1   Evaluation of the Health Promotion Model to Predict Physical Activity in Iranian

2   Adolescent Boys

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1 **Abstract**

2 **Background:** Promoting sustainable physical activity behavior change is challenging

3 and a number of theoretical models have been developed and applied to this problem.

4 Pender's Health Promotion Model (HPM) is a relatively new model that is based on

5 Bandura's Social Cognitive Theory (SCT) but includes the additional construct of

6 competing demands, which are viewed as alternative behaviors (e.g. watching

7 television) that have powerful reinforcing properties. The aim of this study was to

8 evaluate the HPM as a means to predict physical activity in a sample of Iranian

9 adolescent boys. **Methods:** Participants were 515 boys from 100 junior high and high

10 schools in Sanandaj, Iran. The mean age of participants was 14.33 years (SD = 1.6,

11 range: 12 -17). Participants completed questions assessing social cognitive variables

12 and structural equation modeling was used to fit the data to the HPM. **Results:** The

13 HPM accounted for 37% of the variance in PA, but did not represent a good fit of the

14 data, $\chi^2 = 913.85$, $df = 473$, $p < .001$. There were significant pathways between

15 physical activity and self-efficacy ($\beta = .25$, $p < .001$), enjoyment ($\beta = .22$, $p < .01$), and

16 physical activity modeling ($\beta = -.13$, $p < .05$). A revised model that included the indirect

17 effects of competing demands explained 34% of the variance in physical activity and

18 represented a good fit to the data, $\chi^2 = 9.12$, $df = 4$, $p = .058$. In the revised model, self-

19 efficacy, commitment to planning and enjoyment were associated with physical activity.

20 **Conclusions**: According to the HPM competing demands influence physical activity. In

21 the study sample, competing demands were not related to physical activity but they

22 were inversely associated with commitment to planning.

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1 Introduction

2   Physical activity is associated with improved physical, psychological and

3 social health (United States Department of Health & Human Services, 1996). However,

4 physical inactivity is a global health concern, which has contributed to an obesity

5 epidemic (World Health Organization, 2002). Although children and adolescents are

6 more active than adults, many young people do not engage in recommended levels of

7 physical activity (Rey-Lopez, Vicente-Rodríguez, G., Biosca, M., Moreno, LA., 2008).

8 In addition, physical activity declines precipitously with increased age among

9 adolescents, especially in girls (Nelson, Neumark-Stzainer, Hannan, Sirard, & Story,

10 2006, Brodersen, 2006). However, there has also been shown to be a decline of physical

11 activity in Iranian boys. In a recent study involving Iranian adolescents, 46% of boys

12 were found to be in the pre-adoption stage of exercise behavior change and average

13 amount of physical activity per day was more significantly less in 15-17 year olds (49

14 minutes) than 12-14 year olds (56 minutes) (Taymoori, Rhodes & Berry, in press).

15 Given that experiences related to participation in activity during childhood and

16 adolescence may influence adult physical activity, it is critical that predictors of

17 physical activity in Iranian boys be studied so that effective PA interventions can be

18 developed for this population.

19   Promoting sustainable physical activity behavior change is challenging and a

20 number of theoretical models have been developed. Social Cognitive Theory (Bandura,

21 1986) is one of the most widely used models of behavior change used in physical

22 activity research and proposes that behavior change is influenced by environmental

23 factors, personal factors, and attributes of the behavior itself. This interaction is referred

24 to as 'reciprocal determinism' as each factor may affect or be affected by the others.

25 Two kinds of expectation are central to the SCT: outcome expectations and efficacy

1 expectations. Outcome expectations are beliefs about whether a given behavior is likely

2 to lead to certain outcomes, e.g. a belief that exercising an hour a day every day of the

3 week will lead to weight loss and positive mental health. Efficacy expectations refer to

4 a person's perception of how capable they are of performing the behavior that will lead

5 to positive outcomes, e.g. an individual's confidence that they can overcome barriers

6 and be active every day.

