

# Perceived and Objectively Measured Access to Strength-Training Facilities and Strength-Training Behavior

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## Abstract

**Background** The promotion of strength training is a public health priority. Employing both self-reported and objective assessment of environmental factors is helpful for a better understanding of the environmental influences on strength-training behavior.

**Purpose** This study aims to investigate the associations of perceived and objectively measured access to strength-training facilities with strength-training behavior.

**Methods** A cross-sectional questionnaire survey targeted 3,000 Japanese adults and 1,051 responded validly. Strength-training behavior, perceived access to facilities, and sociodemographic factors were assessed. Objective access to facilities was calculated using a geographic information system. Logistic regression analyses were conducted.

**Results** Perceived good access to the facilities was significantly associated with strength-training behavior, whereas objective access to the facilities was not, even when adjusted for sociodemographic factors and other measures of access to strength-training facilities.

**Conclusions** Perceived access to the facilities may be a stronger predictor of strength-training behavior than objective access.

**Keywords** Resistance training · Environment design · Fitness centers · Geographic information systems · Exercise · Health promotion

## Introduction

Strength training provides numerous health benefits. For example, meta-analyses have revealed that strength training is effective in reducing blood pressure [1], lipids and lipoproteins [2], metabolic syndrome [3], postmenopausal bone loss [4], and physical disability [5]. Thus, in addition to aerobic activities, current physical activity guidelines such as those published in the USA [6] and Japan [7] recommend strength training for public health. However, more than three-quarters of people do not engage in it [8–10]. Therefore, promoting strength training is a public health priority.

To develop effective promotion strategies, it is essential to identify modifiable factors associated with physical activity [11]. In particular, environmental attributes, which can have long-term effects on large populations, represent an emerging area of research [12]. Because environmental influences on physical activities are behavior-specific [13], examining the environmental correlates specific to strength-training behavior is important. A previous study [14] revealed that perceived access to facilities for strength training is one environmental correlate of strength-training behavior. However, although a number of studies have examined environmental influences on physical activity behavior, only a few environmental studies have focused on strength-training behavior [14, 15].

To better understand the environmental influences on strength-training behavior, it is appropriate to employ both self-reported and objective assessments of environmental factors. In other physical activity studies, the importance of employing objective assessments (e.g., use of a geographic

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information system) has been highlighted [16–21]. For example, previous studies have reported a mismatch between perceived and objective measures of environmental factors [18, 21], and objective and perceived measures of the built environment seem to have independent associations with physical activity [16, 17, 20]. However, no studies have examined objectively assessed environmental correlates of strength-training behavior.

The primary purpose of the present study was to investigate the associations of perceived and objectively measured access to facilities for strength training with strength-training behavior.

## Methods

### Participants and Procedures

A cross-sectional survey distributed through postal mail targeted people aged 40–69 years living in Nerima (a metropolis in a special ward of Tokyo; population: 716,124; area: 48.16 km<sup>2</sup>) and Kanuma (a suburban area in Tochigi Prefecture; population: 102,348; area: 490.62 km<sup>2</sup>) in Japan. Stratified by gender, age, and city, 3,000 individuals were randomly sampled using the registry of residential addresses. The survey was conducted in 2011. There were 1,076 (35.9 %) valid responses. Among them, 25 individuals who had missing data for the item on strength-training behavior and/or perceived access to facilities were excluded from the study resulting in a final sample of 1,051 (35.0 %).

Written informed consent was obtained from all respondents. This survey received prior approval from the Waseda University Institutional Ethics Committee (2010-238).

### Measures

#### *Strength-Training Behavior*

The same scale [22] used in a previous environmental study [14] was employed to assess strength-training behavior. Strength training was defined as all exercises that serve to enhance muscular strength and endurance, with regular strength training defined as 2 days or more per week. Respondents were categorized into two groups: those who engaged in regular strength-training behavior and those who did not. In addition, for those who reported regular training, the location (facility or home) was requested.

#### *Perceived Access to Facilities for Strength Training*

Respondents were asked whether their neighborhood (within approximately a 20–30-min walk from their home) had several facilities for strength training using a 4-point Likert scale (strongly disagree; somewhat disagree; somewhat agree;

strongly agree). The test–retest reliability of this measure (Spearman’s correlation coefficient=0.62) was confirmed in a previous study [14].

#### *Objective Access to Facilities for Strength Training*

Objective access to facilities was calculated by ArcGIS 10.0. Facilities for strength training were defined as “all facilities that have equipment for strength training.” Residential addresses of the facilities were obtained from a phone number database. The residential address of each respondent was also used. Although 400 to 3,200-m buffer sizes have often been used in previous studies [20], the buffer size of this analysis was defined as a radius of 1,500 m. This definition corresponded with the definition of neighborhood for the assessment of perceived access to facilities for strength training. The number of facilities within the buffer was calculated for each respondent. To compare perceived and objective access more accurately, the same number of categories for perceived and objective access would be appropriate. Thus, similar to perceived access, respondents were categorized into four groups: no facilities, one facility, two facilities, and three or more facilities.

