



Figure 14. Spatial and temporal changes in mercury.

Contents

UNDERGRADUATE RESEARCH

Evaluating body dissatisfaction as a moderator between physical self-concept and physical activity	1
Stephanie Chen	
Breaking ground in Canaan: African-American community in Lawrence, 1870–1920	9
Paul E. Fowler III	
Quantifying CO₂ removal by living walls: a case study of the Center for Design Research	20
Eric Rivera	
An analysis of electromyography as an input method for resilient and affordable systems: human-computer interfacing using the body’s electrical activity	30
Seth Polsley	
<i>Man of Tomorrow: a film on Jacque Fresco</i>	38
Nathanael Dinwiddie	
Performance study of supertree methods	41
Patrick Niehaus	
Community health club and its application for health promotion and community building in Matazano, Guatemala	46
Karen S. Lewis	
Isolation and crystallization of PvdJp2, a non-ribosomal peptide synthetase domain in <i>Pseudomonas aeruginosa</i>	58
Betsy Ramirez	
The potential of milkweed floss as a natural fiber in the textile industry	64
Julia Nehring	
Optimum protein-excipient interactions using molecular docking simulations	69
Haider Sulaiman Tarar	



Stephanie Chen

HOMETOWN

Overland Park, Kansas

MAJOR

Psychology

ACADEMIC LEVEL

Senior

RESEARCH MENTOR

Ric Steele

Professor of Applied Behavioral Science

Q&A

How did you become involved in doing research?

I started working in a research lab as a Research Assistant during my sophomore year of college when my professors encouraged me to get involved with academic activities on campus. I gradually grew more and more interested in it, and finally decided to do my own independent project: a senior honors thesis.

How is the research process different from what you expected?

I didn't expect that there would be so many administrative aspects to running a study, such as getting IRB approval and applying for grants. However, I think it was really good that I could get that experience during my undergraduate career.

What is your favorite part of doing research?

I enjoy coming up with a research hypothesis and design based on prior studies in the literature.

Evaluating body dissatisfaction as a moderator between physical self-concept and physical activity

Stephanie Chen

ABSTRACT

Physical activity has been shown to be an important behavior, central to long-term physical, social, and mental health benefits. Unfortunately, recent research has also demonstrated that most American adults fall short of the ideal 150 minutes of moderate-intensity exercise and muscle training per week, often leading to serious health implications. The current study seeks to better understand the psychosocial predictors of physical activity (PA), such as physical self-concept (PSC) and body dissatisfaction (BD) in women. Participants ($n=102$, mean age = 19.45, $SD = 1.91$) completed self-report measures of the Physical Self-Description Questionnaire (PSDQ) and the Body Shape Questionnaire (BSQ), with PA being objectively measured through archival data from the student fitness center. It was hypothesized that PSC would positively predict PA and that BD would have a curvilinear moderating effect on the relationship between PSC and PA. Results supported the relationship between PSC and PA, but no moderating effect was found for BD, showing that further research is needed to evaluate the replication of such an effect.

The overall deficiency in physical activity has had an impact on the general health of the population in the United States.

Physical activity has been shown to be an important behavior for general health promotion and maintenance (Haskell et al., 2007; U.S. Department of Health and Human Services [HHS], 2008). Regular exercise for people of all ages produces long-term health benefits; these include sustaining optimum metabolism and body weight, improving bone and muscle density, preventing chronic illnesses such as heart disease or type 2 diabetes, reducing the risk of certain cancers, and promoting overall cardiovascular and muscular fitness (Schnor, Lange, Scharling & Jensen, 2006; Folsom, Arnett, Hutchinson, Liano, Clegg & Cooper, 1997). Beyond these purely physical reasons, physical activity also encourages healthy social opportunities with friends and family, improves mood and mental health, and increases both quality of life and the chances of living a longer life (Osei-Tutu & Campagna, 2005; Wennlof, Yngve, Nilsson, & Sjoström, 2005; Biddle & Mutrie, 2008). The Centers for Disease Control and Prevention (CDC; 2010) recommends that American adults need at least 150 minutes of moderate-intensity aerobic exercise (i.e. water aerobics, fast walking, bike riding on level ground) or 75 minutes of vigorous-intensity exercise (i.e. jogging or running, swimming laps, playing basketball) in addition to muscle training activities on two or more days per week. In terms of amount of activity per day, the recommended guideline is about 30 minutes on most days of the week.