7 Despite recognition of the need to understand physical activity behavior, the

8 majority of variance in physical activity studies remains unexplained. It has been argued

9 that there should be an integration of theoretical approaches to help explain physical

10 activity behavior (Epstein, 1998). The Health Promotion Model (HPM: Pender,

11 Murdaugh, & Parsons, 2002) is derived from Bandura's SCT and the notion of

12 'reciprocal determinism', which proposes that behavior change is influenced by

13 behavior specific cognitions mediated through commitment to a plan of action. Further,

14 behavior can be directly influenced by immediate demands and preferences. The

15 behavior-specific cognitions include benefits, barriers, self-efficacy and affect. Further

16 interpersonal influences and environmental factors can influence commitment. (Srof &

17 Velsor-Friedrich, 2006). While many background factors (e.g. gender, age, genetics)

18 cannot be modified, behavior-specific cognitions (e.g. self-efficacy, perceived barriers)

19 and interpersonal factors (e.g. social support) can be targeted to improve health

20 behaviors. The HPM shares a number of similar constructs with the SCT, such as

21 perceived benefits and perceived barriers and in both theories, self-efficacy is regarded

22 as a central construct. Like the SCT, the HPM includes behavioral factors (e.g. past

23 behavior) which can be predictive of current behavior through habit formation or

24 because the same determinants are operating at the same time (Garcia, Pender,

25 Antonakos, & Ronis, 1998). A key difference in the two theories is that the HPM

1   includes the concept of competing preferences, which are viewed as alternative

2   behaviors (e.g. watching television) that have powerful reinforcing properties.

3   Competing preferences can derail a health promoting behavior in favor of the

4   competing behavior. The extent to which an individual is able to resist these preferences

5   depends upon his or her ability to self-regulate.

6   The HPM has been used to explain the physical activity behavior of

7   adolescents in cross-sectional and longitudinal studies (Garcia, Norton, & Frenn, 1995;

8   Garcia *et al.*, 1998; Wu & Pender, 2002) and the findings from these studies support the

9   theoretical propositions of the HPM (Srof & Velsor-Friedrich, 2006). While these

10 studies have used the HPM to guide their exploration of physical activity behaviors, no

11 previous study has included all of the HPM components into a single model predicting

12 physical activity behavior in adolescents. Although there is data describing the physical

13 activity behavior of adolescents in Western countries, less is known about adolescent

14 physical activity behaviors in other countries. Therefore, the aim of this study is to

15 evaluate the efficacy of the HPM as a means to predict physical activity behavior in

16 Iranian adolescent boys.

17 **Methods**

18 *Participants*

19   Adolescents were selected using a cluster random sampling method. Based on

20 the results of a pilot study and using a .95 confidence level, it was concluded that a

21 sample size of 534 would give adequate power, 4 male junior high schools and 4 male

22 high schools were randomly selected from 100 schools located in Sanandaj Iran. At the

23 junior high schools, three classes from each grade of 7 to 9 were selected for inclusion.

24 Similarly, at each high school, three classes from each grade of 10 to 12 were selected

25 for inclusion. Response rate was 96.4% after eliminating cases with missing data. The

1 mean age of participants was 14.33 years (SD = 1.6; range: 12 -17). The study was

2 approved by the educational authorities and by the institutional human participants

3 committee. The study investigator sent a written information sheet and consent form for

4 the parents and participants to sign.

5 *Measures*

6   All measures were translated into Persian by a bilingual researcher and then

7 validated using the standard back translation technique by a native Persian who was

8 also fluent in English. Instruments were evaluated by five experts (PhD level) in health

9 behavior, exercise psychology and instrument design and then pilot tested for

10 appropriateness. Following the piloting of questionnaires with 115 participants,

11 revisions in wording and presentation were made based on empirical findings and

12 recommendations from participants in the pilot study. Several items that are pertinent to

13 Iranian culture were added to the final instruments. Due to the emphasis in Iranian

14 culture on family bonds and parents as authority figures, items consistent with this

15 theme were included. The following item was added to the self-efficacy scale, "exercise

16 even though I have family chores to complete" and "I don't have my parents'

17 approval", was added to the barriers scale. For the current study, questionnaires were

18 administered to students in their classrooms. A researcher remained in the room during

19 the questionnaire administration and answered any questions.

