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An Analysis of Perception vs. Reality in Physical Fitness and the Effect of Fitness Testing on Physical Activity in College Students

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Overall physical fitness level is well documented as a good indicator of certain health outcomes (Blair, Cheng, Holder, Barlow, & Kampert, 2001). There are also many benefits to physical activity beyond health factors. For example, there is a significant correlation between amount of physical activity and fitness, and academic performance in students (Chomitz et al., 2009). One of the major benefits for young populations is that it is socially desirable for both men and women to be toned and thin, and physical appearance has increasingly become an indication of social value (Wright, O'Flynn, & MacDonald, 2006). Societal desire for this idealized body type has caused a push in the media for physical fitness and healthy lifestyles. Because of the many benefits of physical activity, people generally desire to look fit.

Physical fitness is comprised of five main components; body composition, flexibility, muscular strength, muscular endurance and aerobic capacity (Thompson, 2014). Body composition describes the makeup of a person's body based on the relative percentage of fat, muscle and water in their body (Riebe, Ehrman, Liguori, & Magal, 2018). Flexibility is a joint's ability to move through a range of motions (Riebe et al., 2018). Muscular strength is defined as a muscle's ability to exert a maximal force one single time, and muscular endurance is a muscle's ability to exert a submaximal force over a period of time (Riebe et al., 2018). Finally, aerobic capacity is the ability of the respiratory, cardiovascular and muscular systems to work together and perform exercise for a prolonged period of time (Riebe et al., 2018). Performance in each of these five categories is used to determine a person's overall fitness level and can be compared to others of the same age and sex. Risks for certain health implications can be estimated by comparing a person's results from each of the five components of fitness to others of the same age and sex.

Each of the previously mentioned components of fitness have certain health implications associated with them. High levels of body fat are connected to increased risk for cardiovascular disease, diabetes, certain cancers and osteoporosis (Kuriyan, 2018). Furthermore, there is evidence that the location of the fat is a more accurate indicator of specific disease risk than the presence of body fat itself (Lee et al., 2018). Muscular strength is inversely related to risk of cancer and to risk of death from all causes (Sofi et al., 2008). Additionally, handgrip strength is significant in the ability to perform activities of daily living, such as opening jars and holding objects (Wearing, Stokes, & de Bruin, 2019). The anaerobic energy systems associated with muscular strength and endurance provide the energy used to initiate any movement and increased levels of strength and endurance have been shown to alter loss of strength with aging, previously viewed as unavoidable (Cahill, Misner, & Boileau, 1997). Flexibility of the joints allows for movement, which is important for the ability to perform activities of daily living and may prevent certain injuries (Riebe et al., 2018). Aerobic capacity has been inversely associated with increase in death from all causes and specifically, death from cardiovascular disease (Riebe et at., 2018). Engaging in 150 minutes of moderate-to-vigorous physical activity per week has been proven to improve overall health and quality of life (Sallis, 2015). Fitness testing in physical education classes is intended to promote a lifetime of physical activity (Barton et al., 2016). Fitness testing in college students has the same goal.

Physical activity and fitness are both important to overall health, as they directly relate to certain health risks. Physical activity is any movement of the body that requires energy, whereas physical fitness is a measure of how well a person can carry out activities (Caspersen, Powell, &

Christenson, 1985). Physical activity is a behavior, whereas physical fitness is an outcome of that behavior. In most cases, increased physical activity levels lead to an increase in physical fitness (Blair et al., 2001). Previous testing with college students has shown that students with lower levels of activity have higher rates of obesity and negative health outcomes (Desai, Miller, Staples, & Bravender, 2008).

Despite the importance of physical activity, people do not always make choices that lead to a healthy life. In a study examining physical activity of non-athlete students at Marshall University, a survey of 472 students found that while 99.6% of students believed that physical activity is beneficial, only 15.7% met the guidelines for moderate aerobic physical activity, only 8.5% for vigorous physical activity and only 37.9% met guidelines for resistance training (Stapleton et al., 2016). Results from a survey of 1044 students at a Midwestern university indicated that the most common self-reported barriers to exercise are a lack of time, energy and motivation, laziness and having other priorities (Ebben & Brudzynski, 2008). Because of the high rates of physical inactivity on college campuses, there is a need for the promotion of physical activity.

