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Variation in Peak Performance: Role of Mental Health and Body Composition

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Abstract

There is abundance of research on peak performance, as there is a demand to understand how to make athletes perform at their very best. It is known that body composition plays a large role in how successful athletes are, especially since most would consider athletic fitness its own category. In more recent years, mental health of athletes has been discussed as a potential influencer with more holistic lifestyle changes being more desirable. This research aimed to examine how body composition and mental health affect performance, an area where research does lack. Over the course of one full school year, a NCAA Division I Track and Field and Cross-Country team in North Carolina was studied with the use of DEXA technology and multiple written mental health assessments. Moreover, a vertical jump test was used to assess the performance of participants. Participants were examined four times throughout their season, relative to the demands of the body particular to each season: pre-season training (September), pre-indoor season (November), pre-outdoor season (March), and the closing of the season (May). At the closing of May 2019, the study was concluded. The following school year was dedicated to data analysis. Using regression analysis, researchers found that body composition was not a predictor of performance within their sample as previous research has suggested. Moreover, within this sample mental health played a role in body composition potentially impacting performance.

1. Introduction

1.1 Athletic Performance and Body Composition

Body composition can be indicative of athletic performance in varying sports. Respective sports have ideal body compositions thought to be optimal to performance.[2] Body mass is a variable that is believed to help explain performance, whereby high levels of lean muscle mass and low levels of fat mass tend to be positive influencers on performance.[2] Visceral fat, that surrounds organs, are essential for function but an accumulation can have adverse effects.[1] Ideal compositions for athletes across different sports depends on the physical demands required by the respective sport.[8] Increased muscle mass aids in predicting the athlete's ability to create force, whereas an emphasis on low body fat is due to the non-functionality of fat in performance. [2] Track and Field/Cross Country is a sport in which body composition has been hypothesized to play a large role in the performance of athletes.[7] The sport often calls for an additional decrease in fat mass, percent body fat, and increase in lean mass over the course of the season.[7] Coaches often develop plans to impact the body composition of their athletes, likely resulting in changings in training load. The examination of body composition over time can reveal changes as workload increases alongside body composition changes. More research is needed to understand if body composition plays this large of a role in performance

Also, performance often is decreased by inadequate recovery of athletes. Factors such as inadequate nutrition and sleep have been shown to perpetuate decreased performance.[7] Stress can also prolong recovery and increase susceptibility to injury in athletes.[5] Athletes with low levels of chronic stress experience a significant decrease in

cortisol post-exercise, allowing for recovery following exhaustive exercise.[5] Whereas, athletes experiencing high chronic stress have decreased recovery due to high levels of cortisol within the body post-exercise.[5] As a result, susceptibility of injury and illness increases as the immune system is weakened by physiological and physical stress.[6]

1.2 Mental Health of Athletes

Research suggests that chronic stress can affect body weight changes and overall body composition.[9] It is not unusual for athletes to be in a continuous state of emotional distress, alongside exhaustive physical demand.[7] The negative impact stress can have on body composition offers room for research to examine the potential relationship between chronic stress of athletes and decreased performance. Mental health practitioners have acknowledged the need for athletes and coaches to care for the mind, body and soul of the competitor, especially with the rise in mental health disorders in the United States.[5] The demands of an athlete go beyond physicality, as research has found that athletes are at a greater risk for mental health challenges, such as anxiety and depression

Many factors go into determining how well an athlete performs on a given day, including training load, diet, and sleep. Endocrine function and lifestyle are factors that vary greatly when assessing performance.[6] It would be beneficial to research peak performance from a holistic viewpoint, in a way that incorporates mental health's role in the relationship between performance and body composition. In an effort to holistically examine an athlete's peak performance, this research strives to examine the following research questions:

1. To what degree does an athlete's level of depression predict their overall performance?
2. To what degree does depression predict body composition?
3. To what degree does body composition predict performance?

2. Methods

2.1 Participants

All participants were current members of a track and field/cross country team at a small liberal arts college in Western North Carolina. Participants were introduced to the research study through a lecture-style seminar by research staff. Coaches and athletic staff were not present during this introduction to lessen undue bias influencing participation. Participants voluntarily signed up for research study. The Institutional Review Board approved this study to take place during the fall of 2018. Prior to initiation of the study, participants signed an informed consent document.