20 *Physical activity*

21   Participation in physical activity was assessed using a modified version of the

22 Child/Adolescent Activity Log (CAAL: Garcia, George, Coviak, Antonakas, & Pender,

23 1997). The CAAL asks respondents to recall the activities (any time they were moving)

24 that they participated in the previous day and the number of minutes of each and

25 requires respondents to keep a log of their time spent in physical activity for six

1 consecutive days (Saturday through Thursday). The average number of minutes spent in

2 physical activity each day is calculated by dividing total minutes spent to number of

3 days. Minor changes in questions were made for Iranian adolescents. For example,

4 some activities in the CAAL such as ice hockey, and ice/roller skating were

5 inappropriate for Iranian adolescents and were replaced with popular activities with

6 Iranian boys such as mountaineering, skateboarding, vast-vast, khat-khat (ball games)

7 and seven stone (similar to hopscotch). The 1-week test-retest reliability of the CAAL

8 with 115 Iranian adolescents selected through cluster random sampling of schools in

9 Sanandaj, Iran was .98 (Taymoori et al., in press).

10 *Psycho-social variables*

11 i)   Perceived benefits are defined as positive or reinforcing aspects of physical

12   activity and were examined using a modified version of the scale developed by

13   Garcia and colleagues (1995). The 8-item measure uses a 4-point Likert scale (1

14   = not at all true to 4 = very true). The 2-week test-retest reliability of the

15   perceived benefits scale was r = .89 and the alpha coefficient was α = .83 in this

16   study.

17 ii)   Perceived barriers refer to real or imagined impediments that prevent, or make

18   participation in physical activity difficult and were measured using a modified

19   version of the scale developed by Garcia and colleagues(1995). The 10 items

20   use a 4-point Likert scale ranging from 1 (not at all true) to 4 (very true). The 2-

21   week test-retest reliability of the scale was r = .77 and the alpha coefficient was

22   α = .78 in the study sample.

23 iii)   Exercise self-efficacy was assessed using a modified version of an 8-item

24   scale(Garcia *et al.*, 1995), in which respondents were asked to indicate their

25   confidence in their ability to be active in a variety of situations. Items are scored

1   on a 4-point Likert scale ranging from 1 (not at all confident) to 4 (very

2   confident). The 1-week test-retest reliability of the self-efficacy scale was $r =$

3   .77 and the alpha coefficient was $\alpha = .90$ in the study population.

4   iv)   Enjoyment of physical activity was measure using the six items from the

5   modified 16-item version of the Physical Activity Enjoyment Scale (Motl *et al.*,

6   2001). An example item is "When I am active I enjoy it". The items were rated

7   on a four-point scale ranging from 1 (not at all true) to 4 (very true). The alpha

8   coefficient was $\alpha = .85$.

9   v)   The social support scale required respondents to indicate how much support they

10   receive from family, sibling and friends to increase their physical activity

11   (Garcia *et al.*, 1995). The 24-item measure (6 items for each subscale measuring

12   social support provided by mother, father, siblings, and friends) uses a 3-point

13   scale (1 = never to 3 = often). The alpha coefficient of the separate social

14   support subscales for mother's support was .85, father's support .83, sibling and

15   peers ranged from .75 to .84.

16   vi)   The exposure to modeling scale was used to assess the respondents' perceptions

17   of the activity levels of significant others (Garcia *et al.*, 1995). Respondents

18   were asked to report how often their family members or peers performed light,

19   medium or hard physical activity. Responses were assessed on 12-items using a

20   3-point scale from 1 (never) to 3 (often). The 1-week test-retest reliability of the

21   exposure to models scale was $r = .80$ and the alpha coefficient was $\alpha = .84$.

22   vii)   Interpersonal norms refer to the expectations of significant others to participate

23   in physical activity (Garcia *et al.*, 1995). This was measured using four items on

24   a 3-point scale, with responses ranging from 1 (never) to 3 (often). One week

1   test-retest reliability for the interpersonal norms scale was $r = .75$ and the alpha

2   coefficient was $\alpha = .72$.