In an attempt to improve fitness and physical activity behaviors, there is a push for health assessments in various forms such as wearable fitness trackers and technology, Body Mass Index (BMI) assessments and on the University of Arkansas campus, health assessments through University Recreation. While these assessments are widely used and their ability to predict health implications is well established, it is currently unknown how they influence behavior or what kind of an impact increasing fitness education has on lifestyle choices in college students. In a study performed with youth tennis players ages 12 to 18, the results from aerobic endurance testing, anaerobic endurance testing, strength and power testing, speed and agility testing, and musculoskeletal testing indicated that an individual's results in each test could be used to create a specific training program that would cater to their weaker components and allow them to improve their overall performance (Fernandez-Fernandez, Ulbricht, & Ferrauti, 2014). Ideally, having accurate results from a fitness test will allow a participant to understand which components of physical fitness they need to improve on. This understanding could help them make changes to improve their overall health. Therefore, it is important to determine the ability of fitness testing to influence changes in intentions and behavior, in order to solidify the importance of fitness testing as a motivator of change.

It is true that a person's report of their expectations of fitness and physical activity levels may not always match their actual expectations, potentially due to self-report bias. This was exemplified in one study comparing self-reported physical activity to accelerometer data, where students tended to overestimate their physical activity levels (Downs, Van Hoomissen, Lafrenz, & Julka, 2014). In an experiment using 62 college students, participants were asked to fill out a health questionnaire as accurately as possible without measuring their actual height and weight and these numbers were used to calculate BMI, then height and weight were measured and compared to the self-reported data (Jacobson & Debock, 2001). The results showed that both men and women tended to overreport height and underreport weight, which altered the calculated BMI (Jacobson & Debock, 2001). A study performed at Illinois State University using 30 undergraduate students compared expectations of their physical fitness to their results on a fitness test (Monroe, Thomas, Lagally, & Cox, 2010). Perceived fitness was measured using the Body Fat, Endurance/Fitness, Flexibility, and General Physical Self-Concept subscales of the Physical Self-description Questionnaire along with an added muscular endurance section (Monroe et al., 2010). Body mass was measured using air displacement plethysmography, cardiorespiratory endurance was estimated using a submaximal treadmill test, muscular endurance was measured using a curl-up test, and flexibility was measured using the sit-and-reach test (Monroe et al., 2010). Comparisons were made between expected and measured fitness and they found that college students' perceptions were moderately related to their actual results, with body composition being the most accurate (Monroe et al., 2010). This study used a less accurate measure of percent body fat, a submaximal test to measure cardiac endurance and did not follow up with participants after the initial testing. Further research is needed using different versions of tests and analysis is needed to determine how the results of the fitness tests effect behavior over time. Overall, there is limited knowledge on whether college students are equally as fit as they believe themselves to be, or if discovering discrepancies in their understanding of their personal fitness will impact their behavior in the future.

While monitoring and fitness assessments are current strategies being used to promote physical activity, there are several factors that influence physical activity behavior, and ultimately fitness, such as a person's intentions. Intentions are indications of how willing a person is to make changes and how hard they are willing to try to make changes, and are the main determinant of behavior change (Murtagh, Rowe, Elliott, McMinn, & Nelson, 2012). According to the Theory of Planned Behavior, intentions are determined by three main things: attitude, subjective social norm and perceived behavioral control, which is their perceived ability to perform a behavior (Murtagh et al., 2012). People who are self-driven are more likely to be successful at making behavior changes regarding physical activity than those who are motivated by external sources (Nurmi, Hagger, Haukkala, Araújo-Soares, & Hankonen, 2016). Furthermore, a study using elementary school children found that children who are already obese are less confident in their ability to make behavior changes, are less likely to ask for help from parents in making changes, and choose activities that allow them to be sedentary over activities involving physical activity (Trost, Kerr, Ward, & Pate, 2001). Receiving poor results on a fitness test can be a negative experience, which reinforces the importance of encouraging participants and providing information that will allow them to realistically set goals for improvement. Because intentions are such a strong indicator of future behavior, it is important to understand a person's intentions to make changes regarding physical activity following a fitness test. This is especially true when working with people who are not already physically active.