2.2 Materials

2.2.1. behavioral assessments

Participants engaged in three rounds of assessments ranging over the course of the track and field season. Each round included a set of seven behavioral assessments assessing the mental health of participants. The first round of assessments included an additional demographics form to assess general characteristics of each participant. Behavioral assessment packets were printed and distributed to participants at the beginning of each experimental round. Participants were instructed to complete questionnaires fully, individually and unanimously. Following the completion, participants would place the completed questionnaire package within a uniquely coded folder upon completion. The present manuscript only details findings from the following two assessments during the first round of data collection.

2.2.1 demographics questionnaire

The demographics questionnaire included information about participants sex, height, weight, ethnicity, classification year in school, transfer status, grade point average, additional training outside, number of years within competitive sports, health concerns, injuries/illness, and diagnosed medical or mental health conditions. This form was abbreviated following the initial testing session.

2.2.2 patient health questionnaire (Spitzer, Williams, & Kroenke, 1999):

The PHQ-9 is used to measure and diagnose clinical depression. The sum of all responses suggests varying levels of depression. Scores range from 0-27, categorizing symptoms as none/minimal, mild, moderate, moderately severe, and severe. PHQ-9 uses a Likert scale that allows participants to choose from a range of response.
PHQ-9 uses 9 DSM-IV criteria to assess the severity of patient symptoms. It is reported to be a reliable and valid measure of depression severity. The PHQ-9 was reported to have good reliability (Cronbach alpha 0.89) and validity (r=0.73).[9]

2.2.3 body composition

Body composition was measured using dual-energy X-ray absorptiometry (DEXA) technology. Participants' heights and weights were recorded prior to the scan. All female identified participants were given an option to take a pregnancy test. Participants who were pregnant were unable to participate in the scan. Researchers prompted participants to lay within the proper perimeter of technology to ensure the scan was successful and accurate. Each participant scan took approximately 15 minutes. Researcher was not present in the room during DEXA scan to prevent excess radiation exposure for examiners. Dependent variables included total percentage of body fat, amount of lean mass in pounds, amount of fat mass in pounds and visceral fat percentage.

2.2.4 peak performance

To assess performance, a vertical max test was used. Researchers measured the reach of each participant during the initial round of assessments. Participants were prompted to stand directly under the VerTec device used and jump vertically without momentum. Researchers used pre-measured vanes on VerTec to record athletes' jumps. To assess performance, the athlete's reach is subtracted from the total vertical jump (max=best jump-reach).

2.3 Design

This longitudinal study aimed to examine the amount of variation in peak performance that is explained by mental health and body composition. Using self-report questionnaires, participants were asked a series of questions to gather demographic data and assess depressive symptoms. Participants were instructed to meet researchers at a location specified prior to the testing session. In addition, participants were told the testing session would require 45 minutes to an hour to complete the questionnaire and body scan subsequently. Participants were instructed to sit individually while completing the questionnaire package. In addition, participants were instructed not to include any identifying information on the cover or throughout the written questionnaire packet. Following completion, participants placed completed questionnaires in uniquely coded packages. Data for all participants were given a unique numerical identifier that was carried over across data collection periods. Therefore, no identifying information was attached to any assessments.

Following the questionnaire, participants were led into a waiting area prior to DEXA scans. During this time, participants were instructed to remove all jewelry from the body. In addition, participants were instructed on the procedure of DEXA scan and given a waiver disclosing radiation potential and disclosure of pregnancy. All participants were offered a pregnancy test prior to DXA scan if there was any uncertainty on behalf of the participant of their pregnancy status. To be eligible for study, all participants signed a waiver form prior to DEXA scan. Participants were led into the examination room by researchers. Weight and height of each participant was inputted into the DEXA database prior to each participant scan. Participants were instructed to lay within measurement perimeter and further adjusted by researcher following initial attempt. Participants were instructed that they researcher would leave the room following the activation of the scan. Each scan took between 15-25 minutes each depending on the composition of the athlete. Upon the completion of the DEXA scan, the researcher re-entered the room and instructed participants to stay in position until the scanning arm returned to home position. Participants were asked if they had any question and instructed that results would be given to the group together.

