Associations Between Physical Facilities and Organizational Participation and Levels of Physical Activity of Adults in Tainan, Taiwan

Susan C. Hu, Nuan-Ching Huang, Ya-Tin Lin, Shiann-Far Kung, and Linda L. Lin

Background: During the past decade many studies have endeavored to evaluate the relationships between environmental attributes and physical activity, but there is limited data on this subject in Taiwan. This is the first study to investigate both objective and subjective environments in relation to different levels of physical activity in adults in Tainan, Taiwan. Methods: A 2-stage survey examining relationships between physical and social environments and physical activity was designed. It was administered to a sample including 231 community directors and 804 randomly selected residents. Community audits and telephone interviews were used as the objective and subjective measures in the study, respectively. Results: No correlation was found between the objective and the subjective measures of physical environments. Only the subjective measures were significantly related to city residents’ physical activities. Perceived physical facility was found to be correlated with engagement in physical activity, whereas organizational participation was associated with the regularity of physical activity. Of the 4 types of leisure activity examined in this study, dancing and aerobic activities are more likely to be engaged in regularly. Conclusions: Factors associated with the regularity of physical activity are not the same as factors associated with engagement in physical activity.

Keywords: built environments, social environments, social network, community audits

It has been documented that physical activity reduces the risk of breast and colon cancer, cardiovascular disease, hypertension, obesity, and all-cause mortality. However, according to a report from the World Health Organization, lack of physical activity is as serious a health hazard as smoking and has been identified as the fourth leading cause of global mortality.

Many studies have shown that physical activity is not only associated with personal factors, but is also highly correlated with environmental factors. For example, engagement in physical activity is related to the availability of pavement, bikeways, or other established exercise settings. Physical settings near the home that can be reached by walking—such as parks, open spaces, playgrounds, grocery stores, department stores, and public transport systems—are also correlated with residents’ levels of physical activity.

Social environment is another significant factor related to physical activity. Past studies have found that social support from family, friends, and other group members is related to physical activity; especially for females. Social support increases motivation to exercise. Thus, research indicates that improvement of existing social networks and the creation of new social networks may effectively encourage people to engage in physical activity.

In short, studies showed that supportive physical and social environments are significantly associated with engagement in physical activity, and that people who engage in physical activity as a result of these factors tend to remain more dedicated to exercising compared with people who began exercising as a result of personal intervention programs.

In terms of measurement, 3 types of measures for physical environments were identified: perceived (self-reported) measures, observational measures (community audits), and geographic information system (GIS) measures. The first is so-called a subjective measure and others are objective measures. When GIS information is lacking, many studies would use audit measures as a good substitute. Few studies have focused on both objective and subjective measures of environments related to physical activity, and the relationships between these 2 types of measures have been inconsistent.

Also, very few studies have focused on both physical and social environments in relation to physical activity in Asian countries. Many questions need to be answered. For example, are physical and social environments related to physical activity behavior in densely populated places such as Asia? Are objective and subjective measures of physical and social environments related to levels of physical activity? What factors are associated with engagement in
physical activity? And what kinds of physical activities are people more likely to engage in regularly?

This is the first study to investigate both objective and subjective environments in relation to physical activity in urban adults in Taiwan using Tainan City as an example. The purpose of this study was to investigate the effects of physical and social environments on physical activity and to explore factors associated with different levels of physical activity.

Methods

A 2-stage survey was designed. The first stage employed community audits to determine objective physical and social environments. The second stage investigated the relationship between subjective physical and social environments and physical activity through telephone interviews. Community audits were used as objective measures in the study because of to measure both physical and social environments in the communities. Typical GIS techniques can only measure physical environments.

Study Area and Participants

The study area was in Tainan City, Taiwan. Tainan is Taiwan’s historic former capital. It’s located in the south of Taiwan, has population of about 770,000, and covers an area of 175 km². The city was divided into 6 districts and 231 ‘li’ (the smallest unit of city administration, each consisting of 500–3000 households). Two kinds of participants took part in this study: 231 li directors (heads of the communities) who were used to measure objective environments, and 804 randomly selected residents who were used to measure subjective environments related to physical activity.

