2022

Unexpected and Usual Breaks' Impact on Body Composition in College Athletes

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UNEXPECTED AND USUAL BREAKS' IMPACT ON BODY COMPOSITION IN COLLEGE ATHLETES

by

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A DISSERTATION

Submitted to the graduate faculty of The University of Alabama at Birmingham,
in partial fulfillment of the requirements for the degree of
Doctor of Philosophy

BIRMINGHAM, ALABAMA

2022

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NUTRITION SCIENCES

ABSTRACT

Body composition is an important factor that determines athletic performance. At the elite level, margins of victory are narrow, with small changes in performance making the difference between victory and defeat. Changes in body composition affect performance, in both improvements and decrements. Athletes regularly experience breaks from structured activity and resources caused by expected circumstances (school breaks, off-season) and unexpected circumstances (injury, COVID-19). Due to differences in diet, physical activity, and other factors, breaks may cause changes in body composition that can hinder or help the athlete upon return to structured resources. Currently, there is a plethora of cross-sectional research about body composition in athletes and changes over the course of a competitive season. However, research about body composition change over breaks is lacking. The purpose of this dissertation was to examine changes in body composition among college athletes over a variety of breaks. Investigation of pre and post measures of body composition were completed during the COVID-19 lockdown (aim 1), winter breaks (aim 2), and summer training cycle (aim 3). Collectively, the results indicated that body composition changes over breaks (aims 1, 2, and 3) and that those changes are sex specific (aims 1 and 2). Aim 1 showed a loss of body fat for males and a gain of body fat for females. Aim 2 showed that males gained body fat during an extended winter break. Aim 3 showed male collegiate basketball players gained fat-free mass and lost fat mass during summer training, partly during a four-week break. Future research should determine how weight-impacting behaviors such as diet and physical activity differ when college athletes are on campus versus on breaks. This research can help athletics staff develop strategies to help athletes maintain optimal body composition and performance during breaks.

Keywords: body composition, COVID-19, breaks, athlete, college

ACKNOWLEDGMENTS

I can't accurately articulate the feelings I have for the people who have helped me along my entire academic career and life. Without their support, guidance, and love, none of this would have been possible. I'd like to specifically thank my father, Greg, for everything he has done for me over the course of our lives. He is my best friend, my greatest supporter, and a great example of what it means to be a great person, friend, and father. We have put so much time, energy, and money into this process, and without you, none of this would be even remotely possible. I cannot and will not ever stop being thankful for everything you've done, do, and will do for me. Further, I would like to thank my committee, Drs. R. Drew Sayer, José R. Fernández, Brenda Bertrand, Eric Plaisance, and Ian McKeag, for the mentorship, time, effort, and patience you have given me during this process. Drew, thanks for agreeing to take me on as your first student; through some trial and error, we made it. Thank you to the lab group for allowing me to present my research and for fostering intellectually stimulating conversations. I would also like recognize all the other professors who were willing to have conversations with me while providing guidance and support, notably Drs. Paula Chandler-Laney, Kimberly Smith, Douglas Moellering, and Daniel Smith. A special thanks to all of the student athletes, coaches, and staff of UAB Athletics for giving me a home during much of my time at UAB and allowing me to conduct my research. Special thanks to all the RDs involved with UAB Athletics during my time there: Dr. Christian Behrens, Kelsey

Rushing, Lee Stowers, MG Bazemore, Maggie Sappington, and Kaitlyn Randall. Finally, I would like to acknowledge and thank all of the other students who helped me along the way with stimulating conversations, advice, and an outlet to vent frustrations. Thank you, everyone!

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INTRODUCTION

College athletics are a fixture of the national sports landscape and were reported to generate $18.91 billion in revenue during the 2018–2019 academic year [1]. As of the 2020–2021 academic year, 99,950 men competed in 25 sports, and 87,425 women competed in 28 sports in the 350 schools comprising Division I, and almost 500,000 athletes competed across 1,000 schools in all three divisions, making up roughly 2% of the entire U.S. college population [1].

The National Collegiate Athletic Association (NCAA), the governing body for college athletics, specifies how much time athletes are allowed to spend on their sport each week. The time an athlete spends in sports is measured by countable athletically related activities (CARA), defined as any required activity with an athletic purpose (e.g., practice, games, etc.) that involves student-athletes directed or supervised by the institution's coaching staff (including strength and conditioning coaches). All sports except for football and basketball may participate in 20 hours of CARA each week during the 132 days of in-season, capped at four hours per day, with a mandatory day off every seven days. During the off-season, CARA is reduced to eight hours per week, except for a 45-day off-season training interval when CARA is increased to 20 hours per week. This 45-day period, although occurring during the off-season, is counted as part of the total 132 in-season training days, reducing continuous training days to 87 days during in-season. Not included in CARA are optional lifts or practices organized by the athletes themselves, warm-up time before practice (e.g., practice starts at 2:00 p.m., but athletes arrive at 1:30 p.m. to prepare), or any type of care provided by athletic trainers, sports medicine doctors, or dietitians. Combining CARA and non-CARA activities, athletes can spend upwards of 30 hours per week in-season on athletic-related activities [2] in addition to time spent on classes and coursework.

Despite the standard definitions of CARA, there is some variability across sports. In baseball, for example, players are allowed eight hours of CARA per week from September to December (during their off-season), scheduled at the discretion of the coaching staff. Generally, four hours are used for strength and conditioning, and four hours are used for practice. Athletes also participate in optional lifts and practices not required by the coaching staff, which increases their overall time commitment above eight hours. The 45-day period where 20 hours of CARA are allowed occurs at the coach's discretion during the months of October–November. Athletes compete in practice or exhibition games against other colleges during this time, which is referred to as "fall ball." As finals start in December, athletes are free of CARA responsibilities until they return in January for the spring semester. At this time, they start 20 hours of CARA per week and continue through the end of the season, which lasts until May or June, depending on post-season play. Upon completion of the season, athletes are free of CARA responsibilities until the following school year. While CARA responsibilities are finished, many athletes participate in optional strength and conditioning sessions and practices organized by strength and conditioning coaches or other athletes over the summer break [2]. Understanding college athletes' schedules and requirements helps practitioners better understand how athletes' experiences change, allowing for better counseling and overall support.

Within this year-long schedule, athletes work with strength and conditioning coaches and other staff to optimize their performance. During the off season, athletes may work to pursue body composition (BC) goals, recover from injury, and correct muscle imbalances (e.g., a baseball player having more muscle mass in the more frequently used arm), eventually transitioning to a higher training volume to build the strength base for the season. Upon the start of the season, athletes participate in a maintenance phase to focus on maintaining strength, enhancing recovery, and maximizing performance during games. When the season concludes, a recovery window will begin, with the focus shifting away from performance and toward injury recovery and the general "wear and tear" that occurs during competition. The duration of the recovery window depends on the sport and athlete, but the cycle begins again after it is over [3].

Body Composition in Athletes

BC is the distribution of the amount of various tissue types in the human body, particularly fat mass and fat-free mass. BC assessment is both cross-sectional and longitudinal, where the method and timing of measurement depends on the person and their goals. Athletes may have BC measured multiple times a year to assess response to training, recovery status, and sport- and/or position-specific requirements for performance success. BC influences power, output, and aerobic endurance, affecting overall performance. Performance has a direct correlation with playing time and prospects, such as monetary gains via increase in name, image, and likeness (NIL) dollars [4-9]. NIL is a new statute through which a college athlete can profit from their name, image, or likeness via sponsorship deals. The more the athlete plays, the more access they may have to NIL opportunities.

The amount of fat mass and fat-free mass athletes have impacts their aerobic endurance, power, and the force they can generate, making BC an important factor for athletic performance [4-7]. Greater fat-free mass – skeletal muscle, in particular – increases the power-producing capacity, while greater fat mass decreases the efficiency of movement and negatively impacts speed and endurance [10-13]. For most sports, the highest fat-free mass to fat mass ratio maximizes athletic performance [14]. This trend is also prevalent across sports with weight class restrictions or with an emphasis on lower body weight [10, 15]. Studies evaluating specific sports have found that athletes with optimal BC for their specific sport and position performed better during competition [11-13, 16]. While no studies have comprehensively compared BC across all collegiate sports, numerous studies have compared BC in sports with varying physical demands.

Studies in male soccer and track and field athletes showed significantly lower body fat percentage and fat mass to fat-free mass ratio compared to athletes in swimming and baseball [17]. No differences were seen in soccer, track and field, and swimming for fat mass, fat-free mass, and body mass. Baseball had significantly higher fat mass and fat-free mass compared to swimming, track and field, and soccer [17]. Another study found that basketball and soccer athletes had similar and lower body fat percentages compared to football, hockey, golf, and wrestling. Football and golf were both significantly higher in body fat percentage than hockey [18].

Similar differences exist in women's sports. Comparing lacrosse, soccer, swimming, track and field, and volleyball, track and field had significantly lower fat mass and body fat percentage, compared to others. When comparing track and field to volleyball, track and field athletes had lower fat mass, percent fat, and weight. Lacrosse, soccer, and swimming had no significant differences across the measures of BC [17]. Another study in basketball, rowing, gymnastics, volleyball, lacrosse, and soccer found significant differences in BC between sports. Basketball and gymnastics had a significantly lower body fat percentage, while volleyball, lacrosse, and soccer had similar values, and rowing had a significantly higher value. For fat-free mass, gymnastics, soccer, and lacrosse had the lowest values but were similar, while basketball, rowing, and volleyball had significantly higher values than the other three [19]. Another study found women's golf had the highest body fat compared to basketball, hockey, soccer, softball, and volleyball [18]. One final study looking at 11 women's sports showed that cross country and gymnastics had the lowest body fat percentage and fat mass index when compared to the others [20].

While athletes in team sports play in the same game, certain positions have different demands that are associated with differing BCs. For example, a study on male and female soccer players found that goalkeepers had significantly higher body fat percentage, fat mass, fat-free mass, and body mass compared to the other positions [12, 17]. In volleyball, middle blockers had higher fat-free mass compared to other positions [17]. Track and field athletes showed similar differences in BC; throwers had higher values for body fat percentage, fat mass, and fat-free mass [21]. In softball, pitchers had consistently higher fat mass and body fat percentage than other position players [22]. In basketball, where there are two distinct positions, guards and forwards, forwards display higher values in all BC measures [23]. American football also shows a significant difference in BC across positions. While there is no significant difference in percent fat among running backs, wide receivers, and defensive backs, offensive and defensive linemen collectively had the highest body fat percentage, fat mass, and fat-free mass across all the positions. Comparing offensive to defensive line, no differences were seen in lean mass, but offensive linemen were significantly fatter than defensive linemen [24]. Results of cross-sectional studies are useful, allowing staff and others to understand what college athletes' BC may be, helping them to set goals for a variety of sports and positions. Cross-sectional data do not tell the full picture, allowing for just a snap shot in time of these athletes.

