Physical activity determinants among students based on Pender’s health promotion model constructs: a cross-sectional study using path analysis

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Abstract
Background: Over recent years, new lifestyles have raised ongoing concerns about the quality of life of students, especially inactivity. The purpose of this study was to determine the factors associated with regular physical activity among students using Pender’s health promotion model.

Methods: The present cross-sectional correlational study was conducted on 650 students of Isfahan University of Medical Sciences, Iran, who were selected by stratified sampling with probability proportional to size. Data were collected using a three-part questionnaire, including demographic profile, Pender’s health promotion model constructs and the international physical activity questionnaire. The strongest determinants of physical activity were identified using structural equation modeling by Amos software. Data were analysed by SPSS software (16) using chi-square, one-way analysis of variance and Spearman correlation.

Results: The results showed walking activity in 69.1%, moderate activity in 3.8% and vigorous activity in 27.1%. According to path analysis, perceived barriers were the most efficient predictor of physical activity among students, and Pender’s health promotion model constructs explained 84.9% of physical activity changes.

Conclusion: The satisfactory predictive value of Pender’s health promotion model constructs for physical activity behaviour focused on effective structures, such as perceived barriers, supports the application of this model to design educational interventions better.

Keywords
Physical activity, Pender’s health promotion model, path analysis

Introduction
Chronic non-communicable diseases are projected to account for three-quarters of deaths in developing countries by 2020, according to the World Health Organization (WHO), with an estimated more than 60% of the global burden of disease.1 Evidence suggests that regular physical activity manages to reduce the risks of chronic diseases and significantly affects mental health and life satisfaction.2 Physical activity is one of the most important determinants of community health promotion and of the main dimensions of a healthy lifestyle,3 as listed among the 15 priorities of behaviour change for improving health.4

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However, the WHO stated that at least 60% of the world’s population has no physical fitness required for healthy status and over 31% of adults older than 15 years have inadequate physical activity. Studies in Iran have also documented that over 70% of people have inadequate physical activity. Motor deprivation causes physical, psychological and intellectual defects in different classes of society. Youth are also not exempt from this rule. New lifestyles over the past few years have raised incremental concerns about the quality of life of students. According to new statistical data, students aged between 18 and 24 years are at risk of chronic illness, and this contradicts past beliefs about the peak of health in this age group. Investigations have reported that most students have dissatisfaction performance on physical activity. According to studies in Iran, only 10% of students have enough physical activity, which seems to be low in comparison with a country such as Australia with 52% participation. Research has shown that the physical activity pattern of students remains stable until the years after graduation. Students with inadequate physical activity in university are likely to remain unchanged and without physical activity, resulting in an increased risk of obesity and health-related problems.

Lack of time was found to be the major barrier to physical activity among students. This may be due to the burden of academic and other extracurricular activities on students. However, studies among sedentary/inactive young adults showed that lack of motivation and fatigue were widely cited barriers to physical activity participation.

There are certain sociocultural factors that appear to be barriers to people’s physical activity, such as low education levels and limited freedom of movement outside of the house.

Very few studies have addressed these issues in Iran. The results of a study indicated that family support, their impression of the body, social capital, cultural capital and economic capital of the citizens and their attitudes towards sport has a positive relationship with improved physical activity.

Given the fact that people choose their lifestyles throughout their school years, and are more inclined to changes and challenges, educational interventions can be effective in this regard. Identifying the processes involved in maintaining and promoting physical activity can help design more effective interventions in the theoretical framework appropriate to this context. Pender’s health promotion model, in which the threat is not proposed as a major source of motivation for the behaviour, was selected for this study in accordance with numerous studies emphasising regular physical activity as well as the limited benefits of preventive models for motivation of healthy lifestyles, especially among children and adolescents who often assume that they are not prone to diseases for various reasons. This model is one of the comprehensive and predictive patterns that has been used globally due to comprehensiveness in identifying determinants of behaviour in more than 40 studies to predict health promotion behaviours in the context of lifestyle, exercise and nutritional habits and is introduced as a guide to discovering complex biological and psychosocial processes that motivate individuals to increase their health behaviours. Based on this model, an ecological approach is needed to change behaviour, taking into account intrapersonal, interpersonal, organisational and social factors.