Vertical Max testing to measure performance was completed the Monday prior to questionnaire and body composition testing sessions for convenience of participants. Vertical max testing followed a team weightlifting session that lasted approximately one hour for all participants. Participants were given three attempts during this

testing session. The highest jump from each data collection round was used during analysis. Participants who were unable to complete the vertical jump test had sport-related injuries that did not allow for the participation of this test.

Following the completion of each data collection round including questionnaire completion, body scan, and vertical max testing, all participant body composition results were returned individually to participants but within a group setting. Researchers discussed the specific variable from the data sheet that would be used in research and explained what those variables meant relative to their sport. Participants were not restricted from sharing results with coaching staff, though they were not prompted to do so.

2.4 Data Preparation and Analysis

Data was analyzed using SPSS software by the researcher and research assistant. Both parties were blind to the identity of participants' data as it was being input and analyzed. All variables were then examined using linear regression analysis to examine the amount of variability that can be explained by each variable.

Results within this report reflect participant data from the first round of data collection, occurring prior to the active season of participants. Exclusion criteria for each variable required that the participant had completed all components of both variables being studied. Listwise deletion allows for varying sample sizes within compared groups.

3. Results

3.1 Participant Demographics

A total of 40 participants completed the initial round of data collection including a written questionnaire, DEXA body scan, and vertical max jumps test. Females made up 53.8% of participants, as males made up 46.2% of participants (Figure 1). One participant failed to specify an identified sex on written questionnaire. The ethnic and racial distribution of participants varied. The largest population within the participant pooled identified as white (55%), the second largest group identified as black/African American (27.5%). Other ethnicities within the participant pool included Asian (2.5%), Hispanic (5%), and multiethnic (7.5%). One participant preferred not to answer (Figure 2). Participants were asked to include the event group with which they most identified within the sport. The largest group identified with distance runners, including those running more than 800 meters (45%). The second largest group identified as sprinters, including runners who ran less than 800 meters (35%). The final two event groups identified within participants included jumpers (12.5%) and throwers (7.5%). There was not an option to identify with more than one event group within the initial question, though there was a later question for participants to identify all events they participated in (Figure 3).