Unfortunately, studies show that physical activity among adults is lacking. Troiano, Berrigan, and Dodd (2008) indicated that, on

average, adults (aged 20-60 years) obtained about 12 minutes combined of moderate and vigorous activity per day. When counting only vigorous physical activity, the mean time dropped to less than two minutes. Given that physical inactivity affects those of all ages, of particular prominence is the lack of activity among the cohort of college undergraduates (King, 1994; Caspersen, Pereira, & Curran, 2000). Studies have shown that this group of individuals exhibits the most dramatic decline in physical activity during the transition from adolescence to early adulthood (Gordon-Larsen, Nelson, & Popkin, 2004; Kwan, Cairney, Faulkner, & Pullenayegum, 2012). As lack of physical activity is one of the most pressing health concerns, interventions targeted at this specific age group could potentially prevent the decrease in regular exercise, thereby carrying health benefits into later life stages.

The overall deficiency in physical activity has had an impact on the general health of the population in the United States. Lack of exercise is a risk factor for obesity and obesity is, in turn, a risk factor for many other negative psychological and physiological health conditions (Stroebe, 2008). In light of the current obesity epidemic in the U.S., these discrepancies between ideal and actual exercise levels are particularly alarming. In 2004, 32.2% of American adults were obese—defined as having a BMI (body mass index) of 30 or higher (Ogden et al., 2006). Compared to the most recent measure of 35.7% in 2009, the prevalence of obesity in American adults is clearly on the rise (Ogden

et al., 2012). Recently, due to marked efforts by the scientific and health communities, the rate of obesity prevalence has slowed. However, the level of physical inactivity in the United States remains high and there is a need for systemic change (Knuth & Hallal, 2009).

The psychosocial predictors of physical activity are not as clearly understood as the aforementioned health implications. Baker and Brownell (2000) theorized a social cognitive model hypothesizing that improvements in psychological factors (i.e. mood, body image, self-esteem, self-concept, and coping) would lead to an improved overall psychological climate, thereby increasing motivation and commitment. This change would, in turn, positively affect adherence to regular physical activity (Baker & Brownell, 2000). Physical activity has been correlated with positive effects on psychological constructs such as mood, vigor, self-esteem, physical self-concept, overall feeling of well-being, and a decrease in depression (Biddle & Mutrie, 2008). A study by Annesi (2006) found that changes in self-efficacy and physical self-concept, specifically, accounted for a significant amount of voluntary physical activity in pre-adolescent children. Since then, physical self-concept—a complex domain including perceived appearance and physical competence—has been studied as a predictor of physical activity (Rodriguez & Audrain-McGovern, 2005). Recent research has suggested that physical self-concept is the most significant predictor of adherence to exercise regimens when compared to other factors such as self-efficacy, mood disturbance, and body satisfaction (Annesi et al., 2011). The current study seeks to replicate this positive association between physical self-concept and physical activity while additionally investigating the possible moderator of body dissatisfaction.