A person's intentions must be altered in order to successfully cause a behavior change. There are 26 techniques that can be used to induce behavior change, including goal setting, providing information about other's approval, giving rewards and identifying barriers (Abraham & Michie, 2008). The five main techniques relevant to encouraging behavior change after fitness testing are providing information about behavior-health links, providing information on consequences, prompting intention formation, giving performance feedback and following up after the fitness test (Abraham & Michie, 2008). Many of these techniques aim to increase self-efficacy, which has consistently been positively associated with physical activity. Self-efficacy is someone's belief in their ability to achieve a goal and has been shown to be a determinant of activity over time (McAuley & Blissmer, 2000). Therefore, having an enhanced perception of self could lead to higher levels of physical activity and improved fitness. Understanding and using these intention changing techniques is important when using a fitness test as an intervention with hopes of causing behavior changes.

Therefore, the purpose of this study was to examine perceptions of fitness in college students and the effect fitness testing has on behavior. To gain a better understanding of how fitness and perceptions relate, results from Exercise is Medicine (EIM) fitness testing were analyzed and compared to the participant's expectations for their performance. EIM is an initiative being implemented on the University of Arkansas campus that looks at physical activity as a way to treat and prevent many medical conditions, and as a fundamental factor of a person's overall health (Sallis, 2015). By reviewing a participant's activity levels following the EIM fitness test, it was determined whether fitness testing had a significant impact on college student's behavior over time. Therefore, the purpose of this study was to:

1. Assess the degree to which perceptions of fitness are associated with measured fitness and,

2. To find out if and how intentions and behaviors change over time after receiving the results of a standardized fitness assessment.

Performing research in this area helped determine whether college students have an accurate understanding of their own fitness and whether fitness testing results play a significant role in future behaviors regarding fitness. By comparing students' perceived fitness to their actual results, it became clear that college students are not able to accurately assess their own fitness and fitness testing is necessary to inform them of their actual fitness levels. Monitoring physical activity one month following the EIM assessment showed how using physical assessments is an effective way to influence colleges students' intentions to make lifestyle changes. It was found that college students were unable to classify their own fitness levels and that fitness testing led to increased intentions to improve physical activity levels in participants.

Study Design:

The first aim of this study is a cross-sectional study which looked at a person's ability to estimate their own fitness level. The second aim is a Quasi-experimental research question - in which the participants' physical activity levels were measured before and after a fitness test intervention.

Participants:

A sample of 30 undergraduate students, ages 18 to 25, who were recruited by the Exercise is Medicine research team to participate in the in-person fitness assessment were selected to participate in further research. Participants were paid $10 after the final follow up to participate in this additional testing. Participants were all currently enrolled as undergraduate students at the University of Arkansas and were able to complete questionnaires in English. Approval from the Institutional Review Board of the University of Arkansas was obtained prior to the completion of any testing with human subjects and written and informed consent was obtained from each participant prior to any data collection.

Measures:

EIM Fitness Assessment. The Exercise is Medicine fitness assessment looks at the five components of fitness using Dual-Energy X-ray Absorptiometry, a hand-grip test, a sit-and-reach test, a push-up test and a maximal treadmill test using Bruce protocol. Body composition was analyzed using a Dual-Energy X-ray Absorptiometry (DXA) scan. The DXA machine analyzed the data and percent body fat was recorded. A hand-grip test was performed using a hand grip dynamometer to measure muscular strength. The participant was asked to stand, holding the dynamometer down at their side and to squeeze as hard as they could for five seconds, and this was repeated three times on each side and the highest from each arm was recorded (Riebe et al, 2018). To measure flexibility, the participant performed the Canadian Trunk Forward Flexion sit-and-reach test (Riebe et al., 2018). This test was performed three times and the highest score was recorded. A push-up test was used to measure muscular endurance. The participant was asked to complete as many push-ups as possible without resting or breaking proper form, according to the ACSM 10th edition (Riebe et al., 2018). This test was completed one time and the number of push-ups completed was recorded. To measure cardiorespiratory fitness, a maximal treadmill test was performed using the Bruce Protocol. This test involved measuring heart rate using a heart-rate monitor, the participant's rate of perceived exertion using a 6-20 scale, and blood pressure during each stage. Each stage lasted three minutes and at the end of each stage the incline and speed of the treadmill was increased. This continued until the participant elected to stop the test (Riebe et al., 2018). To reduce variation in external motivation between participants, researchers commented on a participant's effort levels, rather than performance on tests. Fitness testing occurred and results from each of these categories were classified using the American College of Sports Medicine guidelines, except body composition, which were classified as "lean," "normal," "moderate amount of excess body fat," or "obese" (Riebe et al., 2018).