3 viii)   The commitment to physical activity planning measure includes a variety of

4   strategies individuals use to increase physical activity, such as goal setting and

5   activity monitoring (Pender, 2007). Respondents are asked to indicate how often

6   they use a variety of strategies to increase their exercise adherence, example

7   item, "I plan specific times for exercise or active sports in my weekly schedule".

8   The 11-tem scale was scored from 1 (never) to 3 (often). The alpha coefficient

9   for the study sample was $\alpha = .86$ and the 2-week test-retest reliability of the

10   scale was $r = .90$.

11 ix)   Competing demands are viewed as alternative behaviors (e.g., watching

12   television) with powerful reinforcing properties that can derail a health

13   promoting behavior in favor of the competing behavior and measured by a scale

14   based on Pender's instrument for measuring variables in the health promotion

15   model (Pender, 2007). The 9-item scale contains two choices (A = preferences

16   and B = physical activity). The higher the score on the preferences measure, the

17   more likely preferences will interfere with physical activity. The Cronbach's

18   alpha coefficient on preferences subscale was .83 for this study.

19 *Statistical analyses*

20   Means and standard deviations were calculated using SPSS, version 14 (SPSS

21 Inc., Chicago IL). The proposed model of behavior change was explored using

22 observed variable maximum likelihood (ML) analysis in AMOS 17.0 (SmallWaters

23 Corp., Chicago IL). Model fit was assessed using a number of indices, including chi-

24 square index, goodness-of-fit index (GFI), adjusted goodness-of-fit (AGFI), root mean

25 square of approximation (RMSEA), normed fit index (NFI), comparative fit index (CFI)

1 and parsimonious normed fit index (PNFI). The chi-square tests the null hypothesis that

2 the model is a good fit of the data. While a nonsignificant chi-square result ($p > .05$)

3 indicates that the model is a good fit, it is too sensitive to sample size (Bollen, 1989), as

4 a result additional measures are often used. The GFI provides an estimate of the

5 proportion of variance in the variance-covariance matrix accounted for by the proposed

6 model. GFI scores range from 0 to 1, a score exceeding .9 indicates a good fit. The

7 AGFI provides a GFI score adjusted for the number of parameters in the model. The

8 RMSEA estimates closeness-of-fit compared to the saturated model. RMSEA of .08,

9 .05 and 0 indicates adequate, close and exact fits, respectively (Hu & Bentler, 1999).

10 The NFI is the difference between the two models' chi-squares divided by the chi-

11 square of the independence model. The CFI provides a similar measure, but is

12 independent of sample size. For both the NFI and the CFI, values range from 0 to 1,

13 with scores exceeding .9 indicating a good fit. The PNFI provides a measure of model

14 parsimony. Scores range from 0 to 1, with higher scores indicating a more parsimonious

15 model. Age was included in both models to account for the age-related differences in

16 physical activity among adolescent boys in the sample.

17 **Results**

18   Descriptive statistics for the study variables are reported in Table 1 and

19 correlations among all variables are reported in Table 2. Because it could be justified on

20 theoretical grounds, the interpersonal and psychological variables were correlated in the

21 model. For ease of reading, the correlations among psychological (benefits, barriers,

22 self-efficacy) and interpersonal variables (interpersonal norms, exposure to models,

23 father, mother, sibling and peer support) are not included in Figures 1 and 2

24   The Health Promotion Model (HPM) for adolescent boys is presented in

25 Figure 1. In accordance with the proposed model, commitment to planning was

1 associated with self-efficacy ($\beta = .13$, $p < .01$), enjoyment ($\beta = .14$, $p < .05$), perceived

2 benefits ($\beta = .20$, $p < .001$), PA modeling ($\beta = .19$, $p < .001$), PA norms ($\beta = .15$, p

3 $< .001$), mother social support ($\beta = .12$, $p < .01$), and father social support ($\beta = .16$, $p <$.