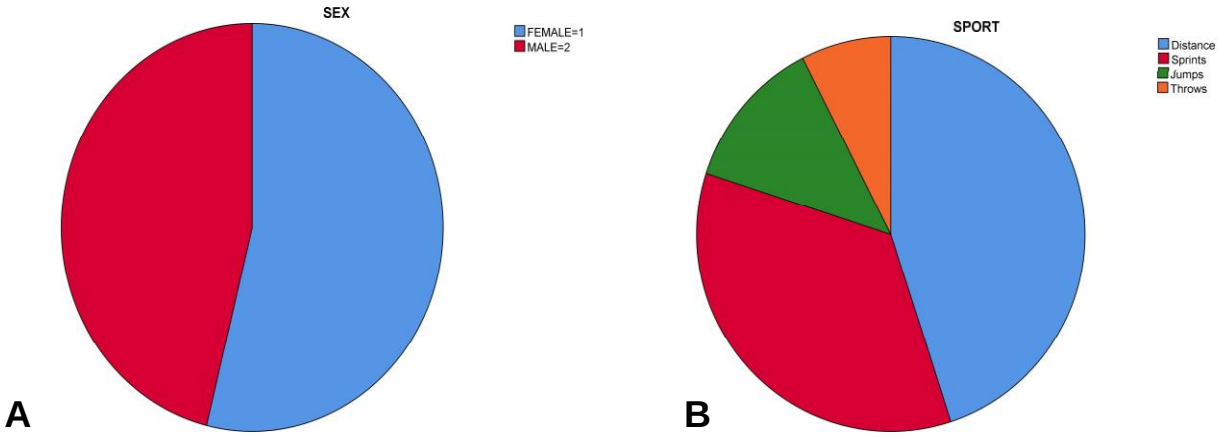

Figure 1A: Sex demographics data Figure

Figure 1B: Sporting event group demographic data

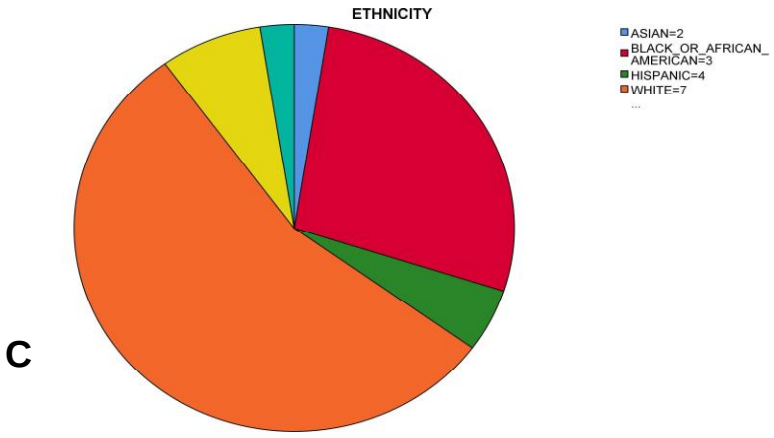

Figure 1C: Race/ethnicity demographic data

3.2 Depression and Performance

In order to examine the degree to which an athlete's level of depression predicts overall performance a linear regression analysis was used. The sample size for these variables (n=26) consisted of 67% of the participants following exclusion criteria. Participants must have completed all components of each variable to be included within data analysis of these variables. The performance statistic, measured by vertical max testing (M=26, SD=6.38) had a small positive correlation with the depression measure using PHQ questionnaires (M=12.3, SD=2.92). Regression analysis of PHQ-9 and vertical max variables showed that depression can help explain some of the variance within performance but is not a significant predictor, R^2= .06, F(1,25) = 1.49, p=.23.

Table 1. Results of Regression analysis for performance and depression

	R	R Square	Adjusted R Square	Std. Error of the Estimate
	.237	.056	.019	6.32275

Table 1. Predictors within this analysis included PHQ total, dependent variable included vertical jump max.

Table 2. Results of ANOVA for performance and depression

		Sum of Squares	df	Mean Square	F	Sig.
	Regression	59.572	1	59.572	1.490	.234
	Residual	999.428	25	39.977		
	Total	1059.000	26			

3.3 Depression and Body Composition

Linear regression analysis was used to examine the degree to which depression predicts body composition. The sample size for the variables (n=36) consisted of a significant amount of the participant pool. Four participants were excluded following exclusion criteria. The independent variable within this analysis was the PHQ-9 total (M= 12.25, SD 3.23) used to predict body composition (M= 31.22, SD= 49.38). Results of the linear regression indicated that severity of depression symptoms significantly predict percentage of body fat, R^2 = .13, F (1,34) = 4.95, p= .33. This regression and ANOVA statistic yield results showing that depression can significantly predict 87% of the variation in percent body fat within the sample.

Table 3. Regression statistics of depression and body composition

	R	R Square	Adjusted R Square	Std. Error of the Estimate
	.356	.127	.101	46.80656

Table 3. Predictors within this analysis included PHQ Total, dependent variable included total percentage of body fat

Table 4. Results of ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
	Regression	10842.300	1	10842.300	4.949	.033
	Residual	74489.030	34	2190.854		
	Total	85331.330	35			

3.4 Body Composition and Performance

To examine the relationship between body composition and performance linear regression was also used. Body composition (M=34.53, SD= 53.63) was used as a predictor for performance (M=25.8, SD 6.23). The sample size present within both variables represented 75% of the participant pool. Results showed that percent body fat within the sample did not predict performance, R^2=.06, F (1,28) = 1.67, p= .21.

Table 5. Regression statistics of body Composition and performance

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.237	.056	.023	6.15838

Table 5. Predictors within this analysis included total percentage of body fat, dependent variable included vertical jump max

Table 6. Result of ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
	Regression	63.380	1	63.380	1.671	.207
	Residual	1061.920	28	37.926		
	Total	1125.300	29			

4. Discussion

4.1 Participants

Participants within this study consisted of a single sport at one university. In order to gather data representative of collegiate athletes, it is important that future research broadens the sample of the study. The initial sample size within this research study included 40 participants. For the purposes of this manuscript, only the first round of data was used. Analysis for the first round of data collection consisted of 40 total participants. Sample sizes within analysis groups vary due to exclusion criteria requiring all components of each variable be completed by participants.