#### *Sociodemographic Factors*

Gender (male or female), age group (40–49, 50–59, or 60–70 years old), current marital status (yes or no), full-time employment (yes or no), educational background (less than 13 years, or 13 years or more), household income level (less than five million yen, or five million yen or more), and body mass index (BMI) [kilogram per square meter]: less than 25, or 25 or higher calculated using self-reported height and weight were assessed (five million yen equals about US\$50,000 and about 38,000 €. In Japan, the average and median household incomes are 5.4 and 4.3 million yen, respectively [23]).

### Analyses

Associations of regular strength-training behavior with sociodemographic factors, perceived access to the facilities, and objective access to facilities were examined by chi-squared tests.

Then, as main analyses, the adjusted odds ratios were calculated to compare the relative associations of perceived and objective access to facilities with strength-training behavior by binary logistic regression analyses. In this examination, adjustments were made in five patterns: unadjusted model (model 1); adjusted for sociodemographic factors (model 2); and adjusted for sociodemographic factors and other measures of access to facilities (model 3). Also, multinomial logistic regression analyses were conducted to reveal whether the

relative associations were different based on where strength training took place (facility or home) after adjusting for sociodemographic factors and other measures of access to facilities.

The data was analyzed in 2012. Statistical significance was set at  $p < 0.05$ . The Statistical Package for the Social Sciences for Windows 18.0 was used for all analyses.

## Results

The characteristics of respondents are summarized in Table 1. Among all respondents, 13.6 % participated in regular strength training. Educational background, household income level, residential area, and perceived access to facilities for strength training were significantly associated with regular strength-training behavior. The kappa statistic for agreement of perceived and objective access to strength training facilities was 0.38 ( $p < 0.001$ ).

Binary logistic regression analyses revealed that perceived access to facilities was significantly associated with strength-training behavior, whereas objective access was not associated, regardless of all adjustment strategies (Table 2). Among those who engaged in regular training, 42.7 % engaged in strength training at facilities, and 57.3 % engaged in strength training at home. Perceived access was significantly associated with strength-training behavior at facilities, but not with strength training at home. Objective access was not a significant correlate of strength training at either home or facilities (Table 3).

## Discussion

This is the first study to assess the objective environmental correlates of strength-training behavior. Although the importance of measuring the objective environment has been emphasized in other types of physical activity studies, previous strength-training studies have examined only perceived environmental correlates [14, 15].

The major finding in the present study is that perceived access, but not objective access, to strength-training facilities is positively associated with strength-training behavior. This indicates that perceived access may be a stronger predictor of strength-training behavior than objective access. However, previous studies found that both perceived and objective environments independently influence other types of physical activities [16, 17, 20]. A potential explanation for the inconsistency between previous studies and the present study is that we used strength training as a type of exercise (a planned and intended activity), while previous studies assessed physical activities (including non-intended activities incorporated into daily life).

**Table 1** Characteristics of respondents

	Total <i>N</i>	Regular strength-training behavior		<i>p</i> Value <sup>a</sup>
		No (%)	Yes (%)	
Total	1,051	86.4	13.6	
Gender				
Male	551	84.8	15.2	0.104
Female	500	88.2	11.8	
Age group (years)				
40–59	304	86.5	13.5	0.997
50–59	359	86.4	13.6	
60–70	388	86.3	13.7	
Currently married				
No	163	87.1	12.9	0.758
Yes	885	86.2	13.8	
Employed in full-time job				
No	476	87.0	13.0	0.611
Yes	567	85.9	14.1	
Educational background (years)				
≥13	559	83.9	16.1	0.012
<13	491	89.2	10.8	
Household income level (million Japanese yen)				
<5	512	89.6	10.4	0.003
≥5	127	83.4	16.6	
BMI status (kg/m <sup>2</sup> )				
≥25	800	85.8	14.3	0.277
<25	251	88.4	11.6	
Residential area				
Nerima	557	83.1	16.9	0.001
Kanuma	494	90.1	9.9	
Perceived access to facilities for strength training				
Strongly disagree	384	92.3	7.7	<0.001
Somewhat disagree	81	86.4	13.6	
Somewhat agree	244	86.9	13.1	
Strongly agree	337	79.2	20.8	
Objective access to facilities for strength training				
No	487	88.7	11.3	0.176
1 facility	131	86.3	13.7	
2 facilities	131	82.4	17.6	
3 or more facilities	302	84.4	15.6	

Sample size varies due to missing data

<sup>a</sup> Chi-squared test

While the odds ratios of the objective access adjusted by the perceived access (model 3 in Table 2) were lower than odds ratios not adjusted by it (model 1 and model 2, Table 2), odds ratios of the perceived access adjusted by the objective access were higher than odds ratios not adjusted by it. Thus, there is a possibility that objective access may have a suppression effect on the associations between perceived access and strength-training behavior. However, because few prior studies have reported the same results, and the design of the present study does not address causal

**Table 2** Associations of perceived and objective access to facilities for strength training with strength-training behavior (all places)