Body Composition Change Across Time in College Athletes

Longitudinal studies of college athletes' BC have been conducted for years. Conflicting results have been observed, due to differences in the methods of measurements, timing, and time points between measurements and resources available to athletes. A summary of some of the studies in college athletes are shown in **Table 1** below.

Table 1. Studies of college athletes BC change over time (No change=NC, Gain=G, Loss=L)

Author	Method	Gender/Sport	Participants	Timeframe	Weight	Fat Mass	Lean Mass
Boykin, J.R.[25]	DXA/BIA	M Football	29	7 weeks	G	NC	G
Rossi, F. E. [26]	BODPOD	M Baseball	30	2 months	NC	L	NC
Roelofs, E. J. [11]	DXA	M/F Swim/Dive	M=8 F=9	4 months	NC	L	G
McFadden, B. A.[27]	BODPOD	F Soccer	21	4 months	NC	L	NC
Frantz, T. L. [28]	SKINFOLD	M Baseball	19	4 months	L	L	NC
Mangine, G.T.[16]	DXA,BIA, WT,BODPOD	M/F Track/field	M=7 F=9	5 months	NC	NC	NC
Peart, A.[22]	DXA	F Softball	42	6 months	NC	L	L
Fields, J. B.[23]	BODPOD	M/F Basketball	M=127 F=196	6 months	M=NC F=NC	M=NC F=NC	M=NC F=L
Minett, M. M. [29]	DXA	F Soccer	23	6 months	NC	G	L
Prokop, M. [30]	DXA	M Hockey	19	6 months	NC	G	NC
Binkley, T. L. [31]	DXA	M Football	46	8 month	G	G	L

Zabriskie, H. A.[32]	DXA	F Lacrosse	20	9 months	NC	L	NC
Roelofs, E[33]	DXA	F Soccer	175	12 months	NC	NC	NC
Peart, A. N.[34]	BIA/BODPOD	F Soccer	18	12 months	L	L	G
Trexler, E. T. [35]	DXA	M Football	57	12 months	NC	L	G
Marthens, J. R.[36]	DXA	M Baseball	91	12 months	L	BC	L
Stanforth, P. R. [4]	DXA	F Basketball, soccer, swim, track, and volleyball	B=38 SC=47 SW=52 TR=49 VB=26	36 months	B=NC SC=NC SW=NC TR=NC VB=NC	B=G SC=NC SW=NC TR=NC VB=NC	B=NC SC-NC SW=G TR=NC VB=G
Katona, A [37]	BODPOD	F Soccer	49	48 months	G	G	G

As shown in **Table 1**, results are mixed, with no consistency in sports or timeframes. Many studies assess athletes at only two time points, pre and post season, which are useful measures but limited in scope. A stronger approach would be to conduct serial assessments over the course of a calendar year. Roelofs' study [33] of female college soccer players used this serial approach; measurements taken six times over the course of the year found that BC fluctuated based on the time of season. Athletes had higher lean mass and lower fat mass during pre-season and maintained throughout the season. Following the season, athletes lost lean mass and gained fat mass during the off-season, with BC returning to the first measurement during pre-season, showing an overall neutral change in BC over the course of study. Over the course of the entire study, there was no change in BC, but with this serial approach, seasonal variation was discovered in these athletes. Similar results are seen elsewhere [16, 31, 34, 35], with the optimal BC (highest lean mass, lowest fat mass) occurring during the pre-season and less optimal BC (lower lean mass, higher fat mass) occurring during the off-season. This review is focused on college athletes, but negative BC changes have also been reported during the off-season for professional athletes [38-40]. Building on the cross-sectional data discussed above, the longitudinal data add more to the overall picture of what college athletes BC looks like. While both of these data sets are useful, a missing piece that is important to study to help staff and practitioners is BC change when athletes are on breaks.

Factors Influencing Body Composition Change in College Athletes

As discussed above, type of sport played, position, and time of year are all factors impacting BC and BC change. Other factors influence BC and its change potentially via indirect mechanisms such as changes in eating behavior, physical activity, and mental state. These factors include COVID-19, access to resources, eating habits, and the transition to college, which are all discussed below.

COVID-19 was an unprecedented situation that led to the cancellation of spring athletics and athletes being sent home with limited knowledge of when they would return. Numerous adverse effects were seen on the mental and physical health of athletes, including struggles returning to sport mentally and physically, difficulty maintaining adequate physical activity, sleep pattern changes, lack of motivation, and overall less healthy behaviors [41, 42]. Research tracking the BC of athletes during this time primarily shows negative effects. Four studies, one in football players [43] with four months between pre- and post-COVID-19 measurements, a two-month study in soccer players [44], a three-month study in soccer players [45], and a two-month study in fencing athletes [46], showed detrimental effects on BC (loss of lean mass and gain in fat mass) due to the lockdowns. Another study found lower muscle mass gain due to the COVID-19 lockdown than a usual spring training cycle in football players [47]. In contrast, a study in soccer athletes showed no change in BC [48] during one month of lockdown. These contradictory results could be due to the short duration of the study.

There is a wide degree of variability in the amount of money universities spend on providing food and nutrition counseling to student-athletes. Some large and well-funded athletic departments spend millions of dollars on feeding athletes, employing dietitians, and providing other resources that can improve BC, while smaller colleges and universities spend significantly less on these resources [49-51]. University-provided meals can comprise a large portion of student-athletes' daily food intake. Providing less food and resources may lead to food insecurity in athletes, an understudied issue that is estimated to be present in 10–25% of athletes [52]. Many athletes come from low socioeconomic status families, which also puts them at a higher risk for food insecurity [53]. Food insecurity also may be driven by busy schedules during school sessions (i.e., classes, team meetings, training, competition) that do not allow athletes to pursue part-time jobs or other avenues to support themselves beyond what is provided [54-56]. Previous research in college students shows that food insecurity is associated with poor BC outcomes, including obesity, lower fat-free mass, and higher fat mass [57].

The eating habits of college athletes can vary greatly compared to age- and sex-matched non-athletes, with timing of meals and the amount of calories consumed being the greatest differences between these groups. Athletes need to structure their diets around school, practice, lifting, and treatment, which can lead to unique meal timing. Diets also tend to change depending on the time of year based on a particular sport. An off-season diet is typically different from an in-season diet, leading to BC changes [10, 14, 58]. Many male athletes take in more than 5,000 kcal per day during in-season training. Preparing that amount of food in a limited amount of time can be difficult. Student-athletes also may lack the nutrition knowledge and cooking equipment to implement proper nutrition practices [56, 59]. In a study of college athletes, a lack of nutrition knowledge was associated with higher percent body fat [60]. Similar findings that could have impacts on health have been observed in students who are not participating in college athletics [61, 62].

Attending college is a significant life event that often effects changes in eating behavior. Where an athlete lives (on versus off campus), who they live with, and access to resources (financial and otherwise) all influence eating behavior and, in turn, BC [63, 64]. For many athletes, the eating environment changes when they move from home to school, leading to better eating at home than at school or the reverse [65, 66]. All of these factors influence and contribute to BC changes during the different phases of a season and from year to year.

Conclusion

BC and changes in BC of collegiate athletes is multifaceted and influenced by a variety of factors, some of which are more easily regulated than others. Change in BC is not inherently negative or positive. As discussed above, slight changes are seasonal and often warranted to help athletes who wish to increase muscle size and strength during the off-season and following a prolonged in-season to promote recovery for the next training cycle and season within a sport. Often, planned breaks at the end of the season and during various training cycles are needed before the start of the next season. During breaks, which require athletes to train on their own away from campus resources, many athletes face challenges they may not have the knowledge, skills, or access to resources to resolve easily. Regardless of when breaks occur, changes in BC can and often do impact performance. BC changes that influence performance in any way could negatively affect playing time and increase injury risk. For example, an increase in fat mass and loss of lean mass in a midfielder in soccer could decrease time in the 40 yard dash or decrease reaction time on a key play. In contrast, a decrease in fat mass in collegiate baseball players could indicate that the athlete is in negative energy balance and could produce loss of skeletal muscle mass with subsequent negative effects on performance. While much has been done to examine changes in BC using cross-sectional and longitudinal methods over the course of one or more seasons, there is currently a lack of information about how BC changes over breaks (unexpected and expected) in collegiate athletes. Results of these studies can help practitioners understand the impact of breaks and help to design programs and utilize resources to help athletes better understand and navigate changes in BC that occur during breaks.

Purpose and Specific Aims

To address this gap, the overall purpose of my dissertation research is to investigate the impact of breaks from athletic training on BC in collegiate athletes. My dissertation comprises the following three specific aims:

Aim 1 – Assess changes in body composition, physical activity, and eating behavior among athletes before and after the COVID-19 lockdown. Body composition data were collected on athletes in January 2020 and August/September 2020, and data were retrospectively used for research purposes. Athletes also completed questionnaires on changes in physical activity and diet during the lockdown period, which will be considered potential mediators of changes in BC. Hypotheses: 1a: Increased fat mass and reduced muscle mass will be observed in athletes over the COVID-19 lockdown. 1b: Increased fat mass and reduced muscle mass will be associated with lowered physical activity and poorer diet over the COVID-19 lockdown. 1c: There will be no differences between the sexes in body composition change among athletes.

Aim 2 – Compare changes in body composition following the usual winter break to changes following the extended winter break due to COVID-19 restrictions. Body composition data were collected in athletes as part of routine care with the knowledge it would also be used for research purposes. For this aim, changes in body composition during a usual winter break (2021: five to six weeks in length) will be compared to the extended winter break (2020: seven to eight weeks in length). Hypotheses: 2a: Increases in fat mass and reductions in muscle mass will be more pronounced during the extended winter break. 2b: There will be no differences between the sexes in the comparison of body composition change among athletes.

Aim 3 – Assess changes in body composition in male college basketball players over the summer training cycle. Previously collected body composition data on men's basketball players will be used to assess changes over a summer training cycle. This involves three separate measures: one at the start of summer training, one at the end of seven weeks of intense summer training, and one at the end of a four-week break from structured training. Hypotheses: 3a: Fat mass will be reduced and fat-free mass will be increased during summer training. 3b: Reductions in fat mass and increases in lean mass gained during summer training will be partially lost during the four-week absence from structured training.

