Abstract

Objective: To examine factors of the youth physical activity promotion (YPAP) model that are associated with Chinese international students’ meeting PA recommendations (MPAR).

Methods: A total of 649 (females = 320, males = 329) Chinese international college students participated in the study. This study was conducted in the United States (US.) between June and August in 2011. Participants completed an online survey regarding their demographic, PA, predisposing, enabling, and reinforcing factors.

Results: Logistic nested-regression analysis suggested that being male, having a higher body mass index, perceived competence, self-efficacy, attitude, and enjoyment all increased (p < 0.001) the participants’ odds of MPAR. Except language barriers, all of the enabling and reinforcing factors predicted MPAR indirectly through the predisposing factors (p < 0.001).

Conclusion: Understanding factors that influence PA among Chinese international students is an important step in the process of promoting their long-term health and wellbeing. Designing program that address the identified key factors may help colleges and universities achieve this goal.

Keywords: Health behavior; Health promotion; Higher education; Youth physical activity promotion model

1. Introduction

Chinese international students are the largest international student group population in the American higher education system. In comparison to American college students and other international students groups, they have also been identified as the least physically active. The most recent physical activity (PA) guidelines suggest that obtaining at least 150 min of moderate-intensity PA per week results in substantial health benefits, which the vast majority of Chinese international college students do not appear to be achieving. Increased PA participation among international students may also provide opportunities to increase intercultural communication and understanding, and help reduce instances of racism and other forms of discrimination, exclusion, and resentment. Given the innumerable cognitive, health, and social benefits associated with PA for all people, identifying factors that influence Chinese international students’ PA participation is eminently important.

Understanding the PA experiences of Chinese international college students is also distinct due to their unique backgrounds. For example, traditional Chinese health beliefs value harmony with nature, which may diminish one’s desire to partake in un-natural actions, such as PA, to change their health status. In addition, since the majority of colleges and universities in China lack comprehensive physical education...
classes and equipment, Chinese students may lack the skills needed to use the exercise facilities that are available on American college and university campuses. Additionally, and similar to other immigrants, Chinese international students may encounter significant obstacles to their PA participation on the basis of their gender, ethnicity, and social class, among other factors. As a result, it is important to explore the specific factors influencing their PA participation. Ultimately such knowledge can help in the design and delivery of culturally acceptable and maximally effective PA intervention programs.

The youth physical activity promotion (YPAP) model offers a potentially useful framework for understanding Chinese international college students’ PA behavior. It was developed from the PRECEDE-PROCEED model, which proposes that in order to design interventions to change health behavior, steps including social diagnosis, epidemiological diagnosis, behavior and environmental diagnosis, and educational and organizational diagnosis need to be followed. Within the educational and organizational diagnosis phase, factors that influence the specific health behavior should be identified, including the predisposing, reinforcing, and enabling factors. The YPAP builds off of the PRECEDE-PROCEED model and adds further specificity.

In accordance with the PRECEDE-PROCEED model, the YPAP model explores the mechanisms of youth PA behavior by identifying predisposing, enabling, and reinforcing factors. Predisposing factors include two parts, “Am I able?” and “Is it worth it?” (simplified as able and worth, respectively, in the following). The able construct relates to self-perceptions of physical ability, including self-efficacy and perceived competence. The worth construct addresses the value (i.e., benefits and costs) placed on expected outcomes associated with PA, including attitude, belief, enjoyment, and knowledge. Enabling factors include variables that allow individuals to be physically active. Conceptually, this would include determinants from the biological and environmental domains such as body fat percentage, fitness level, and accessibility. Reinforcing factors emphasize how the social environmental factors influence PA. As significant others (e.g., parents, peers, and coaches) serve as interpreters, supporters, and providers of experiences for youth, they are also considered as reinforcing factors. On the basis of this model, the predisposing, enabling, and reinforcing factors influence PA directly. In addition, enabling factors also influence PA indirectly through able, and reinforcing factors influence PA indirectly through able and worth. Finally, the model addresses the potentially differentiating role that demographic factors (e.g., age, sex, and race) have on PA behavior (Fig. 1).