Defined as the negative associations with perceived body weight, shape, or image, body dissatisfaction (BD) is a valuable measure of attitudes toward one's body (Cash et al., 2012). The current literature provides evidence of associations between BD and social anxiety, self-esteem, eating disorders, and depression (Russel & Cox, 2003; Grilo & Masheb, 2005; Barker & Galambos, 2007). In a recent study, its weight dissatisfaction facet was also seen to be a moderator of the outcome of weight loss, based on the Yerkes-Dodson law (Johnston, Moreno, Regas, Tyler, & Foreyt, 2012). As postulated by the Yerkes-Dodson law, studies have shown that there is an optimal level of stress or arousal that is beneficial to performance in various tasks, including learning, test scores, and grades (Yerkes & Dodson, 1908; Kuczarski et al., 2002; Childress, Brewerton, Hodges & Jarrell, 1993). In Johnston et al.'s study, the Yerkes-Dodson law was applied to the hypothesis that weight stressor among children enrolled in a weight management program and it would impact their weight loss (Yerkes & Dodson, 1908, Johnson & Wardle, 2005, Johnston et al., 2012). Support was found for a parabolic association when participants with only moderate dissatisfaction lost significantly more weight than children who had extremely high or low measures of dissatisfaction (Johnston et al., 2012). Based on this research, we speculate that body dissatisfaction will operate similarly in a sample of college-aged females, with those experiencing relatively high or low levels of body dissatisfaction participating in less regular physical activity.

In the current study, we investigate physical self-concept as a predictor of physical activity and hypothesize that body dissatisfaction will play a moderating role in that relationship.

Although the sample consists of young adult females, we expect to see the same Yerkes-Dodson phenomenon from Johnston et al.'s study (2012); effectively, after controlling for BMI, those with extremely low or high BD will be less physically active than participants in the more moderate categories of this measure. Also, we hypothesize that subjects with higher measures of physical self-concept will also participate in more regular physical activity.

METHODS

Participants

One group of participants (n=71) was recruited from the online Service Oriented Network Architecture (SONA) system through the author's institution and compensated with course credit to fulfill a research requirement. Another group (n=31) was directly recruited from the student fitness center where data was collected. An information table was set up and participants were invited to participate in a study on "physical activity and health" for no compensation. The sample was comprised of 102 female undergraduates who fulfilled the inclusion criteria of being fluent in English and using the student fitness center to exercise.

Measures

All subjects were given questionnaires, including self-report measures of body dissatisfaction and physical self-concept. Objective measures of BMI and physical activity were also obtained. Analyses included recruitment group and BMI as potential control variables, body dissatisfaction and physical self-concept as IVs (independent variables), and physical activity as the DV (dependent variable).

The Body Shape Questionnaire (BSQ) was used to assess the participants' attitudes about body image. Participants rated how often

they had felt in certain ways about their body within the past month (i.e. "Have you thought that your thighs, hips or bottom are too large for the rest of you?") on a scale with answers ranging from 1-(never) and 6-(always). Individual scores from the 34 items were then summed for a total score, with higher numbers reflecting greater body dissatisfaction.

This measure has been shown to have high internal consistency ($\alpha=.97$) and test-retest reliability ($r=.88$) among adult populations (Rosen et al., 1996). Internal consistency in the present sample was estimated at $\alpha=.97$.

Physical self-concept was measured by the Physical Self-Description Questionnaire (PSDQ; Marsh & Redmayne, 1994). This 70-item self-report survey was designed to assess 11 facets of physical self-concept and fitness: strength, body fat, activity, endurance, sports competence, coordination, health, appearance, flexibility, global physical self-concept, and global esteem (Marsh & Redmayne, 1994). In the present study, the 6-item subscale of physical self-concept in physical activity was used. The scale of the items ranged from 1-false to 6-true for how accurate each statement was for the participant (i.e. "I am satisfied with the kind of person I am physically"). Studies have shown acceptable internal consistency (median $\alpha=.92$) and test-retest reliability ($r=.69-.83$) scores in nonclinical populations (Marsh, 1996). In the present sample, internal consistency was estimated at $\alpha=.95$ for the 6-item subscale.