Measures

Objective Measures (Community Audits). A checklist of community physical and social environments was first developed. Then, we interviewed, face to face, all 231 li directors to determine whether the communities have possessed such resources. Li directors are elected every 4 years in Taiwan, and they play an important role as gatekeepers at the community level. They are very familiar with their neighborhood environment, including the community environments, facilities, resources, features, organizations, and programs.

The contents of the checklist included 1) basic information including the li’s name, population, gender and age distributions, and residents’ occupations; 2) community physical environments including parks, green spaces, schools playgrounds, sports fields, gyms, stadiums, bikeways, and sidewalks in the li; and 3) community social environments including organizations related to physical activity, such as associations, exercise groups, sports clubs, dancing/aerobic groups, and volunteer organizations in the li. All questions were binary (Yes/No) and the data were collected from March to July 2010.

Subjective Measures (Perceived Measures). In the second stage, 1613 phone calls were randomly made to residents living in Tainan city’s 6 districts using a computer assisted marketing interview system (CAMIS). Respondents who did not qualify were excluded, including whose phone number was not a household number (n = 59), who were not aged 20–69 (n = 207), who had physical disabilities (n = 17) or a language problem (n = 40), or refused the interview (n = 486). The remaining 804 valid residents aged 20–69 years old were thus included in the study. The response rate was 49.8% (804/1613). Telephone interviews were performed by the Center for Survey and Statistics Research, Department of Statistics, National Cheng Kung University in October 2010.

The questions for telephone interviews included 1) demographic factors such as gender, age, level of education, employment status, self-rated health status, and living area; 2) physical activity during the past month, including types of physical activity engaged in, where it occurred, how often it was engaged in, and reasons for not engaging in physical activity; 3) types of physical facilities near the home (15–20 minutes by walking or 5–10 minutes by biking), and locations where physical activity was most often engaged in; and 4) social environments related to physical activity, such as exercise climate in the neighborhood and types of exercise groups one is participating in.

The questionnaire was first drafted in accordance with the related literature and reviewed by 5 experts in the fields of public health, health behavior, urban planning, architecture, and kinematics. Then, the draft questionnaire was pretested and revised twice. The first pretest focused on narration of the question descriptions using 8 nonsample people, and the second pretest focused on elaborating on the questionnaire using 22 nonsample people. Lastly, the final edition of the questionnaire was used to collect subjective data through telephone interviews.

Study Variables

Physical Activity. According to the definitions set by the Department of Health in Taiwan, regular exercise means engaging in activities that induce sweating and shortness of breath (>130 heartbeats per minute), which is similar to a moderate to vigorous intensity leisure activity, for at least 20 minutes 3 times a week. In this study physical activity was measured by 1 question: “In the past month, did you do any exercise? If yes, was it regular? (regular exercise is at least 20 minutes of activities that cause sweating and shortness of breath 3 times a week.)” Therefore, respondents who reported meeting the above condition were categorized as engaging in regular physical activity, and those who did not meet the criteria were categorized as engaging in sporadic physical activity.

Those who reported not having engaged in any physical activity in the past month were asked to choose the reason from a list. Those who reported having exercised
in the past month were asked, “What types of physical activity did you engage in?” A checklist of common types of physical activity (such as walking, jogging, sports, dancing, aerobics, tai-chi, yoga, chi-gong, bicycling, swimming, mountain climbing, etc.) was read by the interviewers and the respondents were told that they could choose more than 1 item. In the analyses, 3 levels of physical activity were identified: regular, irregular, and no physical activity in the past month, and 5 types of physical activity were categorized: walking, jogging, sports, dancing, and others (such as swimming, bicycling, and mountain climbing).

**Perceived Physical Facilities.** Perceived physical facilities in this study were measured by asking respondents whether they had the following types of physical facilities appropriate for physical activity near their home: parks, school playgrounds, community activity centers, stadiums or arenas, gyms or swimming pools, open spaces or squares, pavement, etc. In the analysis, the type of facility was recoded as the number of physical facilities and was divided into 4 categories: 0, 1–2, 3–4, and 5+ kinds of facilities.

**Exercise Climate.** Exercise climate was measured by asking respondents how many people they perceived to be engaging in physical activity in their neighborhood. Answers were categorized into 3 groups: many, some, and no people engaging in physical activity.