BODY COMPOSITION CHANGE IN COLLEGE ATHLETES DURING THE COVID-19 LOCKDOWN

by

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International Journal of Sports and Exercise Medicine

Format adapted and errata corrected for dissertation

Abstract

Background

In the spring of 2020, COVID-19 shocked the college sports world with athletes having seasons abruptly canceled and sent home under mandatory lockdown orders. Athletes and athletic performance staff had no idea when they would be back on campus or have access to on-campus athletics facilities. This situation caused substantial concern regarding potential adverse changes to athletic performance and body composition in the athletes. The purpose of this study is to assess how weight, muscle mass, and fat mass changed in collegiate athletes while they were prohibited from using on-campus athletic facilities due to the COVID-19 pandemic.

Methods

Body weight, fat mass, and muscle mass were measured using bioelectrical impedance analysis as part of routine care for 77 collegiate athletes (n=43 male, n=34 female) pre-lockdown (Jan 2020) and shortly after their return to on-campus training (Aug/Sept 2020). 4 questions were asked to assess eating behavior and physical activity. Pre- and post-lockdown body composition data and survey data were analyzed using ANOVA and ANCOVA (SAS 9.4). To account for differences in body size, height was used calculate body mass index (BMI), fat mass index (FMI), and muscle mass index (MMI) for assessing changes in weight, fat mass, and muscle mass, respectively.

Results

No significant differences by sex in BMI or MMI were detected between pre and post lockdown. FMI changed according to sex, males lost FMI and females gained FMI.

Conclusion

These data demonstrate potential sex differences in fat mass changes among college athletes during a mandatory absence from on-campus athletic facilities and in-person support from coaching and performance staff. Future research should determine whether future breaks – either anticipated or unanticipated – influence body composition and what the drivers of changes in body composition may be. Such research may help to develop sex-specific strategies for maintaining optimal body composition and athletic performance during extended breaks from structured athletic training.

Introduction

College athletes train extensively for their sport over the course of the year. During in-season periods, these athletes train up to 20 hours a week with additional hours spent on recovery, for a total commitment of upwards of 30 hours a week. In the off-season, athletes still engage in at least 8 hours of training per week and continue to spend time on recovery. Mandatory breaks from intensive training are integrated into collegiate athletes' training cycles to provide time to focus on academics and health. However, it is possible that athletes may experience reversals of body composition and performance gains during these breaks from training. The impact of mandatory breaks from training on body composition in collegiate athletes, especially unanticipated breaks such as during the COVID-19 lockdown, warrants further investigation.

COVID-19 had numerous adverse impacts on athletes' mental and physical health including a struggle to return to play, difficulty maintaining adequate physical activity (PA), sleep pattern changes, lack of motivation, and overall less healthy behaviors [1, 2]. These behavior changes could have resulted in detraining and reductions in performance [3]. Due to the novelty of the situation, researchers and athletics staff know very little about the consequences of the COVID-19 lockdown on athlete's body composition. Previous studies that have investigated the impact of COVID-19 lockdowns on athlete body composition show conflicting results. Two studies, one in football players [4] with 4 months between pre- and post-COVID-19 measurements and a 2-month study in fencing athletes [5], both showed a gain of fat mass and loss of muscle mass. Alternatively, a study in soccer athletes showed no change in body composition [6] during 1 month in lockdown. These conflicting results could be partially driven by differences in the amount of time between pre- and post-COVID-19 body composition measurements. In particular, it is possible that 1 month of lockdown is not a sufficient amount of time to observe and detect body composition changes.

Body composition is important for performance and success in sports [7-10]. The absolute amount of fat and fat-free mass can impact performance by influencing both strength and speed [11]. Reductions in fat mass and increases in fat-free mass have been shown to increase power output and force generation leading to improved performances [12]. These changes in body composition are influenced by a variety of factors, mainly one's PA regimen and diet [13, 14]. Given that PA and diet are likely to change during extended breaks, particularly when unanticipated as in the COVID-19 lockdown, it is possible that body composition was adversely impacted during this time.

To date, little is known about body composition changes in athletes during the COVID-19 lockdown, and the data currently available in the literature are conflicting. It is important to understand how breaks from structured activity impact body composition in order to maximize player readiness and to understand the influence of diet and PA on these changes. The purpose of this study was to investigate changes in body composition during the COVID-19 lockdown and determine if body composition changes were different between male and female athletes. We also obtained question data from athletes on eating and physical activity behaviors to assess how these may have influenced body composition changes. We hypothesized that body composition would be worse (i.e., increased fat mass and reduced fat-free mass) upon the return from the COVID-19 lockdown and that there would be no sex differences body composition changes. We further hypothesized that unhealthy changes in diet (greater overall intake and reduced diet quality) and PA (reduced overall PA and reduced quality of PA) would at least partially explain changes in body composition.

Methods

Participants

Data for this study were obtained from student-athletes enrolled at a Southeastern division 1 university (University of Alabama at Birmingham, UAB). Body composition assessments are routinely conducted on many student-athletes, which were used for this analysis. Athletes eligible for inclusion in this analysis were those with valid body composition measures from Jan/Feb 2020 (pre-COVID-19 lockdown) and Aug/Sept 2020 (post-COVID-19 lockdown) and participated in the following sports: baseball, softball, women's basketball, men's soccer, and beach volleyball. Student-athletes participating in football, men's and women's golf, men's and women's tennis, track and field, cross country, court volleyball, rifle, and men's basketball were not eligible for inclusion in this analysis due to not routinely having body composition measured, different dates of measurement, or different methods for measuring body composition compared to the sports included.

Protocol

Body composition data were collected on athletes prior to lockdown orders being implemented (January/February 2020) and as soon as athletes returned to the university setting (August/September 2020). Athletes also completed questions on changes in PA and diet during the lockdown period, which was investigated as potential mediators of changes in body composition. These questions were created by an author (AJD) who was a registered dietitian for UAB Athletics at the time of data collection. Body composition and question data were initially collected as part of routine care and were retrospectively approved for research use by the Institutional Review Board at the University of Alabama at Birmingham. Student athletes with complete body composition measures from pre- and post-lockdown provided informed consent to allow their data to be used for research purposes.

Body Composition Assessment

Body composition and body weight were measured using Tanita MC-780U (Tanita Corp of America, Inc. Arlington Heights, Illinois, USA) a multi-current 8-mode bioelectrical impedance analysis machine. Outcomes recorded at baseline and follow-up included body weight, percent body fat, fat mass, muscles mass, fat free mass, and total body water percentage. Athletes were assessed in the morning upon waking in a fasted state with lightweight clothing and with socks and shoes removed.

Self-Reported Changes in Diet and PA Behaviors Questions

Changes in the perceived quality and quantity of diet and of PA during the lockdown compared to their usual behaviors were assessed using a 5-point Likert scale. For quality of diet and PA, the Likert scale was anchored with descriptions of 1: A lot worse and 5: A lot better. For quantity of diet and PA, the Likert scale was anchored with descriptions of 1: A lot more and 5: A lot less. Diet and PA quality responses of 1 (A lot worse) and 2 (Slightly worse) and 4 (Slightly better) and 5 (A lot better) were combined into single categories of “worse” and “better,” respectively, which resulted in 3 categories of “worse”, “no change”, or “better” diet and PA quality. Similarly, diet and PA quantity responses of 1 (A lot more) and 2 (Slightly more) and 4 (Slightly less) and 5 (A lot less) were combined into relevant categories resulting in 3 categories of diet and PA quantity (more, no change, and less). The questions available for reference in in appendix 1.

Statistical Analysis

Descriptive statistics were conducted to obtain mean and standard deviation for quantitative variables and frequency statistics for the diet and PA survey responses. Height was used to calculate BMI (kg body weight/m^2), muscle mass index (MMI, kg muscle mass/m^2), and fat mass index (FMI, kg fat mass/m^2) to account for differences in overall body size among the athletes. Exploratory analyses were performed to identify potential confounders for the statistical models using correlation analysis with body composition variables and survey data. Primary models were initially used to test for differences in body composition changes by sex without including diet and PA behavior survey responses. This decision was made because these survey-based questions were initially created by AJD for non-research purposes and their inclusion in the analysis should be considered as exploratory. Initial, primary models included the following: Analysis of Variance (ANOVA) was used to test for differences in changes in BMI between male and female athletes. Sex differences between MMI and FMI change were assessed using analysis of covariance (ANCOVA) with FMI and MMI as covariates, respectively. Subsequently, more comprehensive and exploratory ANCOVA models were used to test for sex differences in body composition changes with the inclusion of survey responses for diet and PA quality and quantity. In all of the models described above the dependent variable was body composition change and the independent variable was sex. Significance was set at $p<0.05$ for all outcomes and SAS version 9.4 (Cary, NC) was used for all statistical analyses.

Results

As shown in Figure 1, N=77 of the total 120 student athletes eligible for the study had complete body composition data from before and after the COVID-19 lockdown. Self-reported diet and PA data were provided by 73 of 77 athletes. Body composition characteristics of the n=77 athletes are shown in Table 1.

Table 2 shows results from the initial minimally-adjusted models for sex differences and body composition change. The overall models for ΔFMI ($F=8.79$, $p < .01$) and ΔMMI ($F=3.58$, $p=0.03$) were significant, whereas the overall model for ΔBMI was not significant ($F=3.43$, $p=0.07$). Over the lockdown, ΔFMI was different between men and women ($F = 11.21$, $p < 0.01$). ΔFMI was reduced in males (-0.22 ± 0.50), which is equivalent to approximately at 1% reduction in total fat mass. Alternatively, ΔFMI increased among females (0.28 ± 0.91) or approximately a 1% increase in fat mass. There was a trend for a sex difference in ΔBMI ($F=3.43$, $p = 0.07$) that appears to be driven by ΔFMI as there was no significant difference in ΔMMI by sex.

As shown in table 3. the majority of athletes reported that the quality of their diet either did not change or improved during the COVID-19 lockdown, with only 20 athletes (27%) reporting worse diet quality. Half of the athletes reported eating more during the COVID-19 lockdown, while the other 50% reported either eating less or no change. Approximately half of athletes reported a decrease in both the quality and quantity of PA during the COVID-19 lockdown.

Table 4, Table 5, and Table 6 are results of more comprehensive models testing for sex differences in body composition changes with the inclusion of the survey responses of diet and PA quality and quantity. The overall models for ΔBMI ($F=0.75$, $p =$

0.66) and ΔMMI (F=1.61, p = 0.13) were not statistically significant and therefore results from these analyses are inconclusive. The overall model for ΔFMI was statistically significant (F=2.16, p = 0.03), but including diet and PA survey responses did not alter the observed sex difference in ΔFMI and no main effects were detected for diet or PA.