The YPAP represents a structure of predictors for understanding PA behavior, with the building blocks of its structure grounded in other well-established health behavior theories and models. For example, Social Cognitive Theory emphasizes the importance of self-efficacy and role modeling, the Theory of Planned Behavior addresses the importance of attitude, while the social-ecological model emphasizes the role of the environment. Many of these predictors have been examined and supported in previous studies. However, it is not clear how these factors collaboratively influence PA behavior, nor are the internal relationships among these factors well-understood. That is, both direct and indirect relationships may exist. The YPAP proposes a new approach for understanding PA behavior by considering individual, social, and environmental factors. The YPAP model has been tested among children, adolescents, and youth, and its ability to predict PA has been partially supported. However, none of the studies have tested the entire model simultaneously. Therefore, the interrelationships among the different constructs within the model remain unclear. It is also unclear whether the YPAP model can be used among young adults. The model was originally developed as a framework to help researchers identify variables that influence youth PA behavior. Yet most of the predisposing factors within the YPAP model appear to be related to young adult college students’ PA behavior as well. For example, college students have proximal access to distinct environmental assets given that most colleges and universities provide various opportunities for PA in the form of physical education classes; intramural, club, and varsity sports; and access to recreation facilities. Awareness and knowledge of these opportunities influences participation. Gym membership on or off campus is another predictor of college students’ PA behavior, as is the distance to and availability of active places for recreation.

As for the reinforcing factors, peers appear to have a stronger social support influence on college students than do parents; however, one’s cultural background may moderate this relationship. Social support may be especially important for Chinese international students since social support is more consistent with a collectivistic worldview. For example, one study found social affiliation to be the primary reason for PA participation among Chinese male and female college students living in the US.

The YPAP model also identified demographic factors, such as age, race, and sex as being influential determinants of PA. English fluency may be a unique demographic factor influencing the PA behavior of people whose first language is not English.
Given its potential as an explanatory model of Chinese international college students PA behavior, we employed the YPAP model as an initial attempt to identify factors associated with meeting PA recommendations (MPAR) among Chinese international students studying in the American higher system. Fig. 1 depicts the model under investigation. We hypothesized that the predisposing, enabling, and reinforcing factors would predict PA participation among Chinese international students both directly and indirectly.

2. Methods

2.1. Participants

A total of 649 (females = 320, males = 329) Chinese international students (18 years or older) participated in this study. The majority were graduate students (87.1%). This ratio was similar to the ratio of the graduate and undergraduate Chinese international students currently studying in the US.1

2.2. Measures

Participants completed a survey comprised of 53 questions measuring demographic and PA variables, along with the predisposing, enabling, and reinforcing factors from the YPAP framework.

2.2.1. Demographics

Participants reported their age, sex, graduate or undergraduate student status, length of time in the U.S., and their height and weight from which body mass index (BMI) was calculated.

2.2.2. PA participation

PA was assessed using the Leisure Time Exercise Questionnaire (LTEQ)24 and a dichotomous item. The LTEQ queries participants regarding their frequency of mild (e.g., easy walking), moderate (e.g., fast walking), and vigorous (e.g., jogging) PAs lasting at least 15 min in duration.

Participants were also asked whether they regularly participated in at least 150 min of moderate intensity PA per week.25 This was a single binary question to which participants responded “Yes” or “No”. Single item measures such as this have been shown to be valid.26

2.2.3. Predisposing

For the predisposing factors, able was measured by competence and self-efficacy. Perceived competence was assessed with the four items from the perceived competence subscale of the Intrinsic Motivation Inventory.27 Responses were scored on a 5-point scale ranging from “strongly disagree” to “strongly agree”. An example item was, “I think I am pretty good at physical activity”.

Self-efficacy to overcome barriers to PA was measured using Tergerson and King’s 4-item scale,28 which focused on items relevant to college students, namely weather, homework, fatigue, and a busy schedule. A sample question is, “How confident are you that you could exercise when you feel tired?” Responses were rated on a 5-point scale from “very unconfident” to “very confident”.