**Organizational Participation.** First, we asked respondents whether they had joined or participated in activities with any exercise-related organizations or groups in the past month including sports teams, dance organizations, aerobic classes, tai-chi groups, chi-gong groups, mountain climbing clubs, or swimming clubs. If the answer was yes, then they were asked what types of organizations or groups they were involved in. In the analysis, this variable was categorized into a binominal yes or no item.

**Statistical Analysis**

The analysis was conducted using the SAS 9.1 statistical software. The descriptive statistics were computed by number (N) and percentages (%). The McNemar test was conducted to understand the concordance between objective and subjective measures of physical environments in the community. The chi-square tests were used to detect the association between levels of physical activity and related correlates. A Spearman correlation test was conducted to clarify the correlations between the 8 independent variables in the study to avoid colinearity in the model. All correlations were less than .25, which indicates a weak correlation; thus no independent variable was excluded in the model.

Then, the logistic regression analyses were conducted to clarify the relationship between the independent variables and the regularity of physical activity while controlling for other demographic factors. Two models were shown in this study. One was factors associated with having physical activity or not and the other was factors associated with regular and sporadic physical activity. The independent/study variables included perceived physical facilities, exercise climate, and organizational participation. All models were adjusted for gender, age, levels of education, self-rated health status, and employee status.

**Results**

As seen in Table 1, the majority of the 804 valid respondents was female (55.9% vs. male 44.1%), aged 30- to 59-years-old (71.9%), had a college education (43.5%), considered themselves to be in good health (60.5%) and was employed (65.9%).

Table 2 shows that more than one-third of respondents (34.5%) engaged in regular activity, 28.6% engaged in sporadic activity, and 37.0% engaged in no physical activity during the previous month. The most popular physical activities were walking (49.9%), jogging (37.1%), sports (31.0%), and dancing (14.6%).

Reasons for not engaging in any activities included no time (69.0%), being lazy (20.2%), feeling tired (14.5%), and no companion (8.1%). The top 3 physical facilities near the home were parks (74.8%), playgrounds (62.7%), and stadiums (41.4%). Noticeably, less than one-third of respondents reported to use the above facilities for physical activities (34.6%, 25.6%, and 8.1%, respectively). With regard to exercise climate, more than 75% of respondents perceived at least some people engaging in physical activity in their neighborhood. However, few respondents participated in sports groups or dance organizations in their community (17.3%).

**Table 1 Sample Demographics (n = 804)**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>354</td>
<td>44.1</td>
</tr>
<tr>
<td>Female</td>
<td>450</td>
<td>55.9</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20–29</td>
<td>148</td>
<td>18.4</td>
</tr>
<tr>
<td>30–39</td>
<td>185</td>
<td>23.0</td>
</tr>
<tr>
<td>40–49</td>
<td>229</td>
<td>28.5</td>
</tr>
<tr>
<td>50–59</td>
<td>165</td>
<td>20.5</td>
</tr>
<tr>
<td>60–69</td>
<td>77</td>
<td>9.6</td>
</tr>
<tr>
<td>Levels of education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary school and below</td>
<td>75</td>
<td>9.3</td>
</tr>
<tr>
<td>Junior high school</td>
<td>85</td>
<td>10.6</td>
</tr>
<tr>
<td>Senior high school</td>
<td>294</td>
<td>36.6</td>
</tr>
<tr>
<td>College and above</td>
<td>350</td>
<td>43.5</td>
</tr>
<tr>
<td>Self-rated health status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>486</td>
<td>60.5</td>
</tr>
<tr>
<td>Fair</td>
<td>236</td>
<td>29.4</td>
</tr>
<tr>
<td>Bad</td>
<td>82</td>
<td>10.2</td>
</tr>
<tr>
<td>Employment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>530</td>
<td>65.9</td>
</tr>
<tr>
<td>No</td>
<td>274</td>
<td>34.1</td>
</tr>
</tbody>
</table>
The Relationship Between Objective and Subjective Measures

To understand the relationship between a person’s objective and subjective measures of physical environments in the community, we conducted a McNemar test. No significant association between objective and subjective measures of physical environments in the community, including parks ($P = .45$), playgrounds ($P = .86$), and number of physical facilities ($P = .07$), was found. In other words, objective measures were not consistent with subjective measures of physical environments in this study.