BMI was calculated using the guidelines provided by the Centers for Disease Control and Prevention (CDC 2011, $BMI=kg/m^2$). Participants were measured without shoes and in light clothing using digital scales (model number SECA 813, SECA Corp., Hanover, MD, USA) and a portable stadiometer (model number

SECA 214, SECA Corp.). Participants were measured twice each time, with respect to height and weight, and the average of the two measurements was used for analysis.

The primary measure of physical activity was obtained through archival data from a student fitness center located on the campus of a large Midwestern university. Enrolled students can enter the facilities with their student ID, and there are many available sports and exercise equipment, such as basketball or tennis courts, weight machines, free weights, and machines intended to promote cardiovascular exercises (i.e. treadmills, ellipticals, exercise bikes, etc.). Whenever a participant “checked in” at the front desk with their ID, that information was recorded in the fitness center’s database. For the current study, we obtained permission from the director and staff for the access and usage of this information pertaining only to the consented participants in our study; participants’ “check-in” data were monitored for the period of 28 days.

Procedures

Participants recruited through the SONA system were informed of this study through the university’s online recruiting center, where they were first screened for the inclusion criteria of 1) female gender, 2) English fluency, and 3) using the fitness center to workout. After signing up for the study, participants were scheduled to meet in a large classroom with researchers to give informed consent and complete study questionnaires. Directly recruited participants volunteered for this study at an information table in the fitness center. Afterwards, they were directed upstairs to the data collection classroom to complete the surveys. All were informed that participation was voluntary and that they were free to withdraw at any

point during the study. Full informed consent for the use of their data from the fitness center was obtained. The first time point of data collection was administered in person and included the self-reported physical self-concept and body dissatisfaction surveys. Objective BMI measures were also taken in a private, adjacent classroom. Archival data were gathered at the end of data collection and assessed the number of check-ins for the period of 28 days. All study procedures were approved by the Human Subjects committee of the author’s institution.

RESULTS

Descriptive Statistics

A total of 102 participants were enrolled in the study, two of which were excluded because of failure to obtain the entirety of the surveys and/or measure of physical activity. Specifically, one was omitted for incomplete physical self-concept measures and one was omitted for missing physical activity measures. Of the 100 remaining, all participants were female students enrolled in a large Midwestern university, and age ranged from 17-31 years. As shown in Table 1, 71 participants were recruited online through the SONA system and received credit in return for participation (labeled as SONA). The other 29 participants were recruited directly from the student fitness center either before or after working out

(labeled as DIRECT). This group of subjects fulfilled all aforementioned inclusion criteria and participated on a strictly voluntary basis.

Preliminary Analyses

A correlation matrix was used to evaluate the inclusion of the variables of recruitment process and BMI in the hierarchical regression. Since there were two different methods of participant recruitment, SONA and DIRECT, they were dummy-coded and correlated with the dependent variable of physical activity to see if there was significant association among the variances. Neither recruitment process ($r = 0.08$) nor BMI ($r = -0.01$) had a significant correlation with amount of physical activity; therefore they were both excluded as covariates from the later analysis.

Multiple Polynomial Regression with Interaction Term

To evaluate our hypothesis of physical self-concept positively predicting physical activity, we included it as the first term in the model. To further test the hypothesis of a curvilinear moderation of body dissatisfaction between physical self-concept and physical activity, the covariates included both the individual and squared terms of body dissatisfaction, along with the linear and curvilinear terms of the interaction. The full model included physical self-concept, body dissatisfaction, and

TABLE 1. Means and standard deviations of study variables by recruitment group

Variable	SONA (n=71)	DIRECT (n=29)	Total (n=100)
Age (yrs)	19.47(1.91)	19.96(2.31)	19.45(1.91)
BMI	23.51(3.67)	25.79(6.04)	24.17(4.63)
PSC	25.11(1.05)	24.38(0.73)	26.59(8.62)
BD	88.26(1.0)	85.66(0.97)	87.51(33.25)
PA	4.92(5.82)	5.93(5.7)	5.21(5.87)

Notes: BMI, body mass index; PSC, physical self-concept; BD, body dissatisfaction; PA, physical activity.

the interaction terms as independent variables predicting the objective measure of physical activity from archival data. Results of the regression are depicted in Table 2.

the Yerkes-Dodson phenomenon was not observed in this sample. BD was shown to be positively related to PA, with higher levels of BD significantly predicting higher levels of regular PA.