Worth was measured by attitude towards and enjoyment of PA. Six items rated on a semantic differential scale were used to measure participants’ attitude toward PA. An example item is, “For me, participating in regular PA would be very boring”, with response options ranging from being very boring to very stimulating. The short version of the physical activity enjoyment scale (PACES) was used to measure enjoyment.29 A sample item is, “When I am active I feel as though I would rather be doing something else”. Responses were rated on a 5-point scale from “strongly disagree” to “strongly agree”.

2.2.4. Enabling

The enabling factors included accessibility to PA related resources, perceived safety of the community and campus to perform PA, fitness and skills, knowledge about PA, and language barriers. The 4-item neighborhood environment walking scale (NEWS) was used to measure environmental factors.21 An example item is, “Where I live, there are enough supplies and pieces of sports equipment (like balls, bicycles, skates) to use for physical activity”. To measure the accessibility and safety of PA on campus, two more items were added (e.g., on campus, there are enough supplies and pieces of sports equipment, like balls, bicycles, and skates, to use for PAs). Knowledge about PA was measured using two items from Corbin et al.30 An example is, “I know how to plan my own physical activity program”. Fitness and skills were also measured using two items from Corbin and colleagues. An example item is, “I possess good general physical fitness”. Language barriers were measured by two items: “My English language barriers. The 4-item neighborhood environment walking scale (NEWS) was used to measure environmental factors.21 An example item is, “Where I live, there are enough supplies and pieces of sports equipment (like balls, bicycles, skates) to use for physical activity”. To measure the accessibility and safety of PA on campus, two more items were added (e.g., on campus, there are enough supplies and pieces of sports equipment, like balls, bicycles, and skates, to use for PAs). Knowledge about PA was measured using two items from Corbin et al.30 An example is, “I know how to plan my own physical activity program”. Fitness and skills were also measured using two items from Corbin and colleagues. An example item is, “I possess good general physical fitness”. Language barriers were measured by two items: “My English level influences my participation in physical activity” and, “If I become more fluent in English, I would participate in more physical activity”. Responses were scored on a 5-point scale ranging from “strongly disagree” to “strongly agree”.

2.2.5. Reinforcing

Reinforcing factors included peer support and role modeling. Peer support was measured using a 4-item scale assessing peer praise, encouragement, participation, and the encouragement of others.31 An example item is, “My friends encourage me to do physical activity or play sports”. Role modeling was measured using a 3-item scale evaluating how role models in the social environment influenced the participants’ PA behavior. An example item is, “Seeing people do physical activity in the recreational center (e.g., weightlifting) motivates me to be more physically active”. All responses were rated on a 5-point scale from “strongly disagree” to “strongly agree”.

2.3. Procedures

The Institution Review Board (IRB) at the researchers’ university approved the study. The recruitment emails were sent to the Chinese international students through the Chinese Students and Scholar Association (CSSA) at 60 universities in...
the US. using convenience and snowball sampling methods. Participants who were interested in this study were directed to SurveyMonkey.com where they viewed the “explanation of research study” document. To qualify for the study, participants were asked if they obtained the international student visa (F1 visa) and were originally from Mainland China. After reading that document those who wanted to continue were directed to the actual survey. An identification number was assigned to each participant to maintain anonymity and confidentiality. Participants who decided not to continue could quit the survey at anytime. Data were collected between June and August 2011.

2.4. Analysis

Since all of the scales were 5-point scales, item-mean scores, instead of the item total scores, were calculated as the final score for each scale to make the score of each scale comparable. The range of each scale score was from 1 to 5.

Data analysis comprised two stages: (1) identification of the factors that predicted PA directly, (2) exploration of the mediation effect of the predictors on PA. Binominal nested regression modeling and mediation analysis were completed in STATA version 12.0 (StataCorp LP, College Station, TX, USA), with α set at p < 0.05 for all analyses.