Accuracy of fitness perceptions. Prior to any physical testing, participants were asked a series of questions regarding expectations for their performance on fitness tests that were loosely adapted from Self-Perceived Fitness Questionnaire by Rahmani-Nia, Damitchi, Azizi and Hoseini (2011) (see Appendix A). Data from the expectations survey were then compared to the students' fitness test results, which determined how accurate college students are at analyzing their own fitness levels.

Intentions and Self-Efficacy. Participants' intentions to make changes to their physical activity levels were measured before testing, after receiving their results, and one month after the fitness test. Questions asked before fitness testing and after each accelerometer use asked how ready participants were to make changes in their health at that time in five areas, such as physical activity and healthy eating. Two questions asked following each accelerometer use determined how results from the fitness test impacted perceived physical activity behavior (See Appendix B).

Physical Activity Behavior. Participants wore a GT9x accelerometer on their non-dominant wrist for 7 days to measure their physical activity levels. They were asked to go about their normal lives and to wear the accelerometer at all times, excluding during water-based activities, and to record any time the watch was not worn and sleep times on a log. Physical activity outcomes were mean counts per minute (CPM) and the average vector magnitudes of mean counts per minutes across the X, Y and Z axes. Physical activity levels during wake time were analyzed by two verifiers, using Actilife 6.13.3 software. Lights out and wake times from the participant log were cross validated using the Actilife Link (Darwent, Lamond, & Dawson, 2008). If the participant log conflicted with the Actigraph data, prolonged low activity at night were recorded as lights out time and the first sign of high activity in the morning was recorded as wake time. Sleep time and non-wear times were removed from analysis if they were recorded on the log, as well as any period of 0 CPM lasting longer than 60 minutes during wake time. At the end of that week, participants received a simplified report of their performance on the tests and returned the accelerometer. Approximately 4 weeks after the initial test, participants were contacted through email and asked to again wear an accelerometer for one week to measure physical activity levels, following the same guidelines. Accelerometer data was analyzed in the same way as the previous data.

Procedures:

Twenty-eight participants consented to the current study from participants in the Exercise is Medicine initiative on the University of Arkansas campus. Prior to fitness testing, they responded to a survey which included a section on intentions to make behavior changes in the future. Upon entering the research center and prior to any physical testing, participants were asked a series of questions about their perceptions of their own fitness and intentions to be physically active. Next, they completed five fitness tests in the following order: Dual-Energy X-ray Absorptiometry, hand-grip test, Canadian Trunk Forward Flexion sit-and-reach test, push-up test and maximal treadmill test using Bruce Protocol. Following the assessment, participants were given an accelerometer to wear for 7 days. After returning the accelerometer, participants completed a questionnaire regarding their intentions to be physically active. Four weeks later, they repeated wearing the accelerometer and the questions about intentions.

Statistical Analysis:

For the first aim, results from the perceptions questionnaire and the participants' fitness test results were compared using weighted kappa tests. For the second aim, an intentions questionnaire was administered before the assessment, after receiving results and approximately 4 weeks following fitness assessment. Responses from before and immediately after receiving results were compared and analyzed by a Wilcoxon matched-pairs signed rank test. Responses from immediately after receiving results were also compared to the responses from one month later to see if intention changes were sustained. To measure changes in physical activity, accelerometer data was analyzed using Wilcoxon matched-pairs signed rank tests to identify differences between daily activity levels prior to and approximately one month following the fitness test intervention and differences were used to determine behavior changes. The accelerometer data measured overall physical activity and recorded vector magnitude in counts per minute. Data was analyzed by looking at the average physical activity time per day to determine behavior changes as a result of fitness testing.