Discussion

Results of this study partially support our hypothesis that body composition would be worse (i.e., increased fat mass and reduced fat-free mass) upon return from the COVID-19 Lockdown, but do not support our hypothesis that there would be no sex differences in body composition change. Changes in body composition differed by sex. During the COVID-19 Lockdown women gained fat mass, a negative change, while men lost fat mass, a positive change. Changes in fat mass by sex during the COVID-19 lockdown were not related to self-reported changes in diet and activity levels. No other significant relationships or changes by sex were seen in BMI or MMI.

Results of our study are somewhat different to what has been reported in the general population in response to the COVID-19 lockdown, which have found weight gain that was partially due to a decrease in activity [15, 16]. Prior studies in athletes and non-athlete college students reported a gain in body fat and loss of muscle mass during COVID-19, despite a shorter window of assessment compared to our study (2 months vs. 6-7 months) [5, 17, 18]. The study of elite fencing athletes by Yasuda et al[5] showed no change in body composition for men but a gain in fat mass for women. In male soccer players a similar to the female fencing athletes fat mass increased leading to decreases in sprint performance [17]. Again a similar gain in fat mass was seen in recreationally active college age males during the lockdown, one with no decrease in performance though [18]. Although there was no measure of athletic performance in the current study, previous studies have shown that changes in fat mass are inversely related to athletic performance [3, 11, 12, 19, 20]. The presence of such conflicting findings suggests that more research is needed to fully understand the impact of COVID-19 lockdowns on body composition and health-related behaviors.

Question data in the current study showed that the majority of athletes had a decrease in both quality and quantity of PA. On the other hand, a majority reporting that they consumed a greater amount of food but also that the quality of their diet was higher during the COVID-19 lockdown. Studies looking at similar outcomes in non-athletes also showed an increase in obesogenic diet behaviors and a decrease in PA due to COVID-19 [16, 18, 21-24]. The decrease in PA seen could be explained by the mass closure of gyms due to the pandemic and the resulting surge in the purchases of home fitness equipment. This situation led to long waits for equipment, causing many individuals to resort to bodyweight workouts or to not exercise at all. A study in rugby players found similar results with their athletes increasing both the quality and quantity of their diet during this time period [24]. In the current study none of the changes in diet or PA were associated with changes in body composition. This could be partially due to the unvalidated nature of our survey and the brief, single question measures of the relatively complex constructs of the amount and quality of diet and PA. Another possibility could be that while athletes increased their food intake they also increased the quality of their diet, which may have helped mitigate any adverse changes caused by an increase in food intake and decrease in physical activity.

There are a couple explanations that could be driving this change of diet behavior during COVID versus at school. Studies have shown that during college it can be hard for students to eat well due to access and time constraints [25-27]. These issues would be higher in college athletes due to extra demands on time, making it harder for them to eat how they would like. The decreases in time commitments and possible increase in access could be driving the changes in eating behaviors observed in our study. Another explanation could be that the home environment with parents may provide a more positive food environment for athletes compared to on-campus living (e.g., parent preparing meals, greater financial access to foods, cooking appliance, etc.). Changes in the food environment were observed in the general college age individuals and drove changes in this population [25]. For athletes being at home due to the structure, access, and time could lead to the reported changes in diet in our study, mitigating some of the negative effects seen in other populations due to the COVID-19 Lockdown.

A strength of our study is that participant sex distribution was approximately equal, and included several different sports which supports the generalizability of these results across sports and athletes. The study was limited due to its retrospective nature and the fact that athletes had been back on campus for a variable amount of time before being tested and surveyed. Regardless of this we were able to pair our body composition data with survey data which few studies have been able to do during the COVID-19 Pandemic. Due to the uniqueness of the situation, our survey had not previously been validated but it was based off of questions asked in previously validated surveys. BIA is both a strength and limitation of this study. It is a strength due to its ability to detect changes in body composition as well as weight. It is a limited, however, because BIA can be influenced by hydration status and electrolyte status. However, the measurements were collected in a fasting-state in the morning on both occasions to partially mitigate this limitation.

Overall, our study found that body composition changed over the COVID-19 Lockdown in a sex-specific manner with decreases in adiposity for male athletes and increases in adiposity for female athletes. Together with the existing literature about body composition changes during breaks in training, these results will inform practitioners about how body composition is impacted by planned and unplanned interruptions to training for male and female athletes. Athletic programs should be aware of unanticipated interruptions and have plans in place to support athletes during these interruptions. Future studies should prospectively evaluate whether these body composition trends are apparent during usual breaks for college athletes, and use validated methods to objectively evaluate diet and behavior change during breaks.

Acknowledgements

The study was designed by Aston Dommel and R Drew Sayer and data were collected by Aston Dommel; the data were analyzed by A Dommel, JR Fernandez, and RD Sayer; and data interpretation and manuscript preparation were undertaken by A Dommel, JR Fernandez, and RD Sayer. All authors approved the final version of the paper. A Dommel is supported by a NIH T-32grant (T32HL105349) awarded by the Heart, Lung and Blood Disease Institute (NHLBI) and additionally supported by Award Number P30DK056336 from the National Institute Of Diabetes And Digestive And Kidney Diseases. The authors have no conflicts of interest in this study. Additional contributions in manuscript development were made by Paula C. Chandler-Laney. The authors would also like to thank the Nutrition and Obesity Research Center at the University of Alabama at Birmingham and UAB Athletics for support during development of this publication.

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Appendix 1

1. How do you feel the quality of your diet changed over the course of lockdown compared to your usual diet at UAB? (select one)
    a. A lot worse
    b. Slightly worse
    c. No change
    d. Slight better
    e. A lot better
2. How do you feel the quantity of your diet changed over the course of lockdown compared to your usual diet at UAB? (select one)
    a. A lot more
    b. Slightly more
    c. No change
    d. Slight less
    e. A lot less
3. How do you feel the quality of your physical activity changed over the course of lockdown compared to your usual physical activity at UAB? (select one)
    a. A lot worse
    b. Slightly worse
    c. No change
    d. Slight better
    e. A lot better
4. How do you feel the quantity of your physical activity changed over the course of lockdown compared to your usual physical activity at UAB? (select one)
    a. A lot more
    b. Slightly more
    c. No change
    d. Slight less
    e. A lot less

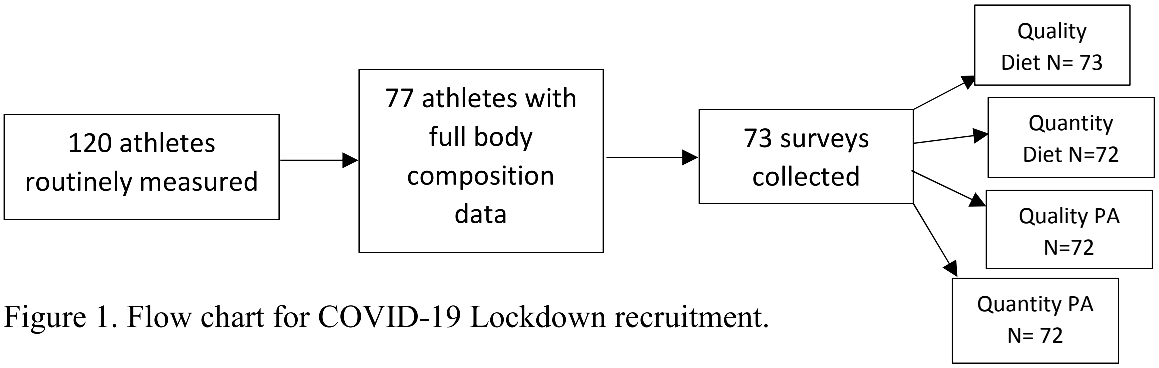

Figure 1. Flow chart for COVID-19 Lockdown recruitment.

	Male	Baseball	Men's Soccer	**Female**	Women's Basketball	Softball	Beach Volleyball
N	43	24	19	34	8	16	10
AGE (y/o)	20.30 ±1.26	20.79 ±1.14	19.10 ±1.37	19.50 ±1.26	19.63 ±.74	19.69 ±1.40	19.10 ±1.37
HT (in)	72.34 ±2.80	73.48 ±2.26	70.89 ±2.79	68.09 ±2.93	70.88 ±2.30	66.47 ±2.60	68.45 ±2.11
ΔBMI	-0.21 ± .91	-0.18 ±1.07	-0.25 ±.68	0.23 ± 1.2	0.24 ± 1.17	0.39 ±1.26	-.001 ±.126
ΔFMI	-0.22 ±.50	-0.26 ±.57	-0.18 ±.42	0.28 ±.91	0.35 ±.92	0.35 ±.93	0.13 ±.94
ΔMMI	0.006 ±.66	0.07 ±.77	-0.07 ±.49	-0.04±.45	-0.11 ±.52	0.05 ±.46	-0.13 ±.41

Table 1. Descriptive Characteristics of Athletes included in the COVID-19 analyses (n=77). Data are mean ± SD.

	F value	P value	Male Mean ±SD	Female Mean ±SD
ΔFMI	11.21	<.01	-.22 ±.50	.28 ±.91
ΔBMI	3.43	.07	-.21 ± .91	.23 ± 1.2
ΔMMI	1.53	.22	.006±.66	-.04±.45

Table 2. Results of Unadjusted ANOVA for ΔBMI and ANCOVA for ΔFMI and ΔMMI

Question	Response	Total	Male	Female
Quality of diet	Got worse	20 (27%)	11(55%)	9(45%)
	No change	18(25%)	12(67%)	6(33%)
	Got Better	35(48%)	20(57%)	15(43%)
Quantity of diet	Ate more	36(50%)	24(67%)	12(33%)
	No Change	20(28%)	11(55%)	9(45%)
	Ate less	16(22%)	7(44%)	9(56%)
Quality of PA	Got worse	39(54%)	23(59%)	16(41%)
	No change	19(26%)	11(58%)	8(42%)
	Got Better	14(20%)	8(57%)	6(43%)
Quantity of PA	Did more	17(23%)	10(59%)	7(41%)
	No Change	20(28%)	15(75%)	5(25%)
	Did less	35(49%)	18(51%)	17(49%)

Table 3. Descriptive Characteristics of Self-Reported Change in Quality and Quality of Diet and Physical Activity

Variable	F Value	P Value
Quality of Diet	.62	.54
Quantity of Diet	1.91	.16
Quality of PA	.11	.89
Quantity of PA	.06	.94
Sex	1.15	.29

Table 4. Adjusted ANCOVA for ΔBMI

Variable	F Value	P Value
ΔFMI	6.10	.02
Quality of Diet	1.99	.15
Quantity of Diet	1.65	.20
Quality of PA	.72	.49
Quantity of PA	.39	.68
Sex	2.38	.13

Table 5. Adjusted ANCOVA for ΔMMI

Variable	F Value	P Value
ΔMMI	6.10	0.02
Quality of Diet	3.13	0.06
Quantity of Diet	1.58	.22
Quality of PA	.61	.55
Quantity of PA	.57	.57
Sex	7.74	.01

Table 6 Adjusted ANCOVA for ΔFMI

BODY COMPOSITION CHANGE IN COLLEGE ATHLETES DURING HOLIDAY BREAKS

by

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International Journal of Sports and Exercise Medicine

Format adapted and errata corrected for dissertation

Abstract

Background

Changes in eating and physical activity during the winter holiday season are commonly associated with weight gain in the general population. Concerns around weight and fat gain are also relevant to collegiate athletes who are generally unable to access on-campus dining and exercise facilities during this time. These concerns were exaggerated in 2020 due to changes in the academic and sports calendar as a result of the COVID-19 pandemic that lead to a holiday break that was 3 weeks longer than normal for many college athletes. The purpose of this study was to investigate changes in body mass index (BMI), fat mass index (FMI) and muscle mass index (MMI) among college athletes during an extended and usual holiday break.