4 01). Commitment to planning was associated with PA ($\beta = .14$, $p < .05$). There were

5 significant pathways between PA and self-efficacy ($\beta = .25$, $p < .001$), enjoyment ($\beta =$

6 $.22$, $p < .01$), and PA modeling ($\beta = -.13$, $p < .05$). Competing demands was not

7 associated with PA. The model accounted for 37% of the variance in PA, but did not

8 represent a good fit of the data, $\chi^2 = 913.85$, $df = 473$, $p < .001$, GFI (goodness-of-fit) =

9 $.85$, AGFI (adjusted goodness-of-fit) = $.63$, RMSEA (root mean square of

10 approximation) = $.20$, [90% confidence interval = $.19$ to $.21$], NFI (normed fit index) =

11 $.84$, CFI (comparative fit index) = $.84$, PNFI (parsimonious normed fit index) = $.40$.

12 Filled-in lines represent significant pathways, dotted lines represent non-significant

13 pathways ($p \geq .05$).

14   In the first model, the relationship between competing demands and physical

15 activity was not statistically significant. Based on the relationships identified in the

16 bivariate correlations, it was hypothesized that competing demands might mediate the

17 relationship between psychological constructs and physical activity behavior. A revised

18 model based on this hypothesis explained 34% of the variance in PA and represented a

19 good fit to the data, $\chi^2 = 9.12$, $df = 4$, $p = .058$, GFI (goodness-of-fit) = $.1.00$, AGFI

20 (adjusted goodness-of-fit) = $.96$, RMSEA (root mean square of approximation) = $.05$,

21 [90% confidence interval = $.00$ to $.09$], NFI (normed fit index) = 1.00, CFI (comparative

22 fit index) = 1.00, PNFI (parsimonious normed fit index) = $.14$. In this model, perceived

23 benefits ($\beta = -.28$, $p < .001$), enjoyment ($\beta = -.42$, $p < .001$) and father support ($\beta = -.12$,

24 $p < .01$) were associated with competing demands, which in turn was associated with

25 commitment to planning ($\beta = -.29$, $p < .001$). Self-efficacy ($\beta = .28$, $p < .001$),

1 enjoyment (β = .26, p < .001), and commitment to planning (β = .13, p < .05), were all

2 directly associated with physical activity.

3 **Discussion**

4   This study is the most comprehensive evaluation of Pender's Health Promotion

5 Model (HPM) in an attempt to explain physical activity behavior. Although the model

6 explained 37% of the variance in physical activity, the model did not represent a

7 'good fit' of the data. A revised model explained 34% of the variance and explored

8 the indirect effects of competing demands on physical activity behavior.

9   In the full model, self-efficacy, enjoyment and exposure to models exhibited

10 direct effects on physical activity. There were also indirect effects from self-efficacy,

11 enjoyment, and perceived benefits, through commitment to planning for physical

12 activity. This is consistent with the Pender's Health Promotion Model that behavior-

13 specific cognitions and related affect can have both direct and indirect effects on

14 physical activity (Pender, Murdaugh, & Parsons, 2002). The findings from this study

15 support the importance of perceived self-efficacy and commitment to planning for

16 Iranian adolescent boys, suggesting that a high level of self-efficacy is associated with

17 similarly high levels of physical activity planning. Other researchers have found that

18 self-efficacy is a consistent predictor of physical activity behavior in adolescents (e.g.

19 McAuley & Blissmer, 2000, Sallis, Prochaska, & Taylor, 2000).

20   In the current study, interpersonal norms, exposure to models, social support

21 from father and mother were associated with commitment to planning. Exposure to

22 modeling was the only social variable related to physical activity. However, the

23 relationship was inverse, indicating that adolescent who reported higher levels of

24 exposure to modeling were less active. In the current study, the exposure to modeling

25 construct did not differentiate between modeling from parents, siblings and peers. It is

1   possible that the modeling of physical activity behavior has a different impact

2   depending upon the individual modeling the behavior. For example, Iranian

3   adolescents who have older brothers or sisters who are talented sportspeople may be

4   discouraged from participating in physical activity due to feelings of inadequacy. This

5   may explain the negative association between physical activity and modeling. Two

6   previous reviews concluded that modeling from parents was not related to adolescent

7   physical activity (Sallis *et al.*, 2000; Van der Horst, Paw, Twisk, & Van Mechelen,

8   2007), but less is known regarding the influence of physical activity modeling by

9   siblings and peers. It is also possible that exposure to modeling exerts an influence on

10   physical activity indirectly through self-efficacy.