Results:

The study began with 14 males and 14 females with a median age of 21.75 and average percent body fat of 26.4%. Seventeen participants completed the final follow up.

Table 1. Fitness Perceptions vs. Actual Performance on Fitness Assessment

Measure	Percent Agreement	Agreement (weighted kappa (SE), p-value)
Body Composition	78.6%	0.37 (0.11), <.001
Muscular Strength	75.9%	0.19 (0.11), 0.04
Muscular Endurance	71.4%	0.33 (0.10), <.001
Flexibility	72.3%	0.25 (0.11), 0.01
VO2 Max	84.8%	0.39 (0.12), <.001

Results indicated that initial perceptions and actual fitness levels had only slight to fair agreement in each component of fitness (k = 0.19 – 0.39) when analyzed using weighted kappa tests. Therefore, perceptions are not equal to measured fitness levels, indicating that college students are not capable of predicting their own fitness levels.

Table 2. Intentions to Change Physical Activity Question Results

	Time 1 (n=27)	Time 2 (n=27)	Time 3 (n=17)	1 vs 2	2 vs 3
I am not interested in making changes or improvements I have considered making healthier choices	0 (0%)	0 (0%)	1 (5.9%)	<.001	0.18
I have considered making healthier choices	2 (7.4%)	2 (7.4%)	1 (5.9%)		
I am ready to make a change	3 (11.1%)	3 (11.1%)	0 (0%)		

I have started making healthier choices	13 (48.2%)	14 (52.9%)	8 (47.1%)		
I make healthy choices on a regular basis	9 (33.3%)	8 (29.6%)	7 (41.2%)		

Participants' intentions to make changes were measured before fitness testing, one week after the fitness test and approximately four weeks after the fitness test. Changes in a person's intentions were observed from time 1 to time 2 ($p = <.001$), however, no change was observed between time 2 and time 3 ($p = 0.18$), indicating that changes were sustained over the four week period.

At time 2 and 3, participants were asked if they believed that participating in the EIM fitness assessment increased their intentions. At time 2, 95.9% of participants answered "agree" or "strongly agree," indicating that they believed their intentions had increased and at time 3, 100% of participants responded with "agree" or "strongly agree." Participants were also asked at time 2 and 3 if they believed that their physical activity had increased as a result of fitness testing results. Fifty percent of participants responded with "agree" or "strongly agree" at time 2, and at time 3, 58.8% of responded with "agree" or "strongly agree." This perceived increase in physical activity levels was not supported by accelerometer data which showed equal levels of activity at each wear time.

Table 3. Physical Activity from Accelerometer Wear Times, mean (SD)

	Time 2 (n = 27)	Time 3 (n=17)	P-value
Counts Per Minute	2,240 (1235.5)	1,998.0 (123.5)	0.94
Steps	10,796.2 (1048.8)	10,989.0 (900.5)	0.46

Physical activity levels showed no significant change between time 2 and time 3 when analyzed by Wilcoxon matched-pairs tests using average counts per minute ($p = 0.94$) and average steps per day ($p = 0.46$).

For this study, the first wear time of the accelerometer is referred to as “time 2” because it corresponds with the second intentions questionnaire and the second wear time is referred to as “time 3” because it corresponds with the third intentions questionnaire.

Discussion:

Previous research indicated that fitness testing is necessary to educate a person on their physical fitness levels (Desai et al., 2008). Differences found in this study between fitness perceptions and actual fitness results supported the idea that fitness testing is needed as a tool to correct a person’s perceptions of their fitness levels. This was very similar to findings in other studies with like comparisons (Jacobson & Debock, 2001; Monroe et al., 2010). Having a correct perception of self is important so a person is able to understand their strengths and weaknesses, so they can make improvements where necessary.