Methods

Fat mass, muscle mass, and weight were measured using bioelectrical impedance analysis as part of routine care in college athletes within two weeks of leaving campus and return to campus during the extended winter break in 2020 (n=124 athletes) and the usual winter break in 2021 (n=64 athletes). Change values were calculated for each dependent variable. Differences between extended and normal winter breaks, male and female athletes, and a sex*break interaction were assessed using ANCOVA (BMI and FMI) and Kruskal-Wallis Test (MMI). All analyses were completed using SAS 9.4.

Results

A significant sex*break interaction was observed for BMI and FMI. Male athletes gained BMI and FMI during the extended winter break compared to other sex*break conditions. No differences were found for change in MMI across conditions.

Conclusions

These results demonstrate potential differences in weight and fat mass changes between male and female athletes during an extended holiday break. Future research should investigate whether body composition changes occur during other breaks athletes experience (e.g., summer break) and determine how weight-impacting behaviors such as diet and physical activity differ when they are on campus versus at home. This research can help athletics staff implement strategies to best help athletes maintain optimal body composition and performance during breaks.

Introduction

In Western societies, the holiday season is a time from November through January where there are many holidays centered around food and celebration. For many years it has been a worry for the general population that there is a tendency to gain weight over the holiday season. Research has shown that there is a significant weight gain over the holiday season, roughly 1kg, due to increase caloric intake and decreased physical activity [1-3]. This weight gain is primarily in the form of fat.

While this amount of weight gain may seem modest, even relatively minor changes in body composition may affect athletic performance in highly-trained athletes. Absolute values of fat mass and fat free mass contribute to the amount of force, power, and speed an athlete is able to produce [4]. Greater fat free mass – skeletal muscle in particular – increases the power producing capacity of athletes, while greater fat mass decreases the efficiency of movement and negatively impacts speed and endurance [5-8]. For most sports, having the highest fat free mass to fat mass ratio is the goal to maximize athletic performance.

In collegiate athletes, body composition has been shown to change over time including within competitive seasons [4], during breaks from structured training [9], and over the course of their college careers [10]. Increases and decreases in both fat free mass and fat mass have been observed. These changes are due to many factors; time of year, type of training, injury, and dietary changes. There is also research showing that athletes may gain weight over the holiday season [11, 12].When athletes have increases in fat mass and decreases in fat free mass performance can decrease [6, 13]. Similarly, when athletes go on breaks from structured training, their performance is decreased upon return [14-17].

COVID-19 changed the entire structure of college athletics in 2020. Most spring seasons were cancelled, and many fall season structures were disrupted and some "fall sports" held competitive seasons in the spring [18]. It also lead to changes in the academic calendar for many schools. During a usual winter break, athletes are off campus for roughly 4-6 weeks. Due to COVID-19, many schools transitioned to online school after the Thanksgiving holiday, making an extended winter break off campus of 7-8 weeks [19]. Many areas around the country placed restrictions on business and activities during the holiday season to help mitigate the spread of the virus.

The holiday season is generally a concern for coaches and staff of college athletes due to possible body composition changes and associated performance decreases. This concerned was magnified during the fall of 2020 due to the longer holiday break, less access to resources than usual holiday breaks, and that most primarily fall sports became spring sports during the 2020-2021 school year. The purpose of this research was to investigate whether the extended holiday break resulted in different body composition changes than a usual holiday break in collegiate athletes and whether these changes differed between male and female athletes. It was hypothesized that there would be decreases in muscle mass and increases in fat mass over the holiday breaks, that these changes would be more pronounced during the extended holiday break, and there would be no sex differences in body composition changes.

Methods

Protocol

Body composition data were collected on athletes within two weeks of leaving and returning for winter breaks in 2020 (November 2020 and January 2021) and 2021 (December 2021 and January 2022). Due to changes implemented by the university to prevent the spread of COVID-19, the 2020 winter break was approximately 3 weeks longer than the 2021 winter break. Students left campus the week of Thanksgiving and were not allowed to return to campus until January 2021. All study procedures were reviewed and approved by the University of Alabama at Birmingham (UAB) Institutional Review Board, and athletes provided written informed consent prior to their participation.

Participants

Data for this study were obtained from student-athletes enrolled at a Southeastern division 1 university (UAB). Body composition assessments are routinely conducted on many student-athletes. For this study, the timing of body composition assessments were adjusted to ensure 2-week windows for research purposes. Athletes eligible for inclusion in this analysis were those with valid body composition measures taken within two weeks before and after the holiday breaks in 2020 and 2021. Athletes participated in one the following sports: baseball, softball, women's soccer, men's soccer, court volleyball, and beach volleyball. Student-athletes participating in football, men's and women's golf, men's and women's tennis, track and field, cross country, rifle, and women's and men's basketball were excluded from the study due to not routinely having body composition measured, different dates of measurement, or different methods for measuring body composition compared to the sports included.

Body Composition Assessment

Body composition and body weight were measured using Tanita MC-780U (Tanita Corp of America, Inc. Arlington Heights, Illinois, USA) a multi-current 8-mode bioelectrical impedance analysis machine. Outcomes were recorded pre and post winter breaks. Outcomes used for this study include body weight, fat mass, and muscles mass. Athletes were assessed in the morning upon waking in a fasted state with lightweight clothing and with socks and shoes removed.

Statistical Analysis

Descriptive statistics were conducted to obtain mean and standard deviation for quantitative variables. Height was used to calculate BMI (kg body weight/m^2), muscle mass index (MMI, kg muscle mass/m^2), and fat mass index (FMI, kg fat mass/m^2) to account for differences in overall body size among the athletes. Analyses were performed to identify potential confounders for the statistical models using correlation analysis with body composition variables. These confounders were included in the appropriate models as follows: for BMI included age, for FMI included age and MMI, and for MMI included age and FMI. For each break, a change variable was created for BMI, FMI, and MMI. These change variables where then compared via general linear models, ANCOVA's, to test for the main effects of break, sex and a sex*break interaction on each body composition variable. A repeat variable was created to account for those participants (n=31) who contributed data to both the 2020 and 2021 winter breaks. This repeat variable was included as a covariate in each model. If a change variable was unable to fit the model, a Kruskal-Wallis nonparametric test was used to assess differences between breaks. Significance was set at $p<0.05$ for all outcomes and SAS version 9.4 (Cary, NC) was used for all statistical analyses.

Results

As shown in **Figure 1**, n=140 athletes provided informed consent and n=124 completed both body composition measures during the extended winter break in 2020. Also shown in **Figure 1**, n=95 athletes provided informed consent and n=64 completed both body composition measures during the usual winter break in 2021. Participant characteristics as measured at the pre-winter break time points are shown in **Table 1**. Ages, weights, and body compositions of the participants are consistent with expectations for college-aged competitive athletes. **Table 2** shows body composition change of participants over both breaks.

Table 3 and **Table 4** show the results of the ANCOVA for ΔBMI ($F=4.30$, $p<.01$). A significant main effect of sex and a sex*break interaction were observed for ΔBMI. **Table 5** and **Table 6** show the results of the ANCOVA for ΔFMI ($F=4.47$, $p<.01$). A significant main effect of sex and a sex*break interaction were observed for ΔFMI. Observed increases in BMI and FMI in males during the extended winter break were greater than changes in BMI and FMI during the usual winter and were also greater than changes observed in females during both winter breaks.

For ΔMMI, the overall models were unable to fit the data. Relationships between ΔMMI and variables of interest were assessed using a Kruskal-Wallis Test nonparametric test and no significant differences were found between ΔMMI and any independent variables.

Discussion

Results from this study partially support the hypothesis that muscle mass would decrease and fat mass increase, with greater changes seen during the extended winter break. However, muscle mass was not affected by the winter break and sex differences in body composition were not expected. Our research shows that FMI and BMI increased in males during the extended winter break compared to the usual winter break and compared to female athletes during either break. Body composition was generally unchanged among female athletes.

Results of the current study during an extended winter break due to COVID-19 are also largely consistent with previous findings of increased weight and fat mass among college athletes during the initial COVID-19 lockdowns in the spring of 2020 [20, 21]. These changes could be due to restrictions placed on gyms and other activities in parts of the country during the winter of 2020/21. Our research is also somewhat consistent with what is seen in the general population during the holiday season, a gain in weight and fat mass in both sexes [1-3]. Our research showed a gain in weight and fat mass in males – but not female – athletes over what is generally considered the holiday season (Thanksgiving – New Year), but only during the extended winter break of 2020. No body composition changes were observed among athletes during the 2021 winter break, which was 3 weeks shorter than in 2020, and the usual length for athletes.

Body composition changes during breaks, both unexpected (e.g., COVID-19, injuries, family emergencies) and expected (e.g., holiday breaks, summer breaks, postseason) in athletes needs to be better understood to allow athletics staff to best use their time and energy. Breaks are built into athletes' schedules to allow time for rest and recovery from the strain experienced during intense training and competition. Previous research in athletes has demonstrated that body composition and athletic performance are often affected by breaks from structured training. [16, 17, 22, 23]. However, the timing of a break – whether unexpected or expected – in relation to the rest of the season structure or training mesocycle may determine the relative importance of the break on the overall athletic performance. For example, a study in women's soccer players showed a gain in body fat and loss of muscle mass over the winter offseason, but a body composition had recovered back to baseline prior to the start of the competitive season [11]. In this case, winter is the offseason for soccer, and athletics staff may not be especially concerned with body composition changes during this time because they have the entire pre-season cycle to prepare for competition. Alternatively, the winter break for baseball the leads directly into their season, which causes athletics staff and coaches to be more concerned about changes in body composition and performance at this time. The fact that athletes were in different stages of their season could have influenced the results of the current study, due to the variety of sports included and the relation of the winter breaks to their respective competitive seasons. Future research in this field may consider also investigating the timing of breaks from campus residence and training in relation to the athletes' competitive seasons rather than at specific times in the calendar year as in the current research.