4.2 Depression and Body Composition

The results of the regression analysis of depression and body composition showed that depression was predictive of percent body fat within this study. This finding is not like any within literature known to the researchers. It suggests that an athlete's level of depression symptoms have some relationship with levels of body fat. This can be supported by literature examining stress and its impact on body composition overall.[7] It is known that cortisol within the body causes the storage of nutrients to shift.[7] Athletes who experience high levels of depressive symptoms may store fat differently than their counterparts. While coaches may shift training regimes to maintain a specific body composition, mental health must be considered. Research has also discussed the stigma within the sports environment around the topic of mental health.[7] Coaches often do not take mental health concerns as seriously as other physical injuries, as the sport culture is slow to tend to psychological treatment.[6] This research suggests it may be more beneficial to target the mental health, rather than body composition, of an athlete when assessing and judging body fat of athletes.

4.3 Depression and Performance

The regression analysis of the PHQ questionnaire total and the vertical max variable showed that depression was not a predictor of performance. This does not confirm the researcher's hypothesis that mental health directly impacts performance. Previous research did not directly address this research question. The findings did not agree with the researcher's hypothesis that depression would play a role in performance. Literature discussed the importance for care of the mind, body and soul of athletes though not directly related to performance.[7] Moreover, it could suggest that a more holistic approach to measuring mental health could be useful. Though depression was not directly predictive of performance, its relationship with body composition posed questions about possible indirect relationships between depression and performance. Depression was predictive of body composition, a variable that previous literature had found to be an indicator of performance. If mental health has some impact on the way the body stores fat, lean mass, other minerals, the effect this has on performance needs to be further studied.

4.4 Body Composition and Performance

Upon the completion of regression analysis for percent body fat and vertical jump maxes, researchers found that body composition was not predictive of performance within this sample. The finding is contrary to previous literature of body composition and performance that argued that body composition was indicative of performance.[2] Literature reporting that body composition is predictive of performance has gained a large following amongst coaches and trainers of elite athletes.[8] This research does not negate finds but does open room for research on the role mental health may play in the relationship between body composition and performance. The heavy reliance on what feeds into peak performance prompts further investigation.

4.5 Implications

The findings within this study suggest room for more research to explore the variability within performance that can be explained by body composition and mental health. Though mental health was not predictive of performance, it was predictive of body composition. This research suggests that current literature arguing that body composition may be an adequate and comprehensive indicator of performance may be incomplete and suggests that other variables may play a role in that relationship.

5. Limitations

5.1 Standardized Testing Session

Although body scans and written questionnaire data was collected from participants on the same day, the performance variable was measured prior to those sessions. A standardized testing session, where all data collection occurs on one given day, can remove some variability from data. In measuring mental health, alongside the vertical jump variable, measurements on different days give room for the mental health of the participant to change significantly from the time when performance was initially measure.[4] In replication, researchers should design a procedure that instructs participants to complete the written questionnaire, followed by the DEXA body scan. After some type of warm-up for the body, participants would then take the vertical jumps test following the completion of both the written questionnaire and the body scan.

5.2 Sample Size/Demographic

Although our participant pool varied in race/ethnicity and gender, it included one sport from a single university. Widening the participant pool to include other sports and other universities can allow for more reliable results. With these adjustments, the participant pool is likely to better represent the population being studied. Moreover, the inclusion of other sports can allow for more measures of performance to be explored as a baseline measure for all sports. While VerTec technology is a great standard for predicting physical performance, it does measure low-limb strength and vertical power, both elements not necessarily for all sports.[9] An improved method for measuring overall performance can improve the design of this study.

5.3 Mental Health Measure

This study focused on using depression as a measure of mental health within our participants. As mental health research continues to show, there is a large range of mental health struggles. Measuring other aspects of mental health will allow for a more holistic look at the mental health of participants. Those who may not experience depressive symptoms may experience other mental health struggles that were not measured within this study but that may influence body composition and performance. In athletes, literature shows evidence of higher risk for depression, anxiety, and eating disorders, thus there is room for research on how these impacts the relationship between body fat and performance.[8]

6. Conclusion

In conclusion, this research may present some flaws in the current literature in regard to body composition and performance. Body composition was not found to be a predictor of performance within this study, whereas depression was a predictor of body composition. There is room for research to examine the role that mental health plays in predicting body composition. The relationship between body composition and performance may be moderated by mental health in some way.

7. Acknowledgements

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