This model shows the effect of three groups of factors that directly and indirectly affect health promotion behaviour. These factors include individual experiences and characteristics (former behaviours and individual factors), specific behavioral perceptions and emotions (perceived benefits of behaviour, perceived barriers of behaviour, perceived self-efficacy, situational influences, interpersonal influences and behavioral emotions) and the consequences of health-promoting behaviour (commitment to behavioral planning, prioritising and competing demands). The present study was conducted to recognise the status of physical activity among students of Isfahan University of Medical Sciences using Pender’s health promotion model variables to determine whether this theoretical perspective could explain the factors that are relevant and predictive of student participation in physical activity.

**Methods**

The current cross-sectional correlational study was conducted in students of Isfahan University of Medical Sciences. The sample size was estimated at 650 for fitting the structural equation model with respect to the test power of 80% and significance level of 5%. Stratified random sampling was used so that each school was considered to sample selection according to numbers of affiliated students. Students were selected from each of the categories (schools) using systematic random sampling. The samples were selected according to the proportion of students in each school without attention to the study year. There was not any incomplete questionnaire so that all of the returned questionnaires were analysed. Data were collected using a three-part questionnaire. The first part explored the background information and demographic characteristics including age, gender, educational level, marital status and residence. The second part of the questionnaire, which evaluated the physical activity level using the Persian version of the international physical activity questionnaire – short form (IPAQ-SF), has been used in various studies in Iran, with approved validity and reliability. This questionnaire measures the physical activity level in the past 7 days and, according to the total score, categorises the activity into three groups of walking, moderate and vigorous. Based on the IPAQ protocol, the total amount of energy calculated during the week less than 600 met/cal/week shows walking physical activity; the total score between 600 and 3000 met/cal/week means moderate physical activity and the total score of more than 3000 met/cal/week reveals vigorous physical activity.

The next part of the questionnaire was to measure physical activity-related factors, including Pender’s health promotion model constructs designed by the research team, whose validity and reliability were confirmed based on the following steps. The questionnaire, after design, was reviewed initially by 12 health education specialists based on criteria such as grammar, simplicity, comprehensibility, relevance and proportionality to the desired structure, as well as lack of ambiguity. Their recommendations were applied to promote face validity, and necessary amendments were made based on judgements and opinions of experts.

The quantitative method was used to determine the content validity of the questionnaire, followed by the calculation of content validity ratio and content validity index for the items. To do this, the comments of 15 health education and
Table 1. Demographics of the study population.

| Demographic variables   | N    | %   |
|-------------------------|------|-----|
| Gender                  |      |     |
| Male                    | 378  | 58.2|
| Female                  | 272  | 41.8|
| Marital status          |      |     |
| Married                 | 190  | 29.2|
| Single                  | 459  | 70.6|
| Education               |      |     |
| Undergraduate student   | 5    | 0.8 |
| Bachelor's degree       | 424  | 65.2|
| Master student          | 64   | 9.8 |
| PhD student             | 157  | 24.2|
| Socioeconomic status    |      |     |
| Very well               | 29   | 4.5 |
| Good                    | 128  | 19.7|
| Medium                  | 422  | 64.9|
| Weak                    | 71   | 10.9|
| Residence               |      |     |
| Students' dormitory     | 410  | 63.1|
| Student house           | 52   | 8.0 |
| With family             | 188  | 28.9|
| Physical activity       |      |     |
| Intense                 | 176  | 27.1|
| Medium                  | 25   | 3.8 |
| Weak                    | 449  | 69.1|

Results

The mean age of the participants was 24.29 ± 5.35 years and the minimum and maximum age of the subjects were 18 and 39 years, respectively. About 58.2% of the subjects were men and 41.8% were women. Most of the units were single (70.6%). The educational levels were associate degree (0.8%), bachelor's degree (65.2%), master's degree (9.8%) and PhD (24.2%). In this study, the socioeconomic status was good and very good in 24.2% of the students, and poor in 10.9%. The majority of students (63.1%) lived in a dormitory and 240 (36.9%) lived outside the dormitory (with a family or at student home) (Table 1).

Based on the IPAQ scores for 650 students participating in the study, 449 (69.1%) had walking activity, 25 (3.8%) had moderate activity and 176 (27.1%) had vigorous activity (Table 1). One-way ANOVA showed that there is a significant relationship between Pender's health promotion model constructs and physical activity (Table 2).