Little is currently known about the differences between the on campus and home environments for athletes that may have driven the results observed in the current study and previous research. For example, access to food, cooking equipment, and food preparation responsibilities are likely different for many student-athletes on-campus compared to at home [24-27]. Athletes in particular are expected to maintain a very busy schedule during school sessions (i.e., classes, team meetings, training, competition) that are much different from a “typical” college student [28-30]. Depending on the resources available at a university (e.g., Power 5 conference vs. smaller universities), athletes have access to a varying degrees of on-campus nutrition support with many larger, well-funded universities providing food and nutrition counseling to student-athletes [31-33]. Athletes may experience different levels of food security at home compared to on campus, 10-25% of athletes were shown to have food insecurity when on-campus, and little is known about how this compares with their home environment [34]. The differences in many nutrition factors on campus compared to home can impact body composition and should be explored further to allow practitioners to better understand how athletes’ food environments interact with changes in body composition and performance in response training and de-training.

A strength of this study is the relative even distribution of sexes with a variety of different sports making results more generalizable across other athletic populations. Body composition assessments were all conducted within two weeks of leaving and returning to campus, which allowed researchers to mitigate the issue of athletes returning at different times. The lack of an objective performance measure in relation to body composition is a limitation of this study that should be included in future research in this population. BIA is both a strength of this study due to its ability to detect both body composition and weight changes and the simplicity of use in an athletic environment that does not typically conduct research. BIA is limited mostly by the influence of hydration, menstruation, exercise, and electrolyte status on measurements. All body composition measurements were collected in a fasted state in the morning upon waking on all occasions to account for these limitations with BIA.

Overall, our study found that weight and fat mass increased in males over the extended holiday break while no body composition changes were observed among the other groups. Combined with previous literature, our results inform practitioners of the impact of breaks from structured training on body composition changes in male and female collegiate athletes. Athletic department staff should be aware of how breaks from campus impact athletes and have protocols in place to best help athletes during these times.

Acknowledgements

The study was designed by Aston Dommel and R Drew Sayer and data were collected by Aston Dommel; the data were analyzed by A Dommel and RD Sayer; and data interpretation and manuscript preparation were undertaken by A Dommel and RD Sayer. All authors approved the final version of the paper. A Dommel is supported by a NIH T-32grant (T32HL105349) awarded by the Heart, Lung and Blood Disease Institute (NHLBI) and additionally supported by Award Number P30DK056336 from the National Institute Of Diabetes And Digestive And Kidney Diseases. The authors have no conflicts of interest in this study. Additional contributions in manuscript development were made by Paula C. Chandler-Laney, JR Fernandez, K Lee Stowers, and Kimberly Smith. The authors would also like to thank the Nutrition and Obesity Research Center at the University of Alabama at Birmingham and UAB Athletics for support during development of this publication.

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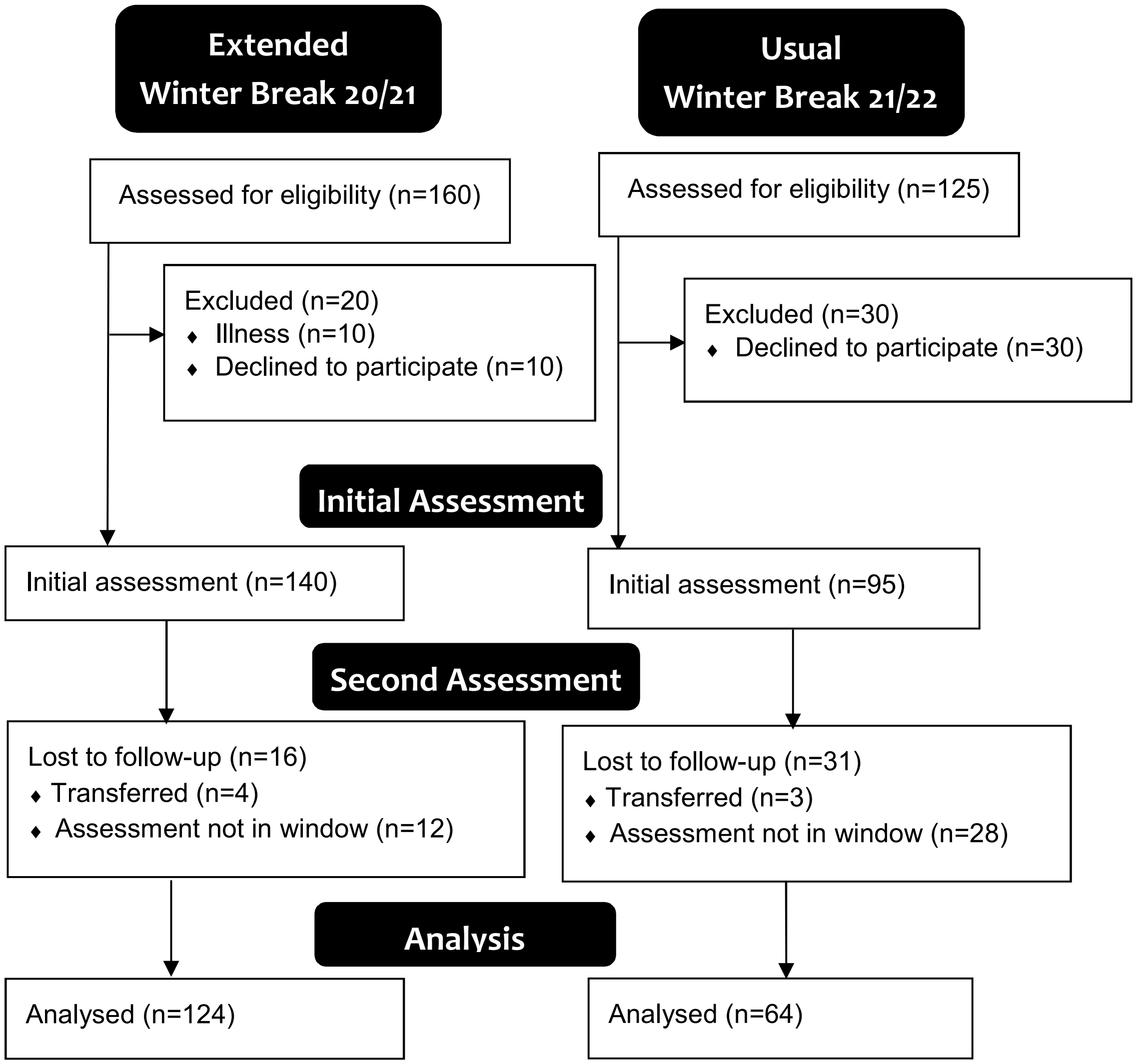

Figure 1. Consort Diagram

	Extended 2020 Winter Break		Usual 2021 Winter Break	
	Male	**Female**	**Male**	**Female**
N	57	67	36	28
AGE (y/o)	20.75 ±1.50	19.61 ±1.47	19.92 ±1.61	20.11 ±1.81
HT (in)	72.21 ±2.68	67.82 ±3.01	72.31 ±2.71	68.43 ±2.64
BMI	24.85 ±3.83	23.08 ±2.71	24.12 ±2.55	23.43 ±2.93
FMI	3.24 ±2.47	5.34 ±2.02	3.06 ±1.78	5.45 ±2.15
MMI	20.58 ±1.75	16.83 ±0.89	20.00 ±1.10	17.06 ±1.13

Table 1. Descriptive characteristics of athletes as measured prior to the extended winter break in 2020 (n=124) and usual winter break in 2021 (n=64). Data are mean ± SD.

	Extended 2020 Winter Break		Usual Winter Break 2021	
	Male	**Female**	**Male**	**Female**
N	57	67	36	28
ΔBMI	0.42 ±0.64	-0.06 ±0.53	0.06 ±.64	0.12 ±.54
ΔFMI	0.37 ±0.50	-0.01 ±0.43	0.03 ±.43	0.06 ±.46
ΔMMI	0.04 ±0.46	-0.05 ±0.28	0.03 ±.49	0.05 ±.35

Table 2. Results table of body composition change during extended and usual winter break. Data are mean ± SD.

Dependent Variable	Independent Variable	Covariates	F Value	P Value
ΔBMI	Sex*Break	Age	0.01	0.92
		Repeat	0.43	0.51
		Sex	4.85	0.03
		Break	0.56	0.45
		Sex*Break	8.84	0.03

Table 3. Results of ANCOVA for ΔBMI

Sex*Break	ΔBMI Adjusted Mean	95% Confidence Limits	
Male*Extended	0.41	0.24	0.58
Male*Usual	0.06	-0.14	0.25
Female*Extended	-0.07	-0.22	0.07
Female*Usual	0.13	-0.09	0.35

Table 4. Results of Tukey Adjusted Means for Sex*Group and ΔBMI

Dependent Variable	Independent Variable	Covariates	F Value	P Value
ΔFMI	Sex*Break	ΔMMI	1.71	0.19
		Age	0.06	0.81
		Repeat	0.09	0.77
		Sex	5.86	0.02
		Break	2.74	0.10
		Sex*Break	8.63	<.01

Table 5. Results of ANCOVA for ΔFMI

Sex*Break	ΔFMI Adjusted Mean	95% Confidence Limits	
Male*Extended	0.37	0.24	0.50
Male*Usual	0.03	-0.12	0.18
Female*Extended	-0.02	-0.14	0.10
Female*Usual	0.07	-0.10	0.24

Table 6. Results of Tukey Adjusted Means for Sex*Group and ΔFMI

BODY COMPOSITION CHANGE IN COLLEGE BASKETBALL
PLAYERS OVER SUMMER TRAINING

by

SHAUN KUO, ASTON DOMMEL, R. DREW SAYER

International Journal of Sports and Exercise Medicine

Format adapted and errata corrected for dissertation

Abstract

Background

Body composition is an important determinant of athletic performance that is directly influenced by training and detraining. Collegiate athletes experience substantial variability in training intensity during a season, but little research has been conducted to track changes in body composition across periods of intense training and breaks from structured sport-related activities.

Methods

Body weight and composition (fat free mass and fat mass) were measured in members of a collegiate men's basketball team over the course of an 11-week summer training period. Dual x-ray absorptiometry (DXA) scans were completed at the beginning of summer training (June 2019), at the end of the 7-week intense training period (July 2019), and after a 4-week break (late August 2019). For analysis measures were converted into indices (kg/m^2).

