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FITNESS/PHYSICAL ACTIVITY

Relationship Between Health-Related Fitness Knowledge, Physical Activity Intensity, and Activity Levels in High School Students

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Abstract

The purpose of this study was to explore the relationship between health-related fitness knowledge (HRFK) and various intensity and activity levels of physical activity in male and female high school students. At the end of a Fitness for Life course, high school students (N = 280) completed a HRFK questionnaire and the Leisure-Time Physical Activity Questionnaire (Godin & Shephard, 1985). Pearson correlations were computed among physical activity levels (mild, moderate, and strenuous). A one-way MANOVA with appropriate follow-up univariate ANOVAs examined the effect of gender on physical activity intensity scores (total, healthy, and strenuous). A one-way ANOVA examined the difference in HRFK scores between the active group and the less active group. Results showed no significant correlation between HRFK and all physical activity scores. Females had higher HRFK scores and males had higher physical activity scores for all intensity levels. Ninety-two percent of all students were classified as active and males were more active than females. There was no significant difference in HRFK scores between the active group and the less active groups.

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Many people believe that engaging in physical activity (PA) is vital in helping to prevent obesity and its attendant diseases (Rogers et al., 2008). PA provides beneficial effects for overweight youth, blood pressure in hypertensive individuals, bone mass, cardiorespiratory health, and psychological well-being (Trost & Loprinzi, 2008). For several years, physical education programs in schools have been recommended as the ideal means for promoting lifetime activity in the adolescent population (Sallis et al., 2012). Yet while physical education should promote lifetime PA, the traditional sports-based physical education programs often offered in schools have had limited success in achieving this aim (Dale & Corbin, 2000; Pangrazi, 2010).

Conceptual Physical Education

To tackle this problem, many high schools in the United States have introduced conceptual physical education (CPE) with a health promotion emphasis as a curricular model (Ayers, 2004). Such CPE courses generally include lessons that teach important health and fitness concepts linked with activity sessions that teach application of these principles and also individual fitness assessments, self-monitoring skills, and fitness programming (Dale & Corbin, 2000). The belief behind the development of CPE is that if students gain knowledge about health-related fitness benefits, they will be more likely to develop good attitudes toward PA and choose more active lifestyles than people not exposed to such information (Goldfine & Nahas, 1993). Indeed, Ennis (2010) suggested that teaching fitness knowledge in physical education is crucial in encouraging lifetime PA.

Some research has examined how high school CPE relates to student health-related fitness knowledge (HRFK), attitudes toward PA, and PA behaviors. Goldfine and Nahas (1993) studied an implemented CPE versus traditional physical education at the high school level and found that CPE was related to better HRFK and more positive student attitudes toward PA. However, there was no difference in PA behaviors between the two groups.

Ferguson et al. (1989) found no relationship between middle school students' HRFK and PA exercise intention. Similarly, Haslem et al. (2016), using structural equation modeling, examined the relationship between student HRFK and overall PA associated with

participating in a Fitness for Life course (a state requirement in high schools), but found none. Conversely, however, DiLorenzo et al.'s (1998) study with eighth- and ninth-grade students found that exercise knowledge was a predictor of PA for both males and females.

CPE Using Fitness for Life

The *Fitness for Life* (Corbin & Le Masurier, 2014) textbook provides extensive CPE course materials that were used in this study. It is just one example of CPE courses that are being taught in high schools in the United States. The aim of the Fitness for Life course is to help students develop the knowledge, skills, and dispositions needed to make effective decisions about personal fitness and wellness. Another study (Thompson & Hannon, 2012) revealed no gender differences on HRFK and PA in high school students who had completed a Fitness for Life course. However, there was a moderate, positive correlation between HRFK and PA; that is, students who scored higher on the HRFK test were also more physically active.

Activity and Intensity Levels of PA

In Thompson and Hannon's (2012) study, the researchers also looked at specific activity levels (frequency of participation) in activities that made students breathe hard. They classified students who had scores of 1–2 on the Physical Activity Questionnaire for Adolescents as low active, scores of 3 as moderately active, and scores of 4–5 scores as high active. They found significant HRFK score differences between low active students and moderately active students, and between low active students and high active students, meaning students with greater HRFK reported higher PA levels.