<table>
<thead>
<tr>
<th>Physical Activity Attributes of Study Sample ($n = 804$)</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical activity in the past month</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular</td>
<td>277</td>
<td>34.5</td>
</tr>
<tr>
<td>Irregular</td>
<td>230</td>
<td>28.6</td>
</tr>
<tr>
<td>No physical activity</td>
<td>297</td>
<td>36.9</td>
</tr>
<tr>
<td>Types of physical activities ($n = 507$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking/strolling</td>
<td>253</td>
<td>49.9</td>
</tr>
<tr>
<td>Jogging/brisk walking</td>
<td>188</td>
<td>37.1</td>
</tr>
<tr>
<td>Sports</td>
<td>157</td>
<td>31.0</td>
</tr>
<tr>
<td>Aerobic/dancing</td>
<td>74</td>
<td>14.6</td>
</tr>
<tr>
<td>Others (swimming, biking, mountain climbing, or going to gym)</td>
<td>151</td>
<td>29.8</td>
</tr>
<tr>
<td>Reasons for no physical activity ($n = 297$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No time</td>
<td>205</td>
<td>69.0</td>
</tr>
<tr>
<td>Being lazy</td>
<td>60</td>
<td>20.2</td>
</tr>
<tr>
<td>Feeling tired</td>
<td>43</td>
<td>14.5</td>
</tr>
<tr>
<td>No companion</td>
<td>24</td>
<td>8.1</td>
</tr>
<tr>
<td>Family affairs</td>
<td>22</td>
<td>7.4</td>
</tr>
<tr>
<td>Lack of suitable places</td>
<td>21</td>
<td>7.1</td>
</tr>
<tr>
<td>Others</td>
<td>27</td>
<td>9.1</td>
</tr>
<tr>
<td>Perceived physical facilities near the home</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parks</td>
<td>601</td>
<td>74.8</td>
</tr>
<tr>
<td>School playgrounds</td>
<td>504</td>
<td>62.7</td>
</tr>
<tr>
<td>Stadiums or Arenas</td>
<td>333</td>
<td>41.4</td>
</tr>
<tr>
<td>Community activity centers</td>
<td>275</td>
<td>34.0</td>
</tr>
<tr>
<td>Gyms or swimming pools</td>
<td>166</td>
<td>20.7</td>
</tr>
<tr>
<td>Open spaces or square</td>
<td>169</td>
<td>21.0</td>
</tr>
<tr>
<td>Number of physical facilities near the home</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>51</td>
<td>6.4</td>
</tr>
<tr>
<td>1–2</td>
<td>316</td>
<td>39.8</td>
</tr>
<tr>
<td>3–4</td>
<td>247</td>
<td>31.1</td>
</tr>
<tr>
<td>5+</td>
<td>180</td>
<td>22.7</td>
</tr>
<tr>
<td>Physical facilities of most frequently use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parks</td>
<td>278</td>
<td>34.6</td>
</tr>
<tr>
<td>School playgrounds</td>
<td>206</td>
<td>25.6</td>
</tr>
<tr>
<td>Stadiums or arenas</td>
<td>65</td>
<td>8.1</td>
</tr>
<tr>
<td>Community activity centers</td>
<td>33</td>
<td>4.1</td>
</tr>
<tr>
<td>Gyms or swimming pools</td>
<td>32</td>
<td>4.0</td>
</tr>
<tr>
<td>Open spaces or square</td>
<td>31</td>
<td>3.9</td>
</tr>
<tr>
<td>Exercise climate in neighborhood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Many people engaging in physical activity</td>
<td>314</td>
<td>39.1</td>
</tr>
<tr>
<td>Some people engaging in physical activity</td>
<td>298</td>
<td>37.1</td>
</tr>
<tr>
<td>Very few people engaging in physical activity or unknown</td>
<td>192</td>
<td>23.9</td>
</tr>
<tr>
<td>Participation in physical activity groups or organizations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>139</td>
<td>17.3</td>
</tr>
<tr>
<td>No</td>
<td>665</td>
<td>82.7</td>
</tr>
</tbody>
</table>

Objective Measures and Levels of Physical Activity

Therefore, the next issue examined was whether objective measures of physical and social environments were related to residents’ physical activity. The chi-square tests in Table 3 show that there was no difference between objective measures and levels of physical activity, which included physical environments such as parks ($P = .29$), schools ($P = .44$), number of leisure facilities ($P = .38$), and social environments, such as exercise groups ($P = .43$) and dancing organizations ($P = .16$).
Subjective Measures and Levels of Physical Activity