2.4.1. Missing and skewed data analysis

Among those who were retained for analyses (n = 649), 504 participants answered every single question leaving 145 participants (22.3%) missing at least one value. After examining the patterns of missing data, the data appeared to be missing at random (MAR). That is, missing values did not seem to be dependent on other variables. Since using list wise deletion for MAR may significantly reduce the sample size and may cause a biased estimation, the multiple imputation method was used.30

3. Results

On average participants were 27.08 ± 4.59 years of age, had BMI of 21.96 ± 4.10 (range 17.0–32.5), and had spent 36.53 ± 33.86 months in the US. Internal consistencies of the scales (Cronbach’s α values) ranged from 0.73 to 0.94 (Table 1). From Table 2, the imputed means for each scale were close to the raw means, which provided additional evidence for the imputation approach employed. Overall, the means ranged from 2.59 to 4.19, with relatively low average scores on self-efficacy to overcome exercise barriers, but relatively high scores on positive exercise attitude and exercise enjoyment.

Though the LTEQ has been successfully used in multiple other studies, it was not used as a primary outcome variable in the current study for several reasons. First, the distribution of scores was very skewed even after imputation (i.e., skewness = 3.82, kurtosis = 19.10). Second, the standard deviation was larger than the total mean score (i.e.,
mean = 49.68, SD = 69.87). Although we tried dropping outliers and combining moderate and vigorous scores, neither approach resolved the issues we encountered with this measure in this sample. Therefore, we used the binary variable of MPAR and “does not meet MPAR” as the dependent measure of PA instead.

As shown in Table 2, we were not able to normalize the distribution using transformation analysis. Since imputing values for the missing data did not adequately adjust the skewed distribution, bootstrapping was used to analyze the original data (i.e., n = 549 for those who did not miss the dependent variable), thereby avoiding biased standard errors.32 There were 346 (63.02%) participants who met the PA recommendation (i.e., 150 min of the PA per week), and those who met the PA recommendation reported more weekly exercise on the LTEQ than those who did not (mean = 61.47, SD = 78.28 vs. mean = 34.61, SD = 56.74, respectively; t (549) = 4.52, p < 0.001, Cohen’s d = 1.50). In spite of the caveats noted above about the LTEQ in this sample, the magnitude of this finding offers concurrent validity related evidence in support of the binary approach employed in this study (i.e., MPAR vs. does not MPAR).

We also explored the bivariate correlation among the able, worth, enabling, and reinforcing factors. The results indicated that for able, the correlation between self-efficacy and perceived competence was 0.38. For worth, the correlation between enjoyment and attitude was 0.59. For enabling factors, the correlations among accessibility, knowledge, language barrier, and skill and fitness were between −0.14 and 0.72. For the reinforcing factors, the correlation between role modeling and peer support was 0.36 (Table 3). The moderate-to-high internal consistency of each scale and low-to-moderate model and peer support was 0.36 (Table 3). The moderate-to-high internal consistency of each scale and low-to-moderate discriminant validities of the scales employed.

Table 3
Correlation matrix of the different scales for the multiple-imputed data (n = 549).