Results

Fat free mass index increased ($p<0.01$) and fat mass index decreased ($p=0.01$) during the 7-week training period. Significant decreases in fat mass index ($p=0.02$) were seen between June and August. Fat free mass index decreased from July to August ($p<0.01$). No significant changes were seen in total body mass throughout the summer training period.

Conclusion

These data demonstrate cyclic changes in body composition during a summer training period that could impact athletic performance. Future research should further evaluate

potential mediators and moderators of changes in body composition and include performance measures. Research in this capacity would allow trainers to optimize performance in athletes and bolster team performance.

Introduction

Basketball is one of the most widely viewed college sport in the United States and is played across the world. It is one of the most technically advanced sports requiring athletes to have total body coordination and top tier levels of fitness. To achieve this, universities spend millions of dollars to maintain their facilities and offer athletes scholarships to attend their school. Universities are very motivated to maintain a successful basketball team at their school because it is the second most profitable sport, behind football, often grossing over eight million dollars per team if they make it to March Madness [1].

Since universities can make a significant amount of money from a high-performing basketball team, staff and coaches are always looking for strategies to improve performance. There are several important indicators of fitness such as aerobic capacity, strength, and power that affect performance. These fitness indicators are directly influenced by body composition, which is affected by exercise training and detraining. Specifically, increases in lean muscle mass and decreases in fat mass, have been shown to bolster athletes' performance because a higher muscle to total weight ratio results in more efficient energy transfer [2-4]. Muscle mass has been found to be the most important factor in body composition for athletes as it is directly involved in force production, which is involved in many aspects of basketball like sprinting, guarding, and jumping [5]. Specifically, players with a higher fat free mass to fat mass ratio can jump higher than those with more fat mass [6].

There is research in body composition changes across a season regarding percent body fat and strength in basketball players [7], and some looking at cross-sectional body composition characteristics [8-10]. It has been reported that both elite and sub-elite basketball players have increased muscle mass compared to population norms. Surprisingly, elite basketball players had increased BMI compared to sub-elite players likely due to the higher energy demands required at their level of play[11]. Several studies report that player body composition changes throughout a season due to the training load variability and intensity. One of these studies suggests that as the season progressed, strength decreased for both the starters and reserve players, which could be attributed to chronic fatigue [12]. Another study suggests that fat free mass, resting energy expenditure, and power all increase over a season [13]. It is possible that progression or regression over a season is variable for athletes depending on their total training stress in part due to training load and play time.

However, there has been little research conducted to track changes in body composition across periods of intense training and breaks from structured sport-related activities especially in elite basketball players. One study followed female collegiate soccer players over a year long period and found that athletes lost lean mass and gained fat mass over the season. This study also found that lean mass was not recovered during the off season suggesting improper off-season programming [14]. Another study followed male NCAA Division I football players and found that athletes lost lean mass during the competitive season, but in their program, they regained lean mass during the off season suggesting that their off-season was properly conducted [15].

The purpose of this study was to investigate the body composition changes across preseason training. Players trained for 7 weeks on campus and then had a 4-week break from on campus activities. It was hypothesized that fat mass will be reduced, and fat free mass will be increased during summer training, but these improvements in body composition will be partially lost during the 4-week absence from structured training.

Protocol

Body composition was measured 3 times over the summer of 2019 using dual x-ray absorptiometry (DXA) in 15 members of a division 1 collegiate men's basketball team from a southeastern university (University of Alabama at Birmingham [UAB]). Three time points were included: early June (start of on campus summer training cycle), end of July (end of on-campus summer training cycle), and end of August (return to campus after a 4-week break from training). These time points were analyzed for changes in body weight, fat mass, and fat free mass over the training cycle.

Recruitment

Data were collected in the summer of 2019 on a men's collegiate basketball team. Deidentified body composition data was given to researchers by the Department of Nutrition Sciences staff at UAB in charge of body composition assessments. Only athletes with valid data at all three time points were provided. Due to the nature of collection and deidentified status, the UAB IRB determined that this research meets exempt status, so no informed consent was obtained to use the data for research purposes.

Body Composition Assessment

Total and regional body composition including body weight, total fat free mass, and fat mass were measured by DXA with the use of a Lunar iDXA densitometer [GE Medical Systems, Madison, WI, enCORE Version 15]. Participants were scanned in light clothing while lying supine with arms at their sides and no metal jewelry on. Some participants were too tall to fit their entire bodies in the DXA scanning area. For uniformity, all participants were scanned with their heads out of the scan area. Participants were told to come in upon waking in a fasted state.

Statistical Analysis

Descriptive statistics were conducted to obtain mean and standard deviation for quantitative variables. Height was used to calculate BMI (kg body weight/m2), fat free mass index (FFMI, kg fat free mass/m2), and fat mass index (FMI, kg fat mass/m2) to account for differences in overall body size among the athletes. Analyses were performed to identify potential confounders for the statistical models using correlation analysis with body composition variables. Based on this assessment, FFMI was added to the model for FMI and vice versa. Age was included as a covariate for all models. Repeated measures ANCOVAs were used to assess body composition change over time for BMI, FMI, and FFMI. A main effect of time was examined between the three data points, pre training, post training, and post 4-week break from training. Significance was set at $p<0.05$ for all outcomes and SAS version 9.4 (Cary, NC) was used for all statistical analyses.

Power Calculation

The sample size for this aim was constrained to n=15 because these data were initially collected for non-research, internal purposes and then retrospectively approved for exempt-status research use. Given an α-error probability of 0.05 and β = 80%, this sample size provides sufficient statistical power to detect an effect size of 0.78, which represents a medium to large effect size according to established criteria suggested by Cohen [16].

Results

Participant characteristics for each time point during the summer training cycle are shown in Table 1. Fifteen participants were included for all time points, which comprises the entire roster. Time 1 is early June, Time 2 is late July 7 weeks later, and Time 3 is late August 4 weeks after Time 2.

BMI, FMI, and FFMI data were not normally distributed and were log transformed to address normality. Table 2 shows the results for the repeated measures ANCOVA for logBMI that showed was no significant difference between the 3 time points ($F=2.71$, $p > .05$). Table 3 and Table 4 show the results of the repeated measures ANCOVA for logFFMI. A significant effect of time was found ($F=12.26$, $p < .01$), with significant differences seen between time 1 to 2 and time 2 to 3, showing a significant gain in FFMI during the first 7 weeks and a partial loss of FFMI during the 4-week break. Table 5 and Table 6 show the results of the repeated measures ANCOVA for logFMI. A significant effect of time was found ($F=4.82$, $p < .05$), with significant differences between time 1 to 2 and time 1 to 3, showing a significant loss of FMI during the first 7 weeks that was maintained over the 4-week break.

Discussion

Body Composition data from sequential DXA scans were used to determine changes across summer training and scheduled breaks. Our data support our initial hypothesis that fat mass would be reduced, and fat free mass will be increased during summer training, but that these improvements would be partially lost during summer training. Importantly, players gained a statistically significant amount of fat free mass during the on-campus training and then lost a significant amount while on break.

Furthermore, athletes lost a significant amount of fat mass during training that was maintained while on break.

The UAB Men's Basketball program is well-established and has been successful in recent years including six trips to the NCAA tournament since 2004. Our data demonstrate that the strength and conditioning staff have implemented a successful on-campus summer training program. While on-campus, athletes are closely monitored for progress in the gym and on the court and were given direct, individual training instructions. With this direct oversight athletes progressed in each of the categories that were monitored: overall loss in fat mass and overall gain in fat free mass. However, when the players went home for break, their body composition regressed as shown by a loss of fat free mass. It has been documented by previous studies that NCAA Division I male athletes do not consume enough overall calories or protein during off season [17]. This would explain the loss of fat free mass along with the relatively consistent findings for total body fat. Additionally, there are multiple at home factors that could have played a role in whether athletes were able to maintain body composition changes such as food insecurity, access to facilities, and vacations.

Food insecurity plays an important role in students' lives in college environments. A meta-analysis published in February of 2022 found that the prevalence of food insecurity was 32.2% among all college students and 23% in student athletes and it disproportionally affects minority students [18]. All of our participants were either Black or Hispanic, ethnicities known to have a higher risk of food insecurity, which may have contributed to the athlete's ability to maintain body composition changes [19]. Also, when students are off campus, they no longer have easy access to university-owned training facilities. Any additional barrier to training, such as transportation or lack of equipment, could impact their adherence to the program and affect result [20, 21]. Beyond food insecurity, the home food environment has been shown to be different than the environment on campus, with differing access to resources, both physical and support [22, 23]. Athletes may also lack the knowledge to implement proper nutrition practices without the help of staff [24] as it has previously been shown that student athletes lack adequate nutrition knowledge [23].

Finally, these athletes had just spent nearly two months on campus for summer training. It is possible they could have experienced a form of burnout and required this time to reset prior to the start of the season both mentally and physically. Burnout is a multifactorial problem, but has been shown to include coach-athlete relationships, scholastic stress, and intrapersonal relationships [25].

This study has some limitations that should be considered when interpreting these data. Initially, this data was not intended for research purposes, rather it was used for internal performance tracking by the basketball team. Therefore, alternative variables such as lack of standardization of the timing of scans could have affected the results. However, DXA scans are the gold standard for body composition measurements and their standard error is significantly less than alternative tests such as skin fold or biometric impedance [26]. Nevertheless, this study is limited by a small sample size and lack of information of what the athletes did on their break. While the overall sample size is small, it should be noted that the sample comprises the entire UAB men's basketball roster.

Future studies should investigate alternative unsupervised breaks. Whether this is two two-week breaks or changing the position of the four-week break in the eleven-week training cycle. Athletic programs would also likely benefit from carefully tracking their athletes over their off-campus stints. However, psychological studies addressing the strains of having direct over sight should be considered. Further research should evaluate potential mediators and moderators of changes in body composition and include more specific performance measures. Research in this capacity may allow strength and conditioning experts to identify strategies to maintain training-induced body composition and performance gains during periods of less structured and intense training.

These data demonstrate that body composition changes during summer training periods which could play a direct role in athletic performance. Further research should attempt to directly correlate body composition and performance. This would allow practitioners to individual performance optimization.