Accordingly, the relationship between subjective measures and levels of physical activity became a matter of curiosity. Results showed that 3 types of physical facilities near the home, including parks ($P = .029$), playgrounds ($P = .005$), and community activity centers ($P = .050$) were significantly associated with levels of physical activity in this study (Table 4). Respondents who reported having physical facilities such as parks (80.1%, 73.5% vs. 70.7%, $P = .029$), school playgrounds (64.3%, 69.6% vs. 55.9%, $P = .005$), and community activity centers (38.6%, 33% vs. 30.9%) near their homes were more likely to be physically active.

Moreover, the number of physical facilities near the home was found to be significantly related to level of physical activity. Those who reported having 5+ kinds of physical facilities near the home were more likely to be physically active (25.0%, 26.8% vs. 17.4%, $P = .003$) than those who reported no physical facilities near home. Similarly, a significantly higher percentage of those who reported having no physical facilities near home were physically inactive (9.9% vs. 5.9%, 2.6%, $P = .003$).

The association between exercise climate, organizational participation, and levels of physical activity is also presented in Table 4. Both factors are significantly associated with levels of physical activity. Participants who perceived many people engaging in physical activity...
in their neighborhood were found to be more likely to engage in regular physical activity compared with those who perceived some or no people engaging in physical activity in their neighborhood (45.5% vs. 42.2%, 30.6%, respectively, $P < .01$). In addition, people who joined exercise groups or dance organizations were found to be 2–3 times more likely to engage in regular physical activity (29.6% vs. 14.4%, 8.1%, $P < .001$).

**Factors Associated With Engagement in Physical Activity: Model I**

The final task was to determine what factors are associated with levels of physical activity. We conducted 2 models of logistic regressions analysis (Table 5). The first was factors associated with engagement in physical activity, and the second was factors associated with regular and sporadic physical activity.

In Model I, physical activity was divided into engaging in physical activity (consisting of both regular and irregular physical activity) and not engaging in physical activity, defined as active (n = 500) and inactive (n = 294). Results showed that 6 independent variables were significantly related to whether people engaged in physical activity. Male residents were more likely to have engaged in physical activity during the previous month than female residents (OR = 1.51, 95% CI = 1.10–2.09). Participants who reported good or fair health were twice as likely to engage in regular physical activity compared with those who reported bad health status (OR = 2.55, 95% CI = 1.58–4.27). Having access to more than 5 PA facilities near the home was also significantly associated with higher levels of physical activity (OR = 2.74, 95% CI = 1.38–5.46).