<table>
<thead>
<tr>
<th>PA</th>
<th>Able</th>
<th>SE</th>
<th>PC</th>
<th>Worth</th>
<th>EY</th>
<th>AT</th>
<th>LB</th>
<th>FS</th>
<th>KN</th>
<th>AC</th>
<th>RM</th>
<th>PS</th>
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<tbody>
<tr>
<td>PA</td>
<td>—</td>
<td>0.46</td>
<td>—</td>
<td>0.42</td>
<td>0.38</td>
<td>—</td>
<td>0.32</td>
<td>0.48</td>
<td>0.26</td>
<td>0.53</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Able</td>
<td>0.46</td>
<td>—</td>
<td>0.34</td>
<td>0.81</td>
<td>—</td>
<td>0.42</td>
<td>0.85</td>
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<td>0.32</td>
<td>0.48</td>
<td>0.26</td>
</tr>
<tr>
<td>SE</td>
<td>0.34</td>
<td>0.81</td>
<td>—</td>
<td>—</td>
<td>0.42</td>
<td>0.85</td>
<td>0.38</td>
<td>—</td>
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<tr>
<td>PC</td>
<td>0.42</td>
<td>0.85</td>
<td>0.38</td>
<td>—</td>
<td>0.32</td>
<td>0.48</td>
<td>0.26</td>
<td>0.41</td>
<td>0.87</td>
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<td>—</td>
<td>0.30</td>
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<tr>
<td>Worth</td>
<td>0.32</td>
<td>0.48</td>
<td>0.26</td>
<td>0.53</td>
<td>—</td>
<td>0.30</td>
<td>0.45</td>
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<td>0.52</td>
<td>0.91</td>
<td>—</td>
<td>0.27</td>
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<tr>
<td>EY</td>
<td>0.30</td>
<td>0.45</td>
<td>0.21</td>
<td>0.52</td>
<td>0.91</td>
<td>—</td>
<td>0.27</td>
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<td>0.26</td>
<td>0.41</td>
<td>0.87</td>
<td>0.59</td>
</tr>
<tr>
<td>AT</td>
<td>0.27</td>
<td>0.41</td>
<td>0.26</td>
<td>0.41</td>
<td>0.87</td>
<td>0.59</td>
<td>—</td>
<td>0.02</td>
<td>0.05</td>
<td>0.05</td>
<td>0.03</td>
<td>0.01</td>
</tr>
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<td>LB</td>
<td>0.02</td>
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<td>0.05</td>
<td>0.03</td>
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<td>−0.01</td>
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<td>0.39</td>
<td>0.42</td>
<td>0.05</td>
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<tr>
<td>FS</td>
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<td>0.67</td>
<td>0.45</td>
<td>0.39</td>
<td>0.42</td>
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<td>0.56</td>
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<td>KN</td>
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<td>0.72</td>
<td>—</td>
<td>0.13</td>
<td>0.24</td>
</tr>
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</table>

Note: All correlations greater than 0.08 are significant at the p < 0.05 level; greater than 0.11, p < 0.01; greater than 0.14, p < 0.001.33

Abbreviations: PA = meets the physical activity recommendation; SE = self-efficacy; PC = perceived competence; EY = enjoyment; AT = attitude; LB = language barrier; FS = fitness and skill; KN = knowledge; AC = accessibility; RM = role modeling; PS = peer support.

Table 4
Nested logistic regression model of prediction of MPAR (bootstrapping = 1000) (n = 504).34

<table>
<thead>
<tr>
<th>MPAR</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2.91***</td>
<td>2.27***</td>
<td>1.49***</td>
<td>1.48**</td>
<td>1.48**</td>
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<tr>
<td>Months in U.S.</td>
<td>1.05</td>
<td>0.97</td>
<td>0.98</td>
<td>0.96</td>
<td>0.96</td>
</tr>
<tr>
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<td>1.24</td>
<td>1.25*</td>
<td>1.26</td>
<td>1.25</td>
</tr>
<tr>
<td>Able</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-competence</td>
<td>2.30***</td>
<td>1.95***</td>
<td>1.75**</td>
<td>1.74**</td>
<td>1.74**</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>1.69***</td>
<td>1.68***</td>
<td>1.67***</td>
<td>1.65***</td>
<td>1.65***</td>
</tr>
<tr>
<td>Worth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attitude</td>
<td>1.18</td>
<td>1.13</td>
<td>1.14</td>
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<td>—</td>
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<tr>
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<td>Enable</td>
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<tr>
<td>Accessibility</td>
<td>1.15</td>
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<tr>
<td>Fitness and skill</td>
<td>1.21</td>
<td>1.19</td>
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<tr>
<td>Knowledge</td>
<td>0.98</td>
<td>0.99</td>
<td>—</td>
<td>—</td>
<td>—</td>
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<tr>
<td>Language barriers</td>
<td>0.99</td>
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<tr>
<td>Reinforce</td>
<td>Peer support</td>
<td>1.09</td>
<td>—</td>
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<tr>
<td>Role modeling</td>
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<td>—</td>
<td>—</td>
<td>0.94</td>
</tr>
</tbody>
</table>

*p < 0.05, **p < 0.01, ***p < 0.001.
Abbreviations: MPAR = meeting physical activity recommendations; BMI = body mass index.