TABLE 2. Z-scored simultaneous regression model with curvilinear interaction term

Predictor Variables	Parameter estimates				
	β	SE	t	p	Partial η^2
Intercept	5.6	0.68	8.18	<.001	
PSC	3.04	0.7	4.36	<.001	0.26
BD	1.3	0.56	2.3	0.02	0.05
BD ²	-0.4	0.5	-0.8	0.43	0.01
PSC X BD	0.42	0.57	0.74	0.46	0.01
PSC X BD ²	-0.2	0.49	-0.42	0.68	0

Notes: F(5, 94)=7.62, p<.001, Adjusted R²=0.25. PSC, physical self-concept; BD, body dissatisfaction.

The overall model fit was acceptable with the ANOVA test, indicating that the amount of variance in physical activity predicted by the two independent variables was significantly different from zero (F(2, 97)=18.83, p<.001). Also, the coefficient of multiple determination demonstrated that the variance among the levels of physical self-concept and body dissatisfaction in this sample predicted about 26% of the variance in physical activity (R²=0.2648).

As demonstrated, PSC and BD both predicted a significant part of the variance in physical activity, as measured by the number of times participants visited the fitness center in a one month period. However, the other three coefficients representing the linear and curvilinear interactions were not significant. Analysis established support for the hypothesis of PSC as a positive predictor of PA. However, there was no evidence for the hypothesized curvilinear moderation of BD on the prior relationship and

DISCUSSION

The current study was a correlational design investigating the relationships between physical self-concept, body dissatisfaction, and physical activity among a group of female undergraduates. It was hypothesized that participants reporting higher physical self-concept would also adhere to a more regular exercise regimen. Also, self-reported body dissatisfaction was hypothesized to have a curvilinear moderating effect between physical self-concept and physical activity, with those in lower or higher categories exhibiting lower amounts of regular exercise than those in moderate categories. As physical activity, or the lack thereof, is an important issue affecting the cohort of college undergraduates, it is important to better understand the psychosocial constructs motivating such behavior in this age group (Troiano, Berrigan, and Dodd, 2008). Results of such a study could inform interventions targeted towards increasing adherence to regular physical activity regimens or

improving weight loss strategies.

Results of the regression indicated that the physical self-concept term was highly significant and corresponded with our hypothesis that it would positively predict higher levels of physical activity. For every one unit increase in standard deviations on our physical self-concept measure (PSDQ), the model predicted an additional three “check-in” time points during the span of one month at the student fitness center.

This demonstrated a strong positive linear relationship between physical self-concept and physical activity, which further supports the findings of earlier studies (Biddle & Mutrie, 2008; Annesi et al., 2011). These

conclusions suggest that those who possess stronger concepts of their physical self (i.e. “I do lots of sports, dance, gym, or other physical activities.”) adhere to a significantly more regular exercise regimen. However, as this concept was not experimentally manipulated, we have no evidence to presume that physical self-concept affects physical activity or vice versa. Overall, this strengthens the support for the importance of this psychosocial predictor in relation to physical activity; therefore, it might be beneficial to take this into consideration when planning clinical interventions or weight loss/exercise programs.

Contrary to our expectations, the relationship between body dissatisfaction and physical activity was not shown to be curvilinear, and there was not a significant moderation of body dissatisfaction on the relationship between physical self-concept and physical activity. Instead, the analyses suggested that an increase in body dissatisfaction significantly predicted greater levels of physical activity. Specifically, for each unit of increase in standard deviations

on the body dissatisfaction measure, it was predicted that the participant would visit the fitness center one more time within the duration of a month. These results suggest that the more dissatisfied the participants felt about their body shape or size (i.e. "Have you ever felt ashamed of your body?"), the more they were motivated to exercise regularly.