Table 3 shows the correlation matrix between Pender’s health promotion model constructs and the study outcome (physical activity). As shown in Table 3, all Pender’s health promotion model constructs had a significant relationship at the level of 0.01 and 0.05, except for the self-efficacy variable and situational determinants that had no significant relationship with the perceived benefits. The details of these relationships as well as the correlation between the other factors are presented in Table 3. There were positive and significant correlations between commitment, benefits, self-efficacy, planning and individual determinants with physical activity (P<0.01). An inverse significant correlation was between barriers, situational determinants and competitors with physical activity (P<0.01).

In this study, the path analysis was used to determine the predictive value of Pender’s health promotion model constructs regarding physical activity. The fitted model has an acceptable fitness. The results show that Pender’s health promotion model constructs explain 84.9% of the changes in physical activity. The path analysis revealed a significant inverse correlation of barriers, situational determinants with physical activity. Based on the results of path analysis, there was a direct and significant relationship between individual determinants, planning, self-efficacy and commitment with physical activity. The indirect effect of the former behaviour on physical activity was direct and significant (β = −0.561). This correlation was higher between physical activity and both perceived barriers (P<0.05 and β = −0.63) and former behaviour (P<0.05 and β = −0.56). The path analysis showed that the relationship between all of Pender’s health promotion model constructs, with the exception of competitive priorities and demands, was strengthened and increased with physical activity through commitment (Figure 1).

Discussion

The American College of Sports Medicine (ACSM) and the Centers for Disease Control and Prevention (CDC) suggested that individuals should have a moderate intensity of physical activity for 30 minutes or more on most days of the week.23 Meanwhile, the present study showed that only 3.8% of the students participating in the study had moderate physical activity and 27.1% had severe physical activity. The results of many studies are all in line with the results of the present study and confirm the inadequate physical activity of Iranian students.2,6,10,11
Because students spend a considerable time attending the classroom, studying and working with computers and the internet, and consequently experience inactivity, and they are expected to join immobile jobs in the future and this physical activity pattern established in these years will continue in the coming years, university seems to be an appropriate platform to create, maintain and promote a healthy lifestyle. Given the fact that students are generally influenced by the environment and the courses offered during their studies, they are ready to accept any changes and challenges in their lives, resulting in an improvement to their lifestyle. Therefore, identifying processes involved in physical activity behaviour and designing appropriate interventions should be considered for this particular group.

The path analysis showed that the former behaviour was one of the most important predictors of physical activity due to the indirect effect on Pender’s health promotion model constructs. This result can be justified in such a way that the predicted or experienced benefits of a behaviour, as defined by Bandura as expected results, will increase the likelihood of repeating that behaviour. Positive or negative feelings are also encoded before, during or after behaviour in the mind, which are remembered when we act in the future, thus forming these cognitions and emotions. This finding is in line with the studies of Ghofranipour et al. and Shin et al.

Based on the path analysis findings in this study, there was a positive and significant correlation between perceived benefits and inverse correlation between perceived barriers and physical activity. The perceived benefits and barriers are two positive and negative cognitive factors that can lead to performance or non-performance of their behaviour, respectively. This is a logical consequence because individuals tend to use their time and resources in activities that increase the likelihood of their positive experiences. When preparedness is lower and obstacles are higher, the action will be impossible to do.

| Constructs                        | Physical activity | F   | P value |
|-----------------------------------|-------------------|-----|---------|
|                                   | Weak             | Medium | Intense | Total |
|                                   | Mean  | SD    | Mean  | SD    | Mean  | SD    | Mean  | SD    |
| Knowledge                         | 17.5  | 2.75  | 19    | 2.17  | 17.74 | 1.22  | 17.62 | 2.42  | 4.81     | 0.008 |
| Attitude                          | 17.67 | 4.88  | 22.64 | 2.09  | 21.38 | 1.71  | 18.87 | 4.54  | 60.17    | 0.000 |
| Prior related behaviour           | 12.6  | 5.39  | 5.8   | 1.29  | 6.09  | 1.45  | 10.58 | 5.46  | 143.55   | 0.000 |
| Activity-related affect           | 17.08 | 4     | 19.68 | 3.62  | 20.41 | 3.66  | 18.08 | 4.17  | 48.13    | 0.000 |
| Commitment                        | 10.59 | 2.75  | 13.8  | 4.64  | 17.94 | 1.08  | 12.71 | 4.11  | 537.19   | 0.000 |
| Perceived benefits                | 29.71 | 5.62  | 31.88 | 4.77  | 32.48 | 4.74  | 30.55 | 5.5   | 17.62    | 0.000 |
| Perceived barriers                | 32.67 | 5      | 20.68 | 3.92  | 16.86 | 1.26  | 27.93 | 8.31  | 896.88   | 0.000 |
| Situational influences            | 17.16 | 4.28  | 16.92 | 4.67  | 17.04 | 1.74  | 15.41 | 4.72  | 184.7    | 0.000 |
| Self-efficacy                     | 19.49 | 6.29  | 31.08 | 2.44  | 34.82 | 2.28  | 24.08 | 8.75  | 533.00   | 0.000 |
| Immediate competing demands and preferences | 20.7  | 5.59  | 12.96 | 1.27  | 12.31 | 1.17  | 18.13 | 6.07  | 217.11   | 0.000 |
| Planning                          | 12.98 | 3.76  | 18.64 | 2.03  | 16.57 | 2.95  | 14.17 | 3.95  | 87.15    | 0.000 |
| Interpersonal influences          | 40.07 | 11.73 | 64.44 | 7.73  | 66.42 | 8.65  | 48.18 | 16.23 | 401.18   | 0.000 |