* Odds refers to sex with males compared to females. All other odds ratios (ORs) are standardized OR, which indicates that a one standard increase in the independent variable results in changes to the OR of MPAR.

3.1. Logistic nested-regression models analysis

We attempted to identify the factors that best predicted the odds of MPAR among Chinese international students. Tables 4 and 5 show the odds ratio of the logistic nested regression comparing the five nested models. The model comparison results indicate that adding able factors (Model 2) significantly increased the odds of MPAR prediction, compared to the base model (Model 1). Adding worth factors (Model 3) significantly increased the prediction of the odds, compared to Model 2. Adding enabling (Model 4) and reinforcing factors (Model 5) did not significantly increase the model prediction, compared to Model 3. Therefore, Model 3 was the final model for MPAR.

In Model 3, sex significantly influenced the odds of MPAR. The odds of males meeting the PA recommendation was 1.49 times greater than the odds of females meeting them (p < 0.001). Being one SD higher on BMI increased the odds of MPAR by 1.25 times (p < 0.05). Being one standard deviation higher on competence and efficacy increased the odds by 1.67 times (p < 0.001). Being one SD higher on enjoyment and attitude increased the odds by 1.21 times (p < 0.001). Table 5 shows the odds ratio of the logistic nested regression model comparison.

Table 5
Nested logistic regression model comparison.

<table>
<thead>
<tr>
<th>Model comparison</th>
<th>χ2</th>
<th>χ2 for change</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1</td>
<td>−323.49</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Model 2</td>
<td>−271.78</td>
<td>103.42</td>
<td>2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Model 3</td>
<td>−267.68</td>
<td>8.20</td>
<td>2</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Model 4</td>
<td>−266.15</td>
<td>3.06</td>
<td>4</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Model 5</td>
<td>−265.86</td>
<td>0.57</td>
<td>2</td>
<td>&gt;0.05</td>
</tr>
</tbody>
</table>
of MPAR by 1.95 and 1.68 times, respectively (both $p < 0.001$).

### 3.2. Mediation effect

Although the direct effects of the enabling and reinforcing factors on PA lacked statistical significance, the indirect effects of the enabling and reinforcing factors on MPAR through able and worth may still exist. We used the user-written command “binary_mediation” in STATA to examine each mediation effect. The results showed that there were no direct effects of the enabling and reinforcing factors on MPAR (all $p > 0.05$), whereas all but the language barriers had indirect effects on MPAR through the predisposing factors (all $p < 0.001$).

### 3.3. Final model

We proposed a final model (Fig. 2) to predict PA based on the nested regression model analysis and mediation analysis. On the basis of this model, only the predisposing factors, able and worth, predicted MPAR directly. All reinforcing and enabling factors, except the hypothesized language barriers, predicted MPAR indirectly through able and worth. Sex and BMI were also predictors of MPAR.

### 4. Discussion

Over half of the participants in this study met the PA recommendation, indicating that they were more physically active than many of their contemporaries in China, as well as more active than what had previously been reported among those enrolled in American colleges and universities. This may be because the physical and social environment of American society has positively influenced their participation. For example, in the current study, social and physical environment factors, such as social support, role modeling, and accessibility to PA resources, were found to have indirect effects on PA participation among Chinese international students. This finding may result from efforts underway in America focused on reprioritizing healthy, active living and building environments that support such practices (e.g., Active Community Environments, Rails to Trails, Michelle Obama’s efforts as First Lady of the United States focused on childhood obesity). It would seem that such endeavors are positively influencing Chinese international students, although the present study does not allow for causal inference. Although the acculturation effect on PA participation remains unclear, the current study does suggest a potential protective effect of American culture on Chinese international students’ PA behavior.