**Table 5  Factors Associated With Different Levels of Physical Activity (PA)**

<table>
<thead>
<tr>
<th></th>
<th>Model I (n = 794)</th>
<th>Model II (n = 500)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Active vs. Inactive</td>
<td>OR</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1.51</td>
<td>1.10–2.09</td>
</tr>
<tr>
<td>Female</td>
<td>1.00</td>
<td>–</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20–29</td>
<td>1.19</td>
<td>0.65–2.20</td>
</tr>
<tr>
<td>30–39</td>
<td>1.21</td>
<td>0.67–2.17</td>
</tr>
<tr>
<td>40–49</td>
<td>1.25</td>
<td>0.71–2.22</td>
</tr>
<tr>
<td>50–59</td>
<td>0.95</td>
<td>0.52–1.72</td>
</tr>
<tr>
<td>60–69</td>
<td>1.00</td>
<td>–</td>
</tr>
<tr>
<td>Levels of education</td>
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</tr>
<tr>
<td>Elementary school and below</td>
<td>1.67</td>
<td>0.95–2.95</td>
</tr>
<tr>
<td>Junior high school</td>
<td>0.97</td>
<td>0.55–1.69</td>
</tr>
<tr>
<td>Senior high school</td>
<td>1.06</td>
<td>0.53–2.13</td>
</tr>
<tr>
<td>College and above</td>
<td>1.00</td>
<td>–</td>
</tr>
<tr>
<td>Self-rated health status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>2.55</td>
<td>1.58–4.27</td>
</tr>
<tr>
<td>Fair</td>
<td>2.07</td>
<td>1.19–3.61</td>
</tr>
<tr>
<td>Bad</td>
<td>1.00</td>
<td>–</td>
</tr>
<tr>
<td>Employment status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>2.35</td>
<td>1.64–3.36</td>
</tr>
<tr>
<td>Yes</td>
<td>1.00</td>
<td>–</td>
</tr>
<tr>
<td>Number of PA facilities near the home</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5+</td>
<td>2.74</td>
<td>1.38–5.46</td>
</tr>
<tr>
<td>3–4</td>
<td>2.05</td>
<td>1.06–3.97</td>
</tr>
<tr>
<td>1–2</td>
<td>2.21</td>
<td>1.16–4.19</td>
</tr>
<tr>
<td>0</td>
<td>1.00</td>
<td>–</td>
</tr>
<tr>
<td>Exercise climate in the neighborhood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Many people engaging in PA</td>
<td>1.66</td>
<td>1.10–2.51</td>
</tr>
<tr>
<td>Some people engaging in PA</td>
<td>0.89</td>
<td>0.60–1.32</td>
</tr>
<tr>
<td>No people engaging in PA</td>
<td>1.00</td>
<td>–</td>
</tr>
<tr>
<td>Participation in sports groups or dance organizations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>2.98</td>
<td>1.81–4.90</td>
</tr>
<tr>
<td>No</td>
<td>1.00</td>
<td>–</td>
</tr>
</tbody>
</table>
as likely to engage in physical activity as compared with those who reported poor health (OR = 2.55, 2.07 vs. 1.00). People who were unemployed had twice as much opportunity to engage in physical activity compared with those with jobs (OR = 2.35, 95% CI = 1.64–3.36). Residents living in neighborhoods with at least 1 kind of exercise facility were found to be twice as likely to engage in physical activity than those without physical facilities in their neighborhood (OR = 2.74, 2.05, 2.21 vs. 1.00, respectively).

Regarding the social environmental factors, residents who joined exercise groups or organizations were shown to be as much as 3 times more likely to engage in physical activity than those who did not (OR = 2.98, 95% CI = 1.81–4.90). Similarly, people who perceived more people exercising in their neighborhoods tended to engage in more physical activity (OR = 1.66, 95% CI = 1.10–2.51). Factors Associated With Regular or Sporadic Physical Activity: Model II

In Model II, only those who reported engaging in physical activity were included. They were divided into 2 groups, those who exercised regularly (n = 272) and those who exercised irregularly (n = 228), to clarify factors associated with the regularity of physical activity. Results showed that 3 independent variables (gender, employment status, and participation in exercise groups) were associated with the regularity of physical activity. Male residents were found to be more likely to engage in physical activity on a regular basis compared with their female counterparts (OR = 1.59, 95% CI = 1.08–2.35). People who were unemployed were twice as likely to engage in physical activity regularly than those with jobs (OR = 2.00, 95% CI = 1.32–3.04). Those who joined exercise groups or organizations were 2.7 times more likely to engage in physical activity regularly than those did not (OR = 2.70, 95% CI = 1.66–4.40). Namely, after controlling for sociodemographic factors, only 1 study variable, organizational participation, was found to be significantly related to regularity of physical activity.

What Kinds of Physical Activity Are More Likely to be Regular?

We were also interested in understanding what types of physical activity people were more likely to engaged in regularly and be executed in exercise groups or organizations. As shown in Table 6, more respondents regularly engaged in sports and dancing (36.9%, 45.9%, respectively) than walking and jogging (20.2%, 18.1%, respectively) in formal or informal exercise groups. Among the 4 types of physical activity, only dancing was significantly engaged in regularly compared with the other types of physical activity (70.3% vs. 52.0%). More than 70% of people who chose aerobic exercise or dancing as their physical leisure activity engaged in these activities regularly, compared with about 50% of those who engaged in other types of physical activity, such as walking, jogging, and sports.

Discussion

This study had 4 important findings. First, objective measures are neither correlated with subjective measures of physical environments nor related to residents’ physical activity. Only subjective (perceived) measures of physical and social environments are significantly associated with levels of physical activity.

Second, different levels of physical activity are associated with different correlates. For example, whether people engaged in physical activity was correlated with perceived physical and social environments. However, when investigating whether this activity was regular or not, only social environmental attributes (ie, organizational participation in this study) were found to be significantly related to the regularity of physical activity.