Though they were not what we expected to find, our results do extend conclusions outlined in a study on "aesthetic exercising," defined as exercising with an aesthetic purpose. Adolescent girls who were more active than their peers showed significantly greater amounts of body image dissatisfaction, and the majority of these girls reported a desire for a "slimmer silhouette" (Laus et al., 2013). Together, this evidence could support the idea that young women frequently exercise for the sake of their appearance instead of strictly having physical health or weight loss as the primary goals. This could apply to the findings in the present sample, especially as most of our participants had BMIs in the normal ranges and only 10% were obese (defined as BMI>30).

The present results on body dissatisfaction did not conform to expectations for several possible reasons. In the Johnston et al. article, a curvilinear relationship reminiscent of the Yerkes-Dodson law of arousal was found between body dissatisfaction and weight loss over a several week-long intervention (2012). It is possible that this parabolic association was largely

due to facets other than exercise in the intervention, such as diet and health education. Also, the sample in this article was comprised of young adolescents (11-14 years), pertaining to a different population from the present sample (17-31 years). Even though the ages are similar, we cannot rule out the possibility that young adults have different thought processes and priorities than teens regarding body dissatisfaction or physical activity. Young adults may regard body dissatisfaction as more of a motivator than an arousal-inducing stressor; therefore those with higher levels of dissatisfaction are not discouraged from working out.

In the future, studies extending this line of research should address some of the present limitations. There may have been a lack of power to detect either the second-order body dissatisfaction or curvilinear interaction term. Also, the convenience sample was drawn from a population of female students at a large Midwestern university, limiting the generalizability to other demographic groups. However, as lack of physical activity is particularly prominent among the cohort of college undergraduates, the results found could still hold some practical implications (King, 1994; Caspersen, Pereira, & Curran, 2000). Furthermore, the sample focused on young adult females who are typically shown to be particularly concerned about body image and have high risks for harmful health behaviors such as eating disorders (Laus et al., 2013). Future studies

should also take multiple measures of body dissatisfaction into account. Even though the BSQ (Body Shape Questionnaire) is a clinically validated measure, it may not have adequately captured the construct of body dissatisfaction in the current sample (Rosen et al., 1996). Finally, in order to more thoroughly explore the present constructs and strengthen the conclusions found, a study should be conducted utilizing a manipulated decrease of body dissatisfaction (i.e. through an intervention or other means) and measuring the impact on regular physical activity.

The present study was a correlational examination evaluating the relationships between physical self-concept, body dissatisfaction, and physical activity in a convenience sample of college-age females. Given our original hypotheses, the data showed support for the expected positive relationship between physical self-concept and physical activity. However, the hypothesized curvilinear interaction of body dissatisfaction was not significant within our sample, suggesting that further research is needed to assess the replication of a Yerkes-Dodson effect among the population of young adult females. If future studies confirm the nature of these psychosocial predictors of physical activity, they would both fill a gap in the literature and hold practical implications for the design of interventions looking to promote physical activity or weight loss.

