required with the purpose of developing effective PA interventions among overweight and obese populations. Future studies should examine both perceived and objectively-assessed environmental factors associated with specific PA behavior.

Keywords: physical activity, overweight, disease prevention, exercise, review

Introduction

Overweight and obesity are associated with an increased risk of morbidity from chronic diseases, higher health-care costs and a lower quality of life1-4). The increasing prevalence of overweight and obesity has been well documented in the United States (US)5-8) and European countries7,8). This trend has also been observed in the Asia-Pacific region in recent years9). Therefore, identifying effective population-based strategies for preventing weight gain is a public health priority not only in Western countries but also in other countries.

Numerous longitudinal and cross-sectional studies have shown that engaging in physical activity (PA) is beneficial for the prevention of overweight and obesity10-15). Based on these findings, the World Health Organization has recommended engaging in at least 30 minutes of moderate-intensity PA daily for the prevention of obesity and other chronic diseases5,16). Despite the benefits, overweight and obese individuals spend less time engaged in PA than normal-weight individuals11-15). Therefore, the development of effective strategies that promote PA in overweight and obese individuals is important to prevent and reduce obesity.

From an ecological perspective, PA is a complex behavior that is influenced by individual, psychological, social, and environmental factors (or correlates), herein also referred to as independent variables17). According to the behavioral epidemiology framework, the identification of factors that influence PA would be useful for developing tailored and effective PA interventions18). Several systematic reviews have examined the correlates of PA among adults and reported several consistent correlates that were associated with higher PA participation or engagement19-21). However, previous studies also found that PA correlates differed by subgroups, including gender22-24) (i.e. social support was associated with PA in men, whereas enjoyable scenery was associated with PA in women), age25) (i.e. street connectivity and traffic safety were associated with walking in younger adults, whereas non-residential destinations and recreation facilities within walking distance were important for older adults that walk) and race/ethnicity26-28) (i.e. social-cognitive variables were more related to PA levels in Caucasian girls, whereas environmental factors were more related to PA in African-American girls). Although the correlates of PA among overweight and obese people may include gender, age and race/ethnicity, there may be other correlates that are different than those found in normal-weight individuals. Possible reasons for different correlates could be that

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overweight and obese populations might be more sensitive at a psychosocial level or in environmental perceptions compared to normal-weight individuals. This could be related to the stigma associated with being obese or discrimination that overweight/obese people experienced during their developing years. If the different factors associated with PA were associated with body mass index status (i.e., overweight, obese), this would suggest a need to develop specific strategies for PA intervention according to BMI status. Therefore, to enhance the understanding of this important research area, the primary purpose of the review was to identify common correlates of PA among overweight and obese populations.

Methods

Search strategies and procedures. Literature searches were conducted for English and Japanese-language articles published between Jan 2000 and Dec 2010 using PubMed, Medline, Psycinfo and the “Japan Medical Abstract Society”. The initial search included entries available from Jan 1990 to Dec 2010. Because of the low numbers of articles published between 1990 and 2000, the lower bound was modified to the year 2000 after completing the entire article screening process. Combinations of the following key words were used for the literature searches: (“obesity” OR “overweight”) AND (“correlates” OR “factors” OR “determinants”) AND (“physical activity” OR “walking” OR “exercise” OR “sports”). In addition, according to the PA correlate classifications used in previous studies, the following search terms were added for sociodemographic correlates: (“sociodemographic” OR “demographic” OR “socioeconomic”). For psychological and social correlates, the following search terms were added: (“psychosocial” OR “psychological” OR “social”). For environmental factors, the following search terms were added (“environment” OR “environmental factors” OR “environmental attributes”). Articles were considered relevant if they reported PA correlates among overweight/obese populations. With regard to the selection process, titles and abstracts of articles were reviewed by a reviewer to exclude articles out of the scope of the study. Then, the selected full-text articles in English were reviewed by a reviewer, and the articles in Japanese were reviewed by two reviewers. Disagreements between the two reviewers were discussed with the other co-authors for a consensus decision.