Third, the more leisure time physical facility in the community was not necessarily better. The percentage of people engaging in physical activity did not significantly differ among those with 1–2 kinds, 3–4 kinds, or > 5 kinds of exercise facilities near the home. Lastly, of the 4 types of leisure activity (walking, jogging, sports, and

### Table 6 What Types of Physical Activity (PA) Were Easier to Join at an Organizational Level and Were Engaged in Regularly? (n = 507)

<table>
<thead>
<tr>
<th>Type of PA</th>
<th>Organizational participation</th>
<th>Regular or not</th>
<th>( \chi^2 )</th>
<th>( \chi^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Walking</td>
<td>51 (20.2)</td>
<td>202 (79.8)</td>
<td>13.37**</td>
<td>142 (56.1)</td>
</tr>
<tr>
<td>Nonwalking</td>
<td>88 (34.6)</td>
<td>166 (65.4)</td>
<td>135 (53.1)</td>
<td>135 (53.1)</td>
</tr>
<tr>
<td>Jogging</td>
<td>34 (18.1)</td>
<td>154 (81.9)</td>
<td>103 (54.8)</td>
<td>103 (54.8)</td>
</tr>
<tr>
<td>Nonjogging</td>
<td>105 (32.9)</td>
<td>214 (67.1)</td>
<td>174 (54.5)</td>
<td>174 (54.5)</td>
</tr>
<tr>
<td>Sports</td>
<td>58 (36.9)</td>
<td>99 (63.1)</td>
<td>76 (48.4)</td>
<td>76 (48.4)</td>
</tr>
<tr>
<td>Nonsports</td>
<td>81 (23.1)</td>
<td>269 (76.9)</td>
<td>201 (57.4)</td>
<td>201 (57.4)</td>
</tr>
<tr>
<td>Dancing</td>
<td>34 (45.9)</td>
<td>40 (54.1)</td>
<td>52 (70.3)</td>
<td>52 (70.3)</td>
</tr>
<tr>
<td>Nondancing</td>
<td>105 (24.2)</td>
<td>328 (75.6)</td>
<td>225 (52.0)</td>
<td>225 (52.0)</td>
</tr>
</tbody>
</table>

* P < .05; ** P < .01.
dancing) examined in this study, only dancing or aerobic exercise were found to be engaged in regularly because people were more likely to join groups or organizations to practice these activities. Noticeably, sports activities, although highly participated in by groups, did not meet the criteria for regular physical activity, perhaps less than 3 times a week.

In contrast to past studies that used GIS techniques for objective measures, this study used community audits as objective measures of physical environments and got similar results, indicating that objective measures of physical environments are not correlated with subjective measures.

Why was community audit not correlated with perceived measures of physical and social environments in the study? This could be explained as a disagreement between measurements and geographical dispersion. The community audit used in this study was based on a checklist of related facilities present in the community, whereas the perceived measures were self-reported responses regarding facilities near the home (within a 15- to 20-minute walk or 5- to 10-minute bike ride). In large communities, although the facilities are in the community, some people may not feel that the facilities are near their home. In small communities people might also report related facilities that are not actually located in their li as nearby. Thus, there was a great discrepancy between objective and subjective measures in this study, especially for those who lived near the border between communities.

Few studies have compared the relationship between objective and subjective measures of physical facilities. McGinn et al22 and Prins et al23 used the truly objective measures of GIS techniques to measure the same residential area of perceived responses but found poor agreement between these 2 measures. Ball et al20 used audit methods within 2 km as objective measures and still got poor agreement between self-reported surveys and objective audit assessment. Thus, it seems that the relationship between objective and subjective measures is in poor agreement and the reasons that different objective measures get similar results should be examined further in the future.

Previous research also showed inconsistent results regarding the relationships between objective and subjective measures and physical activity. For example, Prins et al23 found only that perceived environments, rather than objective measures, to be strongly correlated with physical activity behavior among adolescents. McGinn et al22 found both objective and subjective measures of the constructed environments to be significantly associated with physical activity. Hoehner et al21 indicated that different types of physical activity were related to different objective and subjective environmental characteristics. This study, similar to Prins et al's study, found that only subjective (perceived) environments were highly correlated with levels of physical activity. In other words, the facilities in a community are not related to engagement in physical activity. The subjective measures in this study (perceived facilities near home) reflect the accessibility issue and thus are more correlated with level of physical activity. The other explanation is that people who engage in physical activity may perceive more community resources compared with those who are inactive, thus making the relationship between physical activity and perceived measures more significant.