Other research has also focused on specific activity levels. In Dale et al.'s (1998) study, they classified students as active if they engaged in moderate activity 5 days/week, vigorous activity 3 days/week, muscle fitness 3 days/week, and flexibility 3 days/week. Students were defined as sedentary if they engaged in moderate activity 0–2 days/week and vigorous activity 0–2 days/week. Two groups of ninth graders (CPE and traditional PE) were examined for any lasting effects of these courses on student PA behaviors over the next 3 years of high school. They found that females who had taken CPE in Grade 9 were more active after Grade 11 in strength activities than females in the traditional physical education group and less likely to report

sedentary behaviors. They also found that males in Grade 12 who had taken CPE 2 years earlier participated in moderate activity more than males in traditional physical education.

In a follow-up study, Dale and Corbin (2000) used the same active classification (excluding the flexibility component). Sedentary was classified as 0 days of moderate and vigorous activity. They studied the same students as used by Dale et al. (1998) after those students had graduated from high school and results showed more males from the original CPE group reported they were vigorously active 12 months beyond graduation compared to the group that originally took traditional physical education (Dale & Corbin, 2000). However, in neither study did they examine the relationship of HRFK to PA rates.

Looking specifically at PA intensity levels, Keating et al. (2010) examined HRFK and its relationship to PA levels of intensity with a college population. The levels were specified as vigorous PA, moderate PA, and light PA. They found no significant HRFK differences in any of the levels of PA.

Because research concerning high school CPE and its resultant HRFK as it relates to students' activity and intensity levels of PA is scant and shows mixed results, the relationship between these factors should be more thoroughly examined. Therefore, the purpose of this study was to explore the relationship between HRFK and various intensity and activity levels of PA across male and female high school students.

Method

Participants

This study was conducted in a state in the Intermountain West of the United States that requires high school students to take a Fitness for Life course. Participants were students enrolled in Fitness for Life courses in five high schools in two school districts. Two hundred eighty high school students (125 males, 155 females) were just completing a Fitness for Life course. Participants ranged in age from 15 to 18 years (M = 16) and were Caucasian (n = 224, 80%), Hispanic (n = 36, 12.8%), Asian (n = 8, 2.9%), Pacific Islander (n = 7, 2.5%), and African American (n = 5, 1.8%). Thirty-one percent of the students were on free or reduced lunch.

The teachers (4 men, 4 women) of the Fitness for Life courses had teaching experience that ranged from 6 to 26 years ($M = 13$). All of them said they taught the material outlined in the *Fitness for Life* textbook during the course and used a blend of lecture (four teachers taught HRFK in a classroom and the remaining four teachers taught HRFK in the gym) and lab activities in the gym. The time spent on lectures varied from 15% to 60% ($M_{time} = 28\%$) of total teaching, with the rest of the time spent on lab activities. We made no attempt to intervene in the way the Fitness for Life course was taught.

Instruments

Two instruments were used in this study in the assessment of student HRFK and PA behaviors.

Health-Related Fitness Knowledge Questionnaire

The Health-Related Fitness Knowledge Questionnaire (HRFKQ) consisted of 22 multiple-choice questions (each question was worth 1 point) selected from the Fitness for Life test bank. Each question focused on practical application of the five components of health-related fitness: cardiovascular fitness, flexibility, muscular strength, muscular endurance, and body composition (Corbin & Lindsey, 2005). Here is an example of a stem: "National guidelines state that teenagers should engage in vigorous activity for." The student selects the answer from four choices, and in this example, the answer is "20 minutes, 3 or more times per week." The student's score out of 22 possible points was used as the HRFK score in analysis. According to Thompson and Hannon (2012), the HRFKQ is a valid instrument for measuring HRFK because the items were developed by the creators of the Fitness for Life curriculum and therefore had high content and face validity.

Leisure-Time Physical Activity Questionnaire

The Leisure-Time Physical Activity Questionnaire (LTPAQ; Godin & Shephard, 1985) measures PA behavior by a self-reported 7-day recall. The individual records the number of times that they engage in PA of varying intensity, that is, strenuous, moderate, and mild, during a typical week. Several researchers have confirmed the validity of the LTPAQ and stated reliability of alpha greater than .74 (see Godin & Shephard, 1985; Sallis et al., 1993). Student responses

were also calculated to determine three scores: a weekly Total PA score (mild, moderate, and strenuous PA combined), a Healthy PA score (moderate and strenuous PA combined), and a strenuous PA score as specified by Godin (2011). Godin stated that scores greater than or equal to 24 indicate an individual is active, between 14 and 23 moderately active, and less than 14 insufficiently active.