11   Both mother and father support were indirectly associated with physical

12   activity through commitment to planning. However, in Iranian culture, it is fathers,

13   rather than mothers, who are more likely to participate in activity with boys and watch

14   them participate in a sport. Our finding provides support for the utility of targeting

15   father support as a means of indirectly increasing the physical activity of adolescent

16   boys. In the literature, the association between interpersonal influences and physical

17   activity among youth is inconsistent (Sallis, Prochaska, & Taylor, 2000). Wu and

18   colleagues' study indicated that peer support was directly related to physical activity

19   and like our results there was also an indirect path from peer support to physical

20   activity through self-efficacy (Wu, Pender, & Noureddine, 2003). In the same study,

21   there was no significant path from parent support to physical activity in Taiwanese

22   males. This result is contrary to the findings of others who have found both direct and

23   indirect influences of social support on physical activity behavior in adolescents

24   (Motl, Dishman, Saunders, Dowda, & Pate, 2007; Trost *et al.*, 2003). Other

25   researchers have investigated the specific providers and types of social support that

1   are important for adolescents (Beets, Vogel, Forlaw, Pitetti, & Cardinal, 2006). These

2   findings suggest that it is important to differentiate between parents, as the types and

3   volume of support offered by parents are very different. Beets and colleagues (2006)

4   found that boys received equal amounts of social support from both parents in terms

5   of watching them be active and reinforcement, but were more likely to be transported

6   to physical activity opportunities by their mothers. Wilson and Dollman (2007) found

7   that Anglo and Vietnamese-Australian boys reported more social support from their

8   fathers than their mothers, in terms of playing and encouragement. An important

9   contribution of this research was the examination of social support from four distinct

10   sources (mother, father, sibling and friends).

11   Commitment to planning showed a direct effect on physical activity and there

12   were positive associations between perceived self efficacy, benefits, enjoyment and

13   social support from father in both models. Furthermore, there was a significant

14   inverse relationship between commitment to planning and competing demands in the

15   competing demands in the second model. This is consistent with the Pender's HPM

16   hypothesis and some research with adolescents. For example, an increase in the use of

17   self-management strategies mediated the effects of a physical activity intervention for

18   Iranian adolescent girls (Taymoori & Lubans, 2008). However, a recent physical

19   activity intervention for adolescent girls found that changes in goal setting did not

20   mediate the effects of the intervention (Dishman et al., 2004). The relationships

21   between commitment to planning, psychological variables and physical activity in the

22   current study suggest that future research should explore the role of self-management

23   strategies in the prediction of physical activity behavior.

24   The competing demands construct is one of the unique features of the HPM.

25   Competing demands are viewed as alternative behaviors (e.g. watching television)

1   that can derail health promoting behavior in favor of the competing behavior. In the

2   first model, competing demands were not significantly associated with physical

3   activity. However, in the revised model competing demands were inversely related to

4   commitment to planning. This finding suggests that competing demands might exert

5   their influence on physical activity indirectly through commitment to planning. Wu

6   and colleagues also did not find a negative association between physical activity and

7   competing demands for Taiwanese adolescents, although they did not explore gender

8   differences (Wu & Pender, 2002). Time spent in unproductive sedentary behaviors

9   (e.g. watching TV, playing computer games) is the competing demand that is of most

10   concern. It has often been assumed that physical activity and sedentary behavior share

11   an inverse and causal relationship (Marshall, Biddle, Gorely, Cameron, & Murdey,

12   2004). The displacement hypothesis proposes that time spent in sedentary pursuits,

13   such as TV watching and computer games replaces time spent in physical activity

14   (Biddle, Gorely, Marshall, Murdey, & Cameron, 2004). However, the relationship

15   between time spent in sedentary behaviors and physical activity in youth is

16   indeterminate (Sallis et al., 2000) and it appears that many young people can be very

17   active and still engage in large amounts small screen entertainment. For example,

18   changes in television viewing were not associated with changes in leisure-time

19   moderate/vigorous physical activity in a recent longitudinal study (Taveras et al.,

20   2008). However, a number of interventions have found that targeting sedentary

21   behavior is an effective strategy for increasing physical activity and reducing obesity

22   in children and adolescents (Epstein, Paluch, Gordy, & Dorn, 2000; Gortmaker *et al.*,

23   1999; Salmon, Ball, Hume, Booth, & Crawford, 2008).