REFERENCES

- Annesi, J. J. (2006). Relations of physical self-concept and self-efficacy with frequency of voluntary physical activity in preadolescents: Implications for after-school care programming. *Journal of Psychosomatic Research, 61*(4), 515-520.
- Annesi, J. J., Unruh, J. L., Marti, C. N., Gorjala, S., & Tennant, G. (2011). Effects of the coach approach intervention on adherence to exercise in obese women: Assessing mediation of social cognitive theory factors. *Research Quarterly for Exercise and Sport, 82*(1), 99-108.
- Baker, C.W., Brownell, K. D., Baker, C.W. (2000). Physical activity and maintenance of weight loss: physiological and psychological mechanisms. *Physical activity and obesity, 311-328*.
- Barker, E. T., & Galambos, N. L. (2007). Body dissatisfaction, living away from parents, and poor social adjustment predict binge eating symptoms in young women making the transition to university. *Journal of Youth and Adolescence, 36*(7), 904-911.
- Biddle, S. J., & Mutrie, N. (2008). *Psychology of physical activity*. New York, NY: Routledge.
- Cash, T. F., Fleming, E. C., Alindogan, J., Steadman, L., & Whitehead, A. (2002). Beyond body image as a trait: the development and validation of the Body Image States Scale. *Eating Disorders, 10*(2), 103-113.
- Caspersen, C.J., Pereira, M.A., Curran, K.M. (2000). Changes in physical activity patterns in the U.S., by sex and cross-sectional age. *Medicine & Science in Sports & Exercise, 32*, 1601-1609.
- Centers for Disease Control and Prevention. (2010). *Morbidity and mortality weekly report*.
- Childress, A. C., Brewerton, T. D., Hodges, E. L., & Jarrell, M. P. (1993). The Kids' Eating Disorders Survey (KEDS): A study of middle school students. *Journal of the American Academy of Child Adolescent Psychiatry, 32*, 843-850.
- Crawford, J. R., & Henry, J. D. (2004). The positive and negative affect schedule (PANAS): Construct validity, measurement properties and normative data in a large non-clinical sample. *British Journal of Clinical Psychology, 43*(3), 245-265.
- Folsom A.R., Arnett D.K., Hutchinson R.G., Liao F., Clegg L.X., & Cooper L.S. (1997). Physical activity and incidence of coronary heart disease in middle-aged women and men. *Medicine & Science in Sports & Exercise, 29*(7), 901-9.
- Godin, G., & Shephard, R. J. (1985). A simple method to assess exercise behavior in the community. *Canadian Journal of Applied Sport Science, 10*(3), 141-146.
- Gordon-Larsen, P., Nelson, M.C., & Popkin, B.M. (2004). Longitudinal physical activity and sedentary behavior trends: adolescence to adulthood, *American Journal of Preventive Medicine, 27*, 277-283.
- Grilo, C. M., & Masheb, R. M. (2005). Correlates of body image dissatisfaction in treatment-seeking men and women with binge eating disorder. *International Journal of Eating Disorders, 38*(2), 162-166.
- Haskell, W. L., et al., (2007). Physical activity and public health: updated recommendation for adults from the American college of sports medicine and the American heart association. *Circulation, 116*(9), 1081-1093.
- U.S. Department of Health and Human Services. (2008). *Physical activity guidelines for Americans*. Washington DC: U.S. Government Printing Office.
- Johnston, C. A., Moreno, J. P., Regas, K., Tyler, C., & Foreyt, J. P. (2012). The application of the Yerkes-Dodson law in a childhood weight management program: Examining weight dissatisfaction. *Journal of Pediatric Psychology, 37*(6), 674-679.
- Johnson, F., & Wardle, J. (2005). Dietary restraint, body dissatisfaction, and psychological distress: A prospective analysis. *Journal of Abnormal Psychology, 114*(1), 119-125.
- King, A.C. (1994). Community and public health approaches to the promotion of physical activity. *Medicine & Science in Sports & Exercise, 26*, 1405-1412.
- Knuth, A. G., & Hallal, P. C. (2009). Temporal trends in physical activity: A systematic review. *Journal of Physical Activity & Health, 6*(5), 548-559.
- Kuczmarski, R. J., Ogden, C. L., Guo, S. S., Grummer-Strawn, L. M., Flegal, K. M., Mei, Z., Johnson, C. L. (2002). 2000 CDC growth charts for the United States: Methods and development. *Vital Health Statistics, 11*(246), 1-190.
- Kwan, M.Y., Cairney, J., Faulkner, G. E., & Pullenayegum, E. E. (2012). Physical activity and other health-risk behaviors during the transition into early adulthood: A longitudinal cohort study. *American Journal of Preventive Medicine, 42*(1), 14-20.