Also, males in this sample were 1.49 times more likely than females to meet the PA recommendation. This is consistent with previous research suggesting that female college students are less active than are their male peers. BMI also significantly predicted MPAR. Contrary to previous findings, the current study showed that having a higher BMI was associated with greater odds of meeting the PA recommendation. Given that the majority of participants had a normal body weight, a higher BMI may indicate more muscle mass and a more physically active lifestyle. Or, it could be that the students with higher BMI values were using PA as a means of counteracting the situation.

Consistent with Welk’s YPAP model, the factors that predicted MPAR were the predisposing, enabling, and reinforcing factors. However, the predisposing factors (i.e., perceived competence, self-efficacy, attitude, and enjoyment) were the only factors to predict MPAR directly. Others have also observed the importance of these predictors on PA participation among different college-aged population segments.

Different from the YPAP model, we found that the enabling and reinforcing factors influenced PA indirectly through able and worth, instead of directly. As previous research has focused on the direct influence of the physical and social environmental factors (e.g., accessibility, social support) on PA participation, the plausible mediation effect between those factors and PA participation were neglected. The current study allowed for a more comprehensive view of this situation in an attempt to better understand these relationships and to offer guidance for application of the findings. From this we have clarified that interventions aimed at the enabling and reinforcing factors should focus on increasing the predisposing factors (e.g., perceived competence, self-efficacy) in order to ultimately promote PA participation.

In accordance with previous studies, our study provides additional evidence of the importance of environmental factors on PA participation, in particular its indirect effect. However, the influence of environmental factors on PA participation remains unclear overall. For example, in a previous study objectively measured environmental variables were significantly related to PA, whereas self-reported environmental variables were not. That said, there is clearly

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**Fig. 2.** Final model to predict physical activity for Chinese international students. Able and worth are the two components of the predisposing factors. BMI = body mass index.
growing interest in the relationship between PA and the built environment with much still to be learned.37,38

Finally, although previous research has suggested a relationship between language fluency and PA participation,35 this was not supported in our study. This may be because the majority of participants in our study were graduate students and their admission into graduate school in the United States was at least partially contingent upon their English language fluency.

Compared to previous studies, the proposed final model highlights the direct influences of the predisposing factors and the indirect effects of the enabling and reinforcing factors. In future studies it would be interesting to compare how the YPAP model could be different among different groups (e.g., between American and Chinese college students). Likewise, continued refinement of the model will help maximize its utility and clarify it generalizability across different subgroup populations.

5. Limitations

Our findings are limited by convenience sampling, the retrospective study design, and the self-reported nature of the data obtained. Specifically, the sample was not randomly selected and may not be fully representative. Those who participated seemed relatively active compared to previous reports of this subgroup population. This may represent a social desirability bias too. However, those meeting vs. those not meeting the PA guidelines did report higher activity levels on a separate measure (i.e., LTEQ), which offers some evidence of construct validity.

Future studies should continue to test and modify the YPAP model for the Chinese international student population. Where feasible studies should use objective measures to measure PA and the environmental factors. In addition, the current study is cross-sectional. Therefore, causal inferences about the association between correlates and PA cannot be made. Longitudinal studies are needed to test the cause-effect relationships in the model.

For the already identified predictors, such as the predisposing factors, intervention studies aimed at improving those factors could be implemented to ultimately promote PA participation among Chinese international students. For example, Yan and Cardinal39 proposed a peer education program in which American college students were paired with an international student to help them increase their PA behavior by targeting the individual, interpersonal, and environmental factors following a 12-lesson curriculum.

6. Conclusion

Different from traditional models that only consider individual factors influencing PA behavior, the YPAP model allows for an exploration of both individual and environmental level factors simultaneously. The mediation analyses illustrate the overall relationship between the individual and environmental factors and their effects on PA participation. We believe future interventions can use this as a framework to specify hypotheses about potential pathways toward PA interventions among international students in the American higher education system.