	Model 1		Model 2		Model 3	
	COR (95 % CI)	<i>p</i> Value	AOR <sup>a</sup> (95 % CI)	<i>p</i> Value	AOR <sup>b</sup> (95 % CI)	<i>p</i> Value
Perceived access to facilities for strength training						
Strongly disagree	1.00		1.00		1.00	
Somewhat disagree	1.88 (0.90–3.93)	0.093	1.73 (0.79–3.76)	0.170	1.81 (0.82–4.00)	0.140
Somewhat agree	<b>1.81 (1.07–3.06)</b>	<b>0.028</b>	<b>1.90 (1.03–3.48)</b>	<b>0.040</b>	<b>1.98 (1.06–3.68)</b>	<b>0.031</b>
Strongly agree	<b>3.14 (1.99–4.95)</b>	<b>&lt;0.001</b>	<b>3.28 (1.79–6.00)</b>	<b>&lt;0.001</b>	<b>3.77 (2.02–7.06)</b>	<b>&lt;0.001</b>
Objective access to facilities for strength training						
No	1.00		1.00		1.00	
1 facility	1.25 (0.71–2.22)	0.442	0.83 (0.42–1.65)	0.595	0.62 (0.31–1.24)	0.178
2 facilities	1.67 (0.98–2.84)	0.057	0.99 (0.48–2.02)	0.974	0.84 (0.41–1.71)	0.626
3 or more facilities	1.45 (0.95–2.20)	0.083	0.80 (0.41–1.58)	0.524	0.57 (0.29–1.13)	0.105

Dependent variable: regular strength-training behavior

COR crude odds ratio, AOR adjusted odds ratio, 95 % CI 95 % confidence interval

<sup>a</sup> Adjusted for sociodemographic factors

<sup>b</sup> Adjusted for sociodemographic factors and other measures of access to strength-training facilities

*p*-values <0.05 are in bold

relationships, a further study is needed to appropriately discuss this issue.

The kappa statistic for agreement of perceived and objective access to strength training facilities was 0.38, which is generally regarded as “fair agreement” [24]. According to a previous study [21], degrees of correspondence between perceived and objectively assessed access are quite different by types of physical activity facilities; the correspondence was highest for access to coast (kappa statistic=0.66) and lowest for access to walking/bicycle tracks (kappa statistic=0.03). In a previous study [21], the kappa statistic for access to gyms/health clubs/sports centers was 0.33. Thus, the correspondence between perceived and objective access to a facility for strength training in the present study would be equivalent

to a similar type of facility (gyms/health clubs/sport centers) in the previous study [21].

Regarding where strength training takes place, perceived access was associated with strength-training behavior at facilities, but not at home in the present study. In agreement with a review article [25], which showed that the environmental correlates of walking behavior differ by walking context (transportation, recreation), the present results indicate that a behavior- and context-specific approach is needed to understand environmental influences on strength-training behavior.

One strength of the present study is the use of randomly sampled data. However, it has some limitations. First, these data are cross-sectional and therefore causal associations cannot be demonstrated. Second, response bias might have

**Table 3** Associations of perceived and objective access to facilities for strength training with strength-training behavior at facilities and at home

	Regular strength-training behavior at facilities		Regular strength-training behavior at home	
	AOR <sup>a</sup> (95 % CI)	<i>p</i> Value	AOR <sup>a</sup> (95 % CI)	<i>p</i> Value
Perceived access to facilities for strength training				
Strongly disagree	1.00		1.00	
Somewhat disagree	2.70 (0.64–11.33)	0.175	1.76 (0.69–4.53)	0.238
Somewhat agree	<b>4.20 (1.42–12.48)</b>	<b>0.010</b>	1.42 (0.64–3.15)	0.393
Strongly agree	<b>10.13 (3.40–30.25)</b>	<b>&lt;0.001</b>	1.88 (0.84–4.22)	0.125
Objective access to facilities for strength training				
No	1.00		1.00	
1 facility	0.45 (0.14–1.44)	0.177	0.79 (0.34–1.84)	0.584
2 facilities	1.27 (0.46–3.44)	0.646	0.48 (0.17–1.36)	0.167
3 or more facilities	0.52 (0.19–1.48)	0.221	0.67 (0.27–1.64)	0.378

Dependent variable: no engagement (reference) vs. engagement in regular strength-training behavior

AOR adjusted odds ratio, 95 % CI 95 % confidence interval

<sup>a</sup> Adjusted for sociodemographic factors and other measures of access to strength-training facilities

*p*-values <0.05 are in bold

existed in this survey because the response rate was less than 40 %. Thus, further longitudinal studies with a higher response rate are needed. Despite the limitations, the present study contributes to understanding influences of environmental factors on strength-training behavior.

In conclusion, the major finding of the present study indicates that perceived access to facilities for strength training is a stronger predictor of strength-training behavior than objective access. According to these findings, enhancing awareness of facilities may be effective in promoting strength-training behavior. However, facilities alone might not be adequate to promote strength-training behavior. Based on the present study, further explorations of effective intervention strategies to promote strength training are recommended.

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**Conflict of Interest** The authors have no conflict of interest to disclose.

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