Inclusion criteria. The inclusion criteria were (1) English- and Japanese-language articles published in scientific journals; (2) sample size was larger than 50; (3) study was published between Jan 2000 and Dec 2010; (4) outcome variables, such as PA were objectively measured or self-reported; (5) study had independent variables such as individual, psychological, social, and environmental factors (correlates); and (6) study had BMI measures. More specifically, the subjects were classified as either overweight or obese. For this study, article selection was not conducted according to age groups, and neither were the recommended levels of PA for obesity prevention considered as inclusion and/or exclusion criteria.

Results

For the period Jan 2000 to Dec 2010, a combination of the following search key words: (“obesity” OR “overweight”) AND (“correlates” OR “factors” OR “determinants”) AND (“physical activity” OR “walking” OR “exercise” OR “sports”) provided 8,980 article hits (PubMed/Medline: 7,661; Psycinfo: 1,319) from the three English-language databases. After reviewing the titles and abstracts of the 8,980 articles, five articles were considered relevant as they examined the association between correlates of PA among overweight or obese populations. In addition, after reviewing the 3,793 article hits from an advanced search for sociodemographic (PubMed/Medline: 609; Psycinfo: 211), psychosocial (PubMed/Medline: 1,390; Psycinfo: 576) and environmental (PubMed/Medline: 742; Psycinfo: 265) correlates, published between Jan 2000 and Dec 2010, three additional articles were found to meet the inclusion criteria for this review. After searching with the above combinations of key words in the Japan Medical Abstract Society (N = 251), one Japanese-language article was also included in this review.

Characteristics of the studies

A total of nine articles, published between Jan 2000 and Dec 2010, were deemed to meet the inclusion criteria for this review. Table 1 shows the characteristics of the nine studies listed according to publication date. Most studies originated from the United States, and Europe and there was one each from Brazil and Japan. The independent variables reported by these studies were categorized as individual (sociodemographic), psychological, social and environmental correlates. The outcome variable was self-reported total PA in all of the studies except for those conducted by Morgan et al. and Tsuji, et al. All the studies used a cross-sectional design.

Regarding the participants used in the nine studies, four of the studies included adults, Three studies focused on adolescents, with two of the studies only examining the correlates of PA among overweight girls. And the remaining two studies focused on children. Gesell et al. examined the correlates of PA among 114 overweight children, whereas Morgan et al. identified the correlates of objectively measured PA in 137 obese children.
Correlates of PA among overweight/obese populations

In order to be consistent with the approaches of previous reviews\textsuperscript{19,20}, factors associated with PA, among overweight and obese populations, were categorized as sociodemographic (individual), psychological, social and environmental correlates (Table 2).

Sociodemographic correlates. Three studies examined the sociodemographic correlates of PA among overweight/obese populations. A negative association between PA and age was found in two studies\textsuperscript{11,12}, although this association was not found in overweight Belgian adolescents\textsuperscript{30}. In addition, Hallal et al.\textsuperscript{31} reported that overweight women were more likely to be inactive than overweight men, and that there was a positive correlation between PA and education level in overweight Brazilian adults.

Psychological correlates. Self-efficacy was found to be associated with PA among overweight/obese populations in three studies\textsuperscript{2,28,36}, however this association was not found in other studies\textsuperscript{30,33}. PROS (perceived benefits) or CONS (perceived barriers) of PA were also important psychological factors motivating PA participation. Bourdeaudhuij et al.\textsuperscript{30} identified PROS and CONS of PA among normal-weight and overweight adolescents. The results showed that overweight adolescents who perceived PA as fun (general attitude) and an opportunity for competition (PROS) were more likely to participate in PA, whereas those who reported a lack of interest (CONS) were less likely to engage in PA\textsuperscript{30}. In addition, perceived behavioral control was also a positive psychological correlate of PA among overweight adolescent girls\textsuperscript{38}, whereas perceived barriers of decision balance (CONS) was a negative factor associated with the change in PA stage outcome variable among obese women\textsuperscript{36}. No significant associations were observed between PA and relaxation from work (PROS), lack of time (CONS), belief about physical activity, health-related quality of life or perceived competence\textsuperscript{30,32,33}.