This study also provides some intervention directions for colleges and universities that are interested in promoting PA among Chinese international students. The predisposing factors, including perceived competence, self-efficacy, positive attitude, and enjoyment of PA, are the most important and direct factors influencing PA participation. One or more of these psychological factors should be targeted in PA promotion interventions. In addition, environmental resources and support are important, but these sources alone may not influence PA behavior directly. Instead, colleges and universities should focus on providing both environmental and social resources to increase the predisposing factors within this group. This will afford the Chinese international students the best opportunity to engage in healthy living practices during their transitional time in the U.S.

References

综 述

《运动与健康科学》, 2015(4):156-163

在研究环境下进行体育素养的挑战

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摘要 介绍了美国教育体系下学校环境中“体育素养”的概念。从普通教育和体育教育两个方面阐述了体育素养的演变过程。从“体育教育”到“体育素养”再到“体育能力”，美国教育体系中的体育素养经历了多个阶段的发展。研究中讨论了体育素养的培养方法，包括体育锻炼、体育教育和体育竞赛等。具体包括关键词：体育素养；体育能力；体育教育；体育竞赛等。

关键词 差异；体育教育；体育素养；整体教学方法

原论文

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对运动心理学研究文献中的趋向一回溯成就目标与绩效相关性的 Meta 分析综述

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摘要 本综述对研究文献中的趋向一回溯成就目标与绩效相关性的 Meta 分析进行了综述。根据研究文献中提供的数据，采用 Meta 分析方法，对文献中提供的趋向一回溯成就目标与绩效相关性的数据进行了分析。结果，趋向一回溯成就目标与绩效相关性呈显著正相关，趋向一回溯成就目标与绩效相关性在不同领域和不同目标的差异也存在显著差异。结论，趋向一回溯成就目标与绩效相关性在研究中具有重要的意义。

关键词 目标；绩效；Meta 分析

《运动与健康科学》, 2015(4):174-181

葡萄糖不耐受个体的体育运动能力与运动表现

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摘要 本研究对葡萄糖不耐受个体的体育运动能力与运动表现进行了研究。通过实验，研究了葡萄糖不耐受个体在不同运动条件下的运动表现。结果，葡萄糖不耐受个体的运动表现明显低于对照组。结论，葡萄糖不耐受个体应避免剧烈运动。

关键词 葡萄糖不耐受；运动表现；实验

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单脚坐下和蹲下时膝关节外展肌肉的功能

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摘要 本研究对单脚坐下和蹲下的膝关节外展肌肉的功能进行了研究。通过实验，研究了单脚坐下和蹲下时膝关节外展肌肉的收缩特点。结果，单脚坐下和蹲下的膝关节外展肌肉的收缩强度不同。

关键词 单脚坐下；蹲下；膝关节外展肌肉

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使用 MyWellness Key™ 加速计进行 6 min 跑台步行测试的定量研究

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摘要 本研究对使用 MyWellness Key™ 加速计进行 6 min 跑台步行测试的定量研究进行了研究。通过实验，研究了使用 MyWellness Key™ 加速计进行 6 min 跑台步行测试的定量方法。结果，使用 MyWellness Key™ 加速计进行 6 min 跑台步行测试的定量方法具有较高的准确性。

关键词 MyWellness Key™；加速计；6 min 跑台步行测试

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极端鞋和坡度对跑步时垂直和下肢活动的限制

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摘要 本研究对极端鞋和坡度对跑步时垂直和下肢活动的限制进行了研究。通过实验，研究了不同鞋类和不同坡度对跑步时垂直和下肢活动的限制。结果，不同鞋类和不同坡度对跑步时垂直和下肢活动的限制不同。

关键词 极端鞋；坡度；跑步时垂直；下肢活动

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运动科学中学生体能力的运动行为的形成及其影响因素

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摘要 本研究通过分析运动科学中学生体能力的形成及其影响因素，对学生体能力的形成机制及其影响因素进行了研究。通过实验，研究了学生体能力的形成机制及其影响因素。结果，学生体能力的形成机制及其影响因素不同。

关键词 学生；体能力；运动行为；形成；影响因素