One strength of this study is that it further analyzed factors associated with different levels of physical activity. The results showed that the number of physical facilities, exercise climate, and organizational participation were significantly related to whether people engaged in physical activity or not. These results are consistent with those of other published studies. However, when social demographic factors were controlled in the analysis, the logistic regression showed that regular physical activity was only associated with exercise group participation. This means that engagement in physical activity is not the same as engagement in such activities on a regular basis.

In other words, exercise climate can be seen as a social norm describing the degree to which people engage in physical activity in the neighborhood that might encourage people to take action. However, when examining regular engagement in physical activity this study found that resident participation in exercise groups was the key factor resulting in regular physical activity. This could be explained by interpersonal factors. Exercise groups normally set exercise schedules and follow rules, which could promote the formation regular exercise habits. Participation in exercise groups will also improve interpersonal relationships, help people to learn exercise skills, provide a sense of achievement, and create cohesion, thus promoting regular physical activity.

Regarding types of physical activity, this study indicated that walking and jogging are the most popular types of physical activities in Tainan City. Moreover, parks, school playgrounds, stadiums, and community activity centers were shown to be the places that people most frequently engaged in physical activity. This echoes past studies that indicated that regardless of age, gender, level of education, occupation, special sports venues, and price of learning skills, simple physical activities like walking or jogging, are available anyplace for most residents, resulting in adults exercising in public places twice as frequently as in private places.

Most people prefer the greater accessibility of, and numerous options for activities in, public spaces
compared with indoor spaces. This conclusion is similar to those of other studies that claim that public places like parks and playgrounds are the most popular places for exercise. Therefore, this study suggests that walking and jogging should be the first choices for physical activity promotion on a national level in the future.

In contrast to previous studies, this study did not find that more physical facilities promoted more physical activity. In fact, our results showed that people who perceived 1–2 kinds of physical facilities near their home were almost as likely to engage in physical activity as those who perceived 5 or more kinds of facilities. Thus, the presence of physical facilities near the home is more important than the number of facilities in the neighborhood.

Limitations

The limitations of this study are those inherent in any cross-sectional study, such as difficulty explaining the causality of related factors. Since the information about objective measures was collected using a checklist completed by community leaders, which could be considered to be self-reporting, some may not consider it to be a real objective data.

Telephone interviews might result in subjective perception bias. For example, people who exercise regularly and active community residents are more likely to have seen residents exercising in their neighborhood and leisure facilities than others who are busy with work or other responsibilities. Busy residents have less opportunity to observe the social environments available in a neighborhood and will therefore tend to perceive less activity in their neighborhood. Therefore, it is possible that subjective environments were underestimated after controlling for socioeconomic factors.

We did not ask participants to describe how many minutes per day and how many days per week they engaged in each activity. Therefore, the type of regular physical activity found in the study was the activities listed by respondents who engaged in regular PA, instead of activities being actually engaged in regularly. Other limitations include the limited number of physical and social environmental characteristics related to physical activity that was examined in the study, the lack of psychometric data in the measurement section, and the lack of a true objective measure of neighborhood physical environments. All of these issues should be considered in future research.

Conclusions

This study used both objective and subjective measures of environments and got valuable results indicating that factors associated with the regularity of physical activity are not the same as factors associated with engagement in physical activity. Walking and jogging were the most popular types of physical activity in the community. Dancing and aerobic exercise were found to be the types of physical activity that people engaged in on a regular basis most often.

To promote physical activity in the community, we suggest focusing more on simple physical activities, such as walking and jogging, because they are can be done almost anywhere. However, to encourage people to engage in such physical activity regularly in the future, social networks or walking/jogging groups should be created or promoted more in the community. In addition, more physical facilities for leisure time physical activities in the community do not necessarily result in people using or exercising more. Thus, we suggest future research can focus on understanding the barriers of the utilization of related facilities, especially for public places such as parks, school playgrounds and community activity centers.

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References