Procedures

Prior to the study, the university's Institutional Review Board, both school districts, and all principals at the participating high schools gave approval for the study. The Fitness for Life teachers attended a training seminar so they would know their role in distributing consent/assent forms and in administering each of the questionnaires to their students. Parental consent and child assent forms were obtained from students who volunteered to be part of the study and complete the questionnaires.

The Fitness for Life teachers administered the HRFKQ 2 weeks before the course finished. The LTPAQ was administered 1 week later. During the time the questionnaires were being administered, students who did not volunteer for the study completed an alternative assignment. Also, during this time, we carried out procedural checks by making random visits to the schools to ensure the appropriate protocol was being followed regarding administration of questionnaires.

Data Analysis

Data were entered into a Microsoft Excel file and missing data were dealt with using a list-wise deletion. We used IBM SPSS Statistics for Windows version 25 (2017) to analyze the data. Means and standard deviations were computed for all dependent variables. Pearson correlations were computed among the three levels of LTPAQ PA (mild, moderate, and strenuous) so that we could assess the strength and direction of their relationship to HRFK. A one-way MANOVA and follow-up univariate ANOVAs for post hoc comparisons were computed so that we could examine the gender effect on PA intensity scores (total PA, strenuous PA, and healthy PA). Effect sizes were calculated for each significant difference using eta-squared.

Substantial health benefits occur when students are active (24 units or more), as defined by Godin (2011), that is, when only

moderate and strenuous PA is used in the LTPAQ calculation. There were not enough numbers in either the moderately active group (14 to 23 units) or insufficiently active group (less than 14 units) to have statistical power, so we combined these two groups (labeled less active). A one-way ANOVA was calculated to find out if there was a significant difference in HRFK scores between the active group and the less active group.

Results

Table 1 shows the correlation matrix. There was no significant correlation between HRFK and strenuous PA, moderate PA, and mild PA. There were significant positive, moderate correlations between strenuous PA and moderate PA and between moderate PA and mild PA. There was a significant positive, weak correlation between strenuous PA and mild PA.

Table 1
Bivariate Correlations Among Health-Related Fitness Knowledge and Physical Activity Levels for All Students

Variable	1	2	3	4
Strenuous PA	_			
Moderate PA	.30**	_		
Mild PA	.12*	.54**	_	
HRFK	-.09	-.00	.10	_

* $p = < .05$. ** $p = < .01$.

Table 2 shows the descriptive statistics (means and standard deviations) for the dependent variables. The average HRFK score was 13.49 (61%) for all students. Results of the one-way MANOVA that examined the effect of gender on the HRFK, total PA, healthy PA, and strenuous PA scores revealed a significant effect, Wilks' Λ (4, 275) = .841, p = .000. Follow-up univariate ANOVAs indicated a significant gender difference for HRFK, $F(1, 278) = 29.31$, p = .000, η^2 = .1; total PA, $F(1, 278) = 8.56$, p = .004, η^2 = .03; healthy PA, $F(1, 278) = 11.90$, p = .001, η^2 = .04; and strenuous PA, $F(1, 278) = 19.72$, p = .000, η^2 = .07. Green and Salkind (2005) proposed that eta-squared values of .01, .06, and .14 could be interpreted as small, medium, and large effect sizes, respectively.

Table 2
Descriptive Statistics for HRFK and Physical Activity Levels

	All students				Males		Females	
Variable	***M***	***SD***	**Skewness**	**Kurtosis**	***M***	***SD***	***M***	***SD***
HRFK	13.49	3.83	-.515	.033	12.18	3.75	14.55***	3.56
Total PA	68.26	33.17	1.803	6.999	74.63**	40.31	63.12	25.01
Healthy PA	54.31	28.35	1.76	7.48	60.70**	33.65	49.16	22.02
Strenuous PA	33.69	22.83	2.40	13.27	40.22***	26.90	28.42	17.29

Note. HRFK points possible = 22. Total PA (via LTPAQ) responses were calculated as a total leisurely activity score using strenuous, moderate, and mild PA scores. Healthy PA (via LTPAQ) uses only strenuous and moderate PA scores. Strenuous PA (via LTPAQ) uses only strenuous PA scores.
**$p < .01$. ***$p < .001$.