| Variables                        | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|----------------------------------|---|---|---|---|---|---|---|---|---|----|
| 1 Prior related behaviour        |   | I |   |   |   |   |   |   |   |    |
| 2 Activity-related affect        | 0.48** | I |   |   |   |   |   |   |   |    |
| 3 Commitment                     | 0.379** | 0.277** | I |   |   |   |   |   |   |    |
| 4 Perceived benefits             | 0.434** | 0.435** | 0.143** | I |   |   |   |   |   |    |
| 5 Perceived barriers             | 0.654** | 0.52** | 0.639** | 0.284** | I |   |   |   |   |    |
| 6 Situational influences         | 0.173** | 0.127** | 0.803** | 0.002 | 0.414** | I |   |   |   |    |
| 7 Self-efficacy                  | 0.36** | 0.289** | 0.774** | 0.035 | 0.765** | 0.566** | I |   |   |    |
| 8 Immediate competing demands and preferences | 0.514** | 0.403** | 0.762** | 0.087* | 0.721** | 0.600** | 0.78** | I |   |    |
| 9 Interpersonal influences       | 0.433** | 0.271** | 0.698** | 0.16** | 0.763** | 0.543** | 0.855** | 0.792** | I |    |
| 10 Physical activity             | −0.52** | 0.34** | 0.76** | 0.22** | −0.82** | −0.57** | −0.75** | −0.62** | 0.71** | I |

*Correlation is significant at the 0.05 level.
**Correlation is significant at the 0.01 level.
These results are consistent with Samara et al.\textsuperscript{16} and Taofeek et al.\textsuperscript{15} Therefore, the design of appropriate interventions focused on the benefits of physical activity referred to in various studies, including health, fitness and welfare,\textsuperscript{16} attractiveness, achieving the opportunity to socialise with friends, the creation of positive self-emotions, pleasure and joy,\textsuperscript{27} is an effective step to increase the participation of students in physical activity.

The findings of this study introduced perceived barriers as the most important predictor of physical activity. Perceived barriers affect the health promotion behaviour directly by creating barriers to action, as well as indirectly by reducing commitment to planning behaviour,\textsuperscript{28} confirmed by our study results.

Some of the most important control beliefs as barriers to physical activity reported in various studies are psychological problems, lack of women’s sports complexes, the high cost of sports classes, job difficulties, family responsibilities, bad climatic conditions, inadequate facilities for physical activity in the dormitory,\textsuperscript{29} time constraints, absent programmes and fatigue due to physical activity,\textsuperscript{15} long distances to clubs, lack of encouragement from the university, restrictions imposed by family and society,\textsuperscript{16} homework, injury, money and safety.\textsuperscript{27} Appropriate planning to eliminate these barriers, along with providing sports facilities and enhancing individual skills, can be effective in promoting student physical activity.

The path analysis in the present study showed a positive and significant correlation between self-efficacy and individual determinants with physical activity. Exercise self-efficacy derived from the cognitive social theory of Bandura expresses one’s beliefs or judgements about his or her abilities to perform physical activity and shows one’s belief in doing physical activity in a variety of conditions and with any level of skill. Accordingly, knowledge, skills and achievements alone are not good predictors of exercise behaviour.\textsuperscript{30} Self-efficacy induces physical activity directly by efficiency expectations, and indirectly by determining the level of commitment or insistence on planning a behaviour.\textsuperscript{28} Therefore, it is necessary to pay attention to this variable in creating and promoting health behaviours, because if one does not consider him or herself to perform a task, he or she is naturally less likely to perform that behaviour.\textsuperscript{31} This result can confirm the importance of addressing self-efficacy as a valuable variable in the training related to changing the physical activity behaviour of students. This finding is consistent with the results of Santos et al.,\textsuperscript{32} Peterson et al.,\textsuperscript{33} Cheng et al.,\textsuperscript{34} He et al.,\textsuperscript{35} Taofeek et al.,\textsuperscript{15} Salehi et al.\textsuperscript{36} and Samara et al.\textsuperscript{16}