In this study, intention levels were measured using a short questionnaire regarding intentions to make changes in physical activity behavior in the future. Results showed that intention levels changed from before the fitness test to after. These changes in intention levels were maintained over an approximately four-week time period. Behavior change techniques include providing information about health consequences and providing opportunities for social comparison (Abraham & Michie, 2008). It would follow that educating a person on their fitness levels in comparison of others of the same age and sex would also lead to an increase in intentions to make healthy behavior changes.

Despite changes in intentions, physical activity levels from before receiving results from the fitness assessment and approximately 4 weeks after receiving results, as measured by accelerometer data, showed that these intentions do not necessarily translate into behavior changes. Literature suggested that intentions are the main determinate of behavior change, but the current study did not support this view (Murtagh et al., 2012). This study indicated that while intention changes may be an important factor in making changes, it is not enough to cause behavior changes. Future research could be performed to determine what tools and interventions can be done to actually cause behavior changes to occur.

Strengths of this study included an equal female to male ratio in the initial assessment, a small age range and accuracy of fitness results due to the quality of fitness tests. The follow up aspect of this study to determine intention and physical activity levels was unique and provided more information about this topic. Limitations included a lack of control over accelerometer wear time, participant bias on surveys and inability to complete follow ups due to the COVID-19 school closure. With any study that requires participant cooperation, it can be difficult to ensure compliance.

In conclusion, data from this study indicates that fitness testing is necessary to educate college students on their actual fitness levels. Furthermore, participating in a fitness test causes a change in intention levels which is sustained over a period of time. These intentions do not necessarily lead to behavior changes in physical activity levels over the same amount of time.

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Appendix A.

Perception Questions *(asked prior to fitness assessment)*

1. Compared to other people of your same age and sex, how would you classify your body composition? This scale refers to the relative amounts of fat and muscle in your body (Body Scan).
    a. Lean
    b. Normal
    c. Moderate amount of excess body fat
    d. Obese

2. Compared to other people of your same age and sex, how would you classify your muscular strength? This scale refers to capacity to perform intense muscular work for a short duration (hand grip strength test).
    a. Excellent
    b. Very good
    c. Good
    d. Fair
    e. Poor

3. Compared to other people of your same age and sex, how would you classify your muscular endurance? This scale refers to your ability to do push-ups consecutively and with correct form (from the knees for females).

a. Excellent
b. Very good
c. Good
d. Fair
e. Poor

4. Compared to other people of your same age and sex, how would you classify your flexibility? This scale refers to your capacity to perform movements requiring bending, stretching, etc.
    a. Excellent
    b. Very good
    c. Good
    d. Fair
    e. Poor

5. Compared to other people of your same age and sex, how would you classify your cardiac endurance? (Graded treadmill test)
    a. Superior
    b. Excellent
    c. Good
    d. Fair
    e. Poor
    f. Very poor

Appendix B.

Intention Questions *(asked a total of 3 times: prior to fitness assessment, upon receiving fitness assessment results, and 1 month following receiving results)*

Please indicate how ready you are to make changes or improvements in your health in the following areas

	I am not interested in making changes or improvements	I have considered making healthier choices	I am ready to make a change	I have started making healthier choices	I make healthy choices on a regular basis
Be physically active	○	○	○	○	○
Practice good eating habits	○	○	○	○	○
Lose weight or maintain healthy weight	○	○	○	○	○
Get a full night's sleep every night	○	○	○	○	○
Reduce the amount of stress in your daily life	○	○	○	○	○

Asked upon receiving fitness assessment results and 1 month following receiving results.

1. I feel that participating in the Exercise is Medicine fitness test and learning my actual fitness level has increased my intentions to engage in physical activity.
    a. Strongly Disagree
    b. Disagree
    c. Neither agree nor disagree
    d. Agree
    e. Strongly Agree

2. I feel that I have increased my physical activity as a direct result of learning my actual fitness level in comparison to other people my age.
    a. Strongly Disagree
    b. Disagree
    c. Neither agree nor disagree
    d. Agree
    e. Strongly Agree