Social correlates. Social support has consistently emerged
as an important correlate not only in the general population\textsuperscript{19} but also in overweight/obese populations\textsuperscript{2,28,30}. In addition to social support, social influence\textsuperscript{31} and sport participation\textsuperscript{28} were two social correlates of higher PA among overweight/obese populations.

**Environmental correlates.** Regarding environmental correlates, only perceived environmental correlates of PA, among overweight/obese populations, have been examined. Significant associations between perceived environmental factors and PA were found in three studies\textsuperscript{2,34,35}. The two perceived environmental correlates of PA, that were consistently observed, were good access to facilities\textsuperscript{2,35} and seeing people being active\textsuperscript{34,35}. Furthermore, Santos\textsuperscript{34} reported that overweight/obese Portuguese women were more likely to be physically active if they perceived the presence of infrastructure, good access to destinations, and aesthetics, whereas perceived neighborhood safety was not associated with PA.

**Comparison of the PA correlates between normal-weight and overweight/obese populations**

Five studies compared the PA correlates between normal-weight and overweight/obese populations, whereas four studies only examined PA correlates in overweight/obese populations. The common and different correlates between normal-weight and overweight/obese populations are presented in Table 3. Two studies found that the correlates of PA between normal-weight and overweight/obese populations were different. These correlates were access to facilities\textsuperscript{3} (i.e. access to facilities was found to be associated with PA in normal-weight adults but not in obese adults) and gender\textsuperscript{31} (i.e. gender was a correlate of

### Table 2. Correlates of physical activity among overweight/obese populations

<table>
<thead>
<tr>
<th>Association with PA</th>
<th>Positive association</th>
<th>Negative association</th>
<th>No association</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sociodemographic correlates</td>
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<td></td>
<td></td>
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<tr>
<td>Gender (female)</td>
<td>[31]</td>
<td></td>
<td></td>
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<tr>
<td>Age</td>
<td>[31], [32]</td>
<td>[30]</td>
<td></td>
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<tr>
<td>Educational level</td>
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<td>[31]</td>
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<tr>
<td>Psychological correlates</td>
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<td></td>
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<tr>
<td>Self-efficacy</td>
<td>[2], [28], [36]</td>
<td>[30], [33]</td>
<td></td>
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<tr>
<td>General attitude (Fun)</td>
<td>[30]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PROS – Competition benefit</td>
<td>[30]</td>
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<td></td>
</tr>
<tr>
<td>PROS – Relax from work</td>
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<td>[30]</td>
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<tr>
<td>CONS – Lack of time</td>
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<td>[30]</td>
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<tr>
<td>CONS – Lack of interest</td>
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<td>[30]</td>
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<tr>
<td>CONS – Decisional balance</td>
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<td>[36]</td>
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<tr>
<td>Belief about physical activity</td>
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<tr>
<td>Perceived behavioral control</td>
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<td>[28]</td>
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<td>Health-related quality of life</td>
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<td>Perceived competence</td>
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<td>[32]</td>
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<tr>
<td>Social correlates</td>
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<tr>
<td>Social support</td>
<td>[2], [28], [30]</td>
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<td>Social influence</td>
<td>[33]</td>
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<tr>
<td>Sport participation</td>
<td>[28]</td>
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<tr>
<td>Environmental correlates (perceived)</td>
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<tr>
<td>Access to facilities</td>
<td>[2], [35]</td>
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<tr>
<td>Infrastructure</td>
<td>[34]</td>
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<td>Access to destinations</td>
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<tr>
<td>Seeing people being active</td>
<td>[34], [35]</td>
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<td>Aesthetics</td>
<td>[34]</td>
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<tr>
<td>Neighborhood safety</td>
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PROS (Perceived benefits); CONS (Perceived barriers)
PA in normal-weight adults, but not in overweight/obese adults). The other three studies found no differences in the PA correlates between the two groups.