Pender’s health promotion model suggests family support as an interpersonal determinant predicting health promotion behaviours. It should be noted that 75% of the research based on this model supported the interpersonal effects as a predictor of behaviour.\textsuperscript{37} According to the results of this study, there was a significant relationship between the individual determinants and physical activity. In Pender’s health promotion model, the individual determinants not only

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure1.png}
\caption{Route analysis for prediction of physical activity behaviour by Pender’s health promotion model structures.}
\end{figure}
directly affect health promotion behaviours but also indirectly influence planning through social pressure or encouraging commitment.28

The interpersonal determinants include norms (expectations), social support (material or emotional incentives) and modeling. These three processes affect the person’s ability to undertake a health promotion behaviour.19 The results of the studies by Musselman38 and Maglion and Hayman39 are consistent with our study. Cheng et al. emphasise the social effects of parents and friends on the physical activity of adolescents through the mechanism of behavioral modeling or through social support and self-efficacy,14 which is consistent with our study. These results reveal the importance of family and friends support for promoting the physical activity of a person in educational planning. Educational centres have appropriate environmental structures whose social interactions can greatly affect people’s behaviours.10

Based on the findings from the path analysis, immediate competitors and priorities had an inverse correlation with physical activity. Competitive demands refer to those behaviours that people have relatively low control over due to environmental dependencies, such as work or family care responsibilities. Failure to respond to a demand may have adverse effects on individuals or other important relatives. Competitive priorities point to those behaviours that people have relatively high control over. They can exclude health promotion behaviour in favour of competitive behaviour.19

The present study showed a significant relationship between this construct and physical activity. The need for broad, diverse and attractive planning to increase student motivation to exclude these competitors is notably prevalent due to the presence of strong competitors, including the internet and social networks, music and academic assignments in the student community.

The path analysis results of the present study showed that all of the Pender’s health promotion model constructs, apart from competitive priorities and demands, have been strengthened due to their commitment to physical activity. A commitment to planning is the initiation of a behavioral event, leading individuals into a behaviour and moving ahead with behaviour. A strong commitment to enforcement may also protect a person from competitive priorities and demands.19 Therefore, the inclusion of this issue in designing interventions can be effective in preserving and promoting physical activity in students.

**Limitations**

This was a single-centre study which was conducted only among students of Isfahan University of Medical Sciences. The results may not be generalisable to all university students. It is notable that the lack of similar studies based on Pender’s health promotion model made it difficult to compare the results with similar findings in the discussion section.

**Conclusion**

According to the results of this study, the satisfactory predictive value of Pender’s health promotion model constructs for physical activity behaviour focused on effective constructs supports the application of this model better to design educational interventions. As perceived barriers were the most important predictor of physical activity in this study, it seems that designing interventions to remove or reduce barriers for students could be an effective step to promote physical activity for this group of people. This is a preliminary cross-sectional and theory-based study, the results of which can help health promoters to be able to design and implement evidence-based studies.

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**Authors’ contributions**

Initially conceived and designed the study: FM and SS; conducted the analysis: AF; wrote the paper and made revisions: SS and HS; reviewed the manuscript critically: PS and FM. The final version of the manuscript has been read and approved by all the authors, and the requirements for authorship have been met.

**Availability of data and materials**

The data that support the findings of this study are available from the deputy of research of Isfahan University of Medical Sciences but restrictions apply to the availability of these data, which were used under licence for the current study and so are not publicly available. Data are, however, available from the authors on reasonable request and with permission of Isfahan University of Medical Sciences.

**Ethical approval**

Ethical approval to conduct this study was obtained from the research ethics committee of Isfahan University of Medical Sciences (ID number: IR.MUI.REC.1396.3.578).

**Informed consent**

Written informed consent was obtained from the participants. Furthermore, the students were informed that they had the right to withdraw from the study at any time, and were assured of the confidentiality of the study.

**Conflict of interest**

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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