- Laus, Maria Fernanda, Costa, Telma Maria Braga, & Almeida, Sebastião Sousa. (2013). Body image dissatisfaction and aesthetic exercise in adolescents: are they related?. *Estudos de Psicologia (Natal)*, 18(2), 163-171.
- Marsh, H. W. (1996). Physical self-description questionnaire: stability and discriminant validity. *Research Quarterly for Exercise and Sport*, 67(3), 249-264.
- Marsh, H.W., & Redmayne, R.S. (1994). A multidimensional physical self-concept and its relation to multiple components of physical fitness. *Journal of Sport & Exercise Psychology*, 16, 45-55.
- Marsh, H. W., Richards, G. E., Johnson, S., & Roche, L. (1994). Physical self-description questionnaire: Psychometric properties and a multitrait-multimethod analysis of relations to existing instruments. *Journal of Sport & Exercise Psychology*, 16(3), 270-305.
- Ogden, C. L., Carroll, M. D., Curtin, L. R., McDowell, M. A., Tabak, C. J., & Flegal, K. M. (2006). Prevalence of overweight and obesity in the united states, 1999-2004. *JAMA: Journal of the American Medical Association*, 295(13), 1549-1555.
- Ogden C.L., Carroll M.D., Kit B.K., Flegal K.M. (2012). Prevalence of obesity in the United States, 2009-2010. NCHS data brief, no 82. Hyattsville, MD: National Center for Health Statistics.
- Osei-Tutu K.B., Campagna P.D. (2005). The effects of short- vs. long-bout exercise on mood, VO₂max, and percent body fat. *Preventive Medicine*, 40(1), 92-8.
- Rodriguez, D., & Audrain-McGovern, J. (2005). Physical activity, global physical self-concept, and adolescent smoking. *Annals of Behavioral Medicine*, 30(3), 251-259.
- Rosen, J. C., Jones, A., Ramirez, E., & Waxman, S. (1996). Body shape questionnaire: Studies of validity and reliability. *International Journal of Eating Disorders*, 20(3), 315-319.
- Russell, W. D., & Cox, R. H. (2003). Social physique anxiety, body dissatisfaction, and self-esteem in college females of differing exercise frequency, perceived weight discrepancy, and race. *Journal of Sport Behavior*, 26(3), 297-318.
- Sallis, J.F., Buono, M.J., Roby, J.J., Micale, F.G., & Nelson, J.A. (1993). Seven-day recall and other physical activity self-reports in children and adolescents. *Medicine and Science in Sports and Exercise*, 25, 99-108.
- Schnohr P, Lange P, Scharling H, & Jensen J.S. (2006). Long-term physical activity in leisure time and mortality from coronary heart disease, stroke, respiratory diseases, and cancer. The Copenhagen City Heart Study. *European Journal of Cardiovascular Prevention and Rehabilitation*, 13(2), 173-179.
- Stroebe, W. (2008). Prevalence and consequences of overweight and obesity. (pp. 9-33) American Psychological Association, Washington, DC.
- Troiano, R. P., Berrigan, D., & Dodd, K. W. (2008). Physical activity in the united states measured by accelerometer. *Medicine and Science in Sports and Exercise*, 40(1).
- Watson, D., Clark, L.A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, 54(6), 1063-1070.
- Wennlof A.H., Yngve A., Nilsson T.K., & Sjostrom M. (2005). Serum lipids, glucose and insulin levels in healthy schoolchildren aged 9 and 15 years from Central Sweden: reference values in relation to biological, social and lifestyle factors. *Scandinavian Journal of Clinical and Laboratory Investigation*, 65(1), 65-76.
- Yerkes, R. M., & Dodson, J. D. (1908). The relation of strength of stimulus to rapidity of habit formation. *Journal of Comparative Neurology & Psychology*, 18, 459-482.