**Discussion**

This study reviewed nine articles published between Jan 2000 and Dec 2010 with the aim of clarifying the factors (correlates) associated with PA in overweight/obese populations. The consistently reported correlates of PA were categorized as sociodemographic, psychological, social and environmental. Among the sociodemographic correlates, there were various settings, ages and gender groups. The factors associated with PA in overweight/obese populations fell into all four categories, and included age\(^3\), \(^3\), self-efficacy\(^2\), social support\(^2\), good access to facilities\(^2\), \(^3\), \(^5\), \(^6\), and seeing people being active\(^3\), \(^4\), \(^5\), \(^6\). These findings are important for policy makers and intervention designers for developing effective PA intervention strategies.

Despite finding five consistently reported correlates of PA that can be used for developing strategies for decreasing the overweight/obesity epidemic, further research is still required in this area, specifically in non-western countries. However, the need for developing specific PA intervention strategies for overweight/obese populations remains controversial. Two studies argued that BMI status should be considered when designing PA intervention for overweight/obese individuals\(^2\), \(^3\), whereas other studies recommended that no specific PA strategies are needed for individuals with different weight categories\(^2\), \(^3\). Moreover, no different PA correlates were observed in psychological or social level but in personal characteristics and perceptions of environment between normal-weight and overweight populations. Therefore, these conflicting results suggest that future studies examining PA programs for overweight/obese populations should consider BMI as a potential moderator of the correlates of PA, especially at personal and perceived environmental levels.

In addition, except for Morgan et al.\(^3\) and Tsujishita, et al.\(^3\), the outcome variable of the other seven studies was self-reported total PA. In recent years, the importance of examining the correlates of objectively-assessed PA and specific PA behavior has been emphasized to avoid PA reporting bias\(^3\) and to better understand specific PA outcome and its associated factors\(^3\). However, only one study focused on the correlates of objectively-assessed PA\(^3\) (accelerometers) while no studies focused on specific self-reported PA behavior (such as walking, jogging or cycling) among overweight and obese populations. Therefore, to further identify the correlates of PA, objectively-measured PA or specific self-reported PA behavior between normal-weight and overweight/obese populations should be considered.

Based on the findings of this study, two studies\(^2\), \(^3\) iden-
tified multiple levels of correlates, four studies focused on psychosocial correlates, and two studies examined perceived environmental correlates of PA among overweight/obese populations. Although PA behavior could be influenced by multiple correlates, different types and purposes of PA behaviors occur in specific behavioral settings and are expected to be affected by different environmental characteristics. In this context, a growing number of recent studies have identified specific PA-environmental relationships that facilitate or hinder PA participation. Compared with psychosocial factors, it has been suggested that the manipulation of environmental factors could provide a long-term impact on PA in large populations. It has been suggested that the manipulation of environmental factors could provide a long-term impact on PA in large populations. According to the findings of this review, Santos et al. and Mota et al. identified environmental factors that overweight/obese populations perceive to be related to their PA levels. However, in addition to the perceived environmental factors, several objectively-assessed environmental factors (i.e. higher residential density, more land use mix and higher street connectivity) were found to be consistently related to higher levels of PA. In particular, recent studies have suggested that examining the levels of discord between perceived and objectively-assessed environmental factors could be a potential opportunity for promoting PA behavior change. Furthermore, for targeting specific inactive subgroups, several studies have suggested that the environmental factors associated with PA differ according to sociodemographic subgroups. To date, no studies have examined the objectively-assessed or both perceived and objectively-assessed environmental correlates of PA between normal-weight and overweight populations. As a result, future studies should consider examining the environmental correlates of PA utilizing both perceived and objectively-assessed measurements among populations in different BMI categories.

Conclusions

For obesity prevention, further research is required, particularly in non-western countries, that is aimed at developing effective PA interventions for overweight/obese populations. Future studies should examine both the perceived and objectively-measured environmental factors associated with specific PA behavior. Understanding the impact of these environmental factors on PA may have an important impact on the development of effective PA interventions for overweight/obese populations.

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