Female students had significantly higher HRFK scores (M = 14.55, 66%) than males (M =12.18, 55%). Male students had significantly higher PA scores than females for total PA, healthy PA, and strenuous PA.

In this study, 92% of all students were classified as active, and results of a one-way ANOVA revealed males were significantly more active than females, $F(1, 255) = 15.06$, $p = .000$, males ($M = 64.8$, $SD = 31.80$) and females ($M = 52.03$, $SD = 20.71$). Results of a one-way ANOVA showed no significant difference in HRFK scores between the active group ($M = 13.54$, $SD = 3.74$) and the less active group ($M = 12.96$, $SD = 4.70$), $F(1, 278) = .485$, $p > .05$.

Discussion

The aim of this study was to explore the relationship between HRFK and various intensity levels of PA and activity levels of PA across male and female high school students. First, we would like to address the HRFK scores in this study. Even though we used application-oriented questions taken from the Fitness for Life test bank, a valid source (Thompson & Hannon, 2012), we were disappointed with the low HRFK test scores (mean score was 61%), as it seemed to indicate a lack of course effectiveness. Low HRFK scores following a Fitness for Life course were also reported by Thompson and Hannon (2012), who noted a lower average score of 42%, and by Stewart and Mitchell (2003), who reported a mean score of 57% on a cognitive test of fitness concepts. The low HRFK scores in this study reveal a curricular and pedagogical concern about what material is being covered, how these courses are being taught, and the lack of teacher accountability regarding this issue. Females had higher HRFK scores than males, which is in line with the findings of Keating et al. (2009) but differs from the findings of Thompson and Hannon (2012) and Ferkel et al. (2015), who both found no gender difference, though the latter research was with a college population.

The results of the study showed no relationship between HRFK and all intensity levels of PA as designated in this study. This is supported by previous research findings when no intervention was used (Haslem et al., 2016; Keating et al., 2010) but is in contrast to other studies that found significant relationships (Dale & Corbin, 2000; Dale et al., 1998). The latter two studies used an intervention with the researchers helping to create the CPE courses used in their research.

It seems that when HRFK is being taught, content and pedagogy are crucial in helping students make the connection between what they are learning regarding HRFK and their choice of PA intensity levels.

In this study, there was also no difference in HRFK scores between activity levels (active and less active groups), in contrast to other research findings (Dale & Corbin, 2000; Dale et al., 1998; Thompson & Hannon, 2012). Dale and Corbin (2000) and Dale et al. (1998) used an intervention, as previously mentioned. This study and Thompson and Hannon's (2012) study did not involve researcher intervention in how HRFK was taught in the schools, leaving it to the teachers regarding both content and pedagogy, but whereas the current study found no relationship between HRFK scores and activity levels, Thompson and Hannon found significant HRFK score differences between the low active group and moderately active group and between the low active group and high active group. In all, it seems evident that different uncontrolled pedagogical approaches revealed mixed results.

According to Godin's (2011) definition, the majority of the students in this study (92%) were classified as active. In contrast with the children and adolescents in Sallis et. al (1993), who used the LTPAQ and other PA self-reports, the males in this study were more active and the females slightly less active than the students in their study. The population in this study was possibly more active than normal.

Godin (2011) did not use mild PA scores from the LTPAQ for the calculations of his active and inactive categories. For the correlations in this study, the moderate positive correlation between mild PA and moderate PA indicates that engaging in mild PA is related to participation in moderate PA and therefore perhaps should not be ignored. Engaging in mild PA could help motivate students to take their activity up a notch and participate in moderate PA.

The males had higher scores for total PA than the females, which is in line with some research (Taymoori & Lubans, 2008; Trost et al., 2002; U.S. Department of Health and Human Services, 1996), but differs from Thompson and Hannon's (2012) finding of no gender differences. The males also engaged in more healthy PA and strenuous PA than the females in this study.

Conclusion

Overall, the findings in this study expand on existing knowledge concerning the relationship of HRFK and PA. There are still mixed results from research on HRFK. With such an active population in this study, further research is needed to see if HRFK affects less active populations rather than active ones. A common thread in HRFK research is how poorly students do on HRFK tests. There needs to be a focus on optimizing the pedagogy regarding what and how material is taught, and the seeming disconnect between HRFK and reported PA behaviors in CPE students needs to be addressed.

Future studies, including longitudinal studies, could consider pre–post testing of HRFK and PA. A limitation of this study is that some self-reported data about PA may be different than actual student PA.

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