24   There are several possible explanations for the lack of a negative association

25   between competing demands and physical activity in this study. First, it is possible

1   that the competing demands measure could not assess all potential competing

2   demands in the study sample and a more culturally sensitive measure is required.

3   Second, another possible explanation is that the boys in the study sample were

4   confident of their ability to control their desire for competing demands. Third, as

5   identified in the second model, competing demands might exert an influence on

6   physical activity through commitment to planning. Finally, the competing demands

7   construct may be redundant and its inclusion in a model to explain health behavior is

8   unnecessary.

9   There were several limitations of the present study. First, the data were

10   measured by self-report questionnaire and it is possible that responses were biased

11   due to self-presentational concerns. Second, we did not include all of the potential

12   determinants from the HPM (e.g. situational influences and biological outcomes).

13   Another limitation is the cross-sectional nature of the study which makes it impossible

14   to conclude about antecedents of successful exercise behavior change. Adolescents

15   may make behavioral choices during this developmental period that contribute to

16   lifelong behavioral patterns however longitudinal studies are needed to research this

17   area. Another possible limitation is that although all participants in this study did

18   report on sibling social support (indicating that they had at least one sibling) the

19   nature of siblings (e.g., age, gender, number) of the participants in this study was not

20   addressed. Thus, because of the mixed findings across the literature, further research

21   is necessary to clarify the role that siblings may play in physical activity behavior in

22   Iranian adolescent boys.

23   Although this study has provided important information regarding the

24   correlates of physical activity behavior in a sample of Iranian adolescent boys, we can

25   only hypothesize the direction of causality between constructs. Basing theoretical

1 models on cross-sectional data may lead to erroneous conclusions regarding causal

2 pathways. Longitudinal studies that evaluate changes in constructs and physical

3 activity over time are needed to determine the actual relationship between variables.

4 Few studies have examined potential mediators of physical activity behavior among

5 youth (Lubans, Foster, & Biddle, 2008). Future studies should explore causal

6 pathways using mediation analyses in longitudinal studies to identify mediators and

7 moderators of physical activity behavior in specific populations. Finally, an issue with

8 structural equation modeling that there are always potential models that might fit

9 better and one should therefore as far as possible compare alternative models. While it

10 appears that Pender's HPM may not be an appropriate model to explain health

11 behavior in the study population, a revised model that included the indirect effects of

12 competing demands was a better fit to the data.

13 *Implications for Practice*

14   In conclusion, similar to research with other cultural groups (e.g. McAuley &

15 Blissmer, 2000; Wu et al., 2003) self-efficacy was the strongest predictor of physical

16 activity with this population. Enjoyment and commitment to planning were also

17 important correlates of physical activity in the study sample. Thus, interventions

18 designed to increase physical activity behavior with Iranian boys should address these

19 issues. Overall, the boys in the present study were active less than one hour per day

20 which is lower than recommended guidelines (United States Department of Health &

21 Human Services, 2008) thus interventions are needed to help understand how best to

22 increase physical activity with this population. This research is therefore important

23 because it tests the fit of two models that can be used to develop interventions for

24 increased physical activity with Iranian adolescent boys.

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1   **Table 1: Study measures and descriptive statistics for study participants**

2   **Table 2: Correlations among variables in the study sample**

3   **Figure 1: Standardized parameter estimates for The Health Promotion Model**

4   **for Iranian adolescent boys**

5   **Figure 2: Standardized parameter estimates for a revised model based including**

6   **the indirect effects of competing demands**

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