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	Time 1	Time 2	Time 3
N	15	15	15
Height (in)	74.50 ±3.70	74.50 ±3.70	74.50 ±3.70
Age (y/o)	19.93 ±1.44	20.00 ±1.41	20.00 ±1.41
BMI	24.65 ±2.68	24.89 ±2.69	24.59 ±2.79
FMI	3.40 ±1.34	3.26 ±1.47	3.24 ±1.44
FFMI	19.97 ±1.90	20.47 ±1.80	20.21 ±1.82

Table 1. Participant Characteristics for Times 1, 2, and 3

Dependent Variable	Independent Variable	Covariates	F Value	P Value
LogBMI	Time	Age	4.05	0.06
		Time	2.71	0.10

Table 2. Results of Repeated Measures ANCOVA for LogBMI

Dependent Variable	Independent Variable	Covariates	F Value	P Value
LogFFMI	Time	Age	8.95	0.01
		LogFMI	6.69	0.02
		Time	12.26	<.01

Table 3. Results of Repeated Measure ANCOVA for LogFFMI

Time Frame	Estimate	SE	T Value	P Value
1 to 2	-0.03	0.01	-4.00	<.01
1 to 3	-0.01	0.01	-1.95	.07
2 to 3	0.01	<.01	3.50	<.01

Table 4. Differences of Least Squares Means for LogFFMI and Time

Dependent Variable	Independent Variable	Covariates	F Value	P Value
LogFMI	Time	Age	0.21	0.65
		LogFFMI	4.87	0.04
		Time	4.82	0.03

Table 5. Results of Repeated Measure ANCOVA for LogFMI

Time Frame	Estimate	SE	T Value	P Value
1 to 2	0.09	0.03	2.97	0.01
1 to 3	0.08	0.03	2.77	0.02
2 to 3	-0.02	0.02	-0.70	0.49

Table 6. Differences of Least Squares Means for LogFMI and Time

GENERAL DISCUSSION

Literature is currently lacking on how BC changes in athletes during breaks, both expected and unexpected, when athletes are off campus and may lack the access to staff, facilities, and resources that they have when on campus. The primary goal of this dissertation was to address this gap by measuring BC changes over various breaks. My dissertation research demonstrates that BC is sensitive to change during both unexpected (COVID-19 lockdown) and expected (extended winter and summer) breaks. In aim 1, we found a difference between sexes in response to the break caused by the COVID-19 lockdown, with males losing fat mass and females gaining fat mass. In aim 2, by comparing the extended winter break caused by COVID-19 to that of a usual winter break, we found differences between the sexes that were opposite from aim 1 in BC change. Males during the extended winter break gained weight and fat mass as compared to females during either break or males during a usual break. In aim 3, we found that basketball players gained fat-free mass during a summer training session that was then limited due to a loss of fat-free mass during a required break from campus.

Differences seen in BC change among the aims; primarily, aims 1 and 2 could be driven by timing differences between the two. Aim 1 data were collected as part of routine care and later used for research purposes. During aim 1, many male athletes returned to campus earlier than female athletes. Access to on-campus resources may have led to the loss of fat mass observed in males and gain in fat mass observed in females. Data from aim 2 were also collected as part of routine care, but were collected with the intention to use for research purposes, allowing for tighter control of assessment windows. Tighter control and scheduling of assessments in aim 2 may be why differences exist between aims 1 and 2. Another driver of this possible difference is athletes were assessed during different parts of their athletics season. Aim 1's initial assessment was weeks after the start of spring semester, and the second assessment was in August, while aim 2 was over the winter breaks. The length of time of the studies in aim 1 and 2 may account for differences. Aim 1's assessments were six months apart, whereas aim 2's assessments were four to seven weeks apart, and changes in BC may not have been picked up in aim 2. Similarly, due to the long length of aim 1, athletes may have had changes in BC that recovered back to baseline in time for the second assessment.

Our results are typical of the current literature on BC change during athletes' breaks, which has yielded conflicting and inconsistent outcomes. Some studies show negative changes (gain in fat mass and loss of muscle mass) [31], no change [33], and positive changes (loss of fat mass and gain in muscle mass) [35] during breaks from sport training. Inconsistent results are driven by sports assessed, measurement technique used, assessment time points, and other factors. There is also a broad base of literature on BC change in athletes over time, primarily pre/post season and over years (see Table 1 in the introduction).

Breaks are necessary for the overall health of an athlete [67, 68]. When a season is completed, athletes need time to mentally and physically rest and recover from intense training and competition. This is widely recognized, and the NCAA requires breaks from mandatory training throughout the course of the year to allow time for rest and recuperation [2].

Unexpected breaks from training, such as the COVID-19 lockdown or an injury, can cause changes in lifestyle behaviors (e.g., eating and physical activity), BC, and overall health status (e.g., sleep disturbances, mental health status, motivation status, and loneliness) [41, 44, 69, 70]. The unanticipated nature of these breaks makes them especially difficult to study. While broad training disruptions from the COVID-19 pandemic may (hopefully) be over, it is possible that similar scenarios will happen in the future. The lockdown provided a unique opportunity to study the effects of an unexpected break from training in a large number of athletes. The pandemic was experienced by all athletes, but individually, athletes can have unexpected breaks (injury, death in the family) that take time away from campus resources, possibly leading to changes in BC and performance. COVID-19 allowed researchers to study changes on a population scale and gave insight into how these unexpected breaks may influence athletes. What we have learned and continue to learn about breaks allow practitioners to best serve athletes during tough times when access to resources may be limited. Strategies developed will support positive outcomes for athlete health both during the break and when they return to campus and sport, helping limit return-to-play injuries and allowing athletes to return to full athletic performance faster than prior unexpected breaks.

The timing of a break – whether unexpected or expected – in relation to the rest of the season structure or training mesocycle may determine the relative importance of the break on overall athletic performance. Consider the impact of a winter break on college soccer athletes whose season occurs in the fall. The winter break leads into their off-season, and BC changes during this time are relatively unimportant, as they have six months to reach optimal body composition for their competitive season. This trend was seen in female college soccer players. Athletes gained fat and lost muscle during the winter that was recovered back to baseline before the start of the next season [33]. On the other hand, a summer break would occur immediately prior to the start of their competitive season and would be expected to have a greater impact on performance. Researchers and practitioners need to understand how the timing of breaks in relation to competition may affect overall performance and the relative importance of observed BC changes during the breaks. Practitioners should prioritize pre-season breaks leading into competition compared to post-season breaks that provide more time to prepare for competition.

A future research priority in this field should be understanding the unique differences between on-campus and home environments and their influence on BC changes during breaks. Athletes maintain a schedule during school sessions (e.g., classes, team meetings, training, competition) that is much different from that of a "typical" college student [54-56]. Depending on the resources available at a university (e.g., Power Five conference versus smaller universities), athletes have access to varying degrees of on-campus nutrition support with many larger, well-funded universities providing food and nutrition counseling to student-athletes[49-51]. The provision of these services can have a direct impact on a student-athlete's food insecurity status, especially if they are from a disadvantaged background. Current research shows that 10–25% of college athletes experience food insecurity on campus, while little is known about athlete food insecurity status at home [52]. The food environment on campus versus at home can influence eating behaviors. Cooking space, access, and available appliances are just a few differences between the two environments that may influence diet quality and quantity [63, 65, 71].

Another area of future research is to investigate the food environments and eating behaviors of athletes living on campus (i.e., in student housing) versus off campus during the school session [64]. Athletes living off campus generally have less access to dining facilities compared to athletes living on campus where healthy meals are readily available in large quantities. Living off campus can require additional planning in an athlete's already busy schedule or lead to choosing unhealthier but more convenient food options. Studies also show inadequate scores on nutrition knowledge questionnaires, a possible driver of poor eating practices when away from campus resources [59, 72]. Cultural factors can influence eating behaviors; the cultural practices at home can be different from the practices of the athlete on campus. These and other unknown factors can heavily influence how athletes eat and ultimately affect BC and performance.

While the literature is growing, there is still room to grow the knowledge base surrounding BC change during breaks and possible mediating factors. There is a need for observational studies assessing BC change over holiday breaks, summer breaks, and other breaks of varying lengths. Building on this, assessing performance measures (e.g., jump height, sprint performance, and other sport-specific measures) pre and post breaks allows researchers to know if changes in BC during breaks have detrimental impacts on performance.

This dissertation's focus centered on college athletes' breaks from campus, but breaks in the context of changes from the norm may occur in the general population with consequences to BC. COVID-19 did not just affect athletes; it had significant impacts on the health of the general population, possibly due to similar factors that affected athletes [69, 70, 73]. Extended vacations, remote work, major injuries, caring for loved ones, and other experiences can be viewed as breaks that could impact BC in persons experiencing these changes. Similarly, when these “breaks” occur, changes in access to facilities, support systems, eating habits, and other factors may contribute to detrimental changes in BC. Whereas in athletes, performance is paramount, in regards to BC in the general population, overall health is often prioritized. A higher body fat percentage and lower muscle mass is associated with many negative health outcomes for the general population, including heart disease and diabetes [74-76]. Extended breaks and multiple breaks can compound these changes. A better understanding of these “breaks” in the general population can help healthcare providers develop resources and care strategies similar to those practitioners may want to develop for athletic populations.

All three of the aims in this dissertation have strengths. Included in aims 1 and 2 was a broad mix of sports with roughly equal numbers of male and female athletes, allowing for greater generalizability. While in aim 3, the sample was small with only males, we were able to recruit the whole men’s basketball team for the study. All three aims used validated measures of BC assessment with a standardized protocol strengthening the study and results. Limitations of these aims are that no performance measures are tied to the BC change. This made it impossible to assess whether the changes we saw had a deleterious impact on athletic performance. Nor were other factors assessed that could have influenced BC change. While there are limitations with the BC measures used, these were mitigated by a standardized protocol for assessment. Combined with previous literature, the results of this dissertation and future studies will inform athletic departments on how to prepare for breaks, both expected and unexpected, helping athletes maintain healthy habits and lessening deleterious impacts on BC.

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APPENDIX A

INSTITUTIONAL REVIEW BOARD APPROVAL

THE UNIVERSITY OF ALABAMA AT BIRMINGHAM

Office of the Institutional Review Board for Human Use

470 Administration Building
701 20th Street South
Birmingham, AL 35294-0104
205.934.3789 | Fax 205.934.1301 | irb@uab.edu

APPROVAL LETTER

TO: Dommel, Aston J

FROM: University of Alabama at Birmingham Institutional Review Board
Federalwide Assurance # FWA00005960
IORG Registration # IRB00000196 (IRB 01)
IORG Registration # IRB00000726 (IRB 02)
IORG Registration # IRB00012550 (IRB 03)

DATE: 02-Feb-2021

RE: IRB-300006333
IRB-300006333-001
Body Composition Change in College Athletes over an Extended Break

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The IRB reviewed and approved the Initial Application submitted on 30-Nov-2020 for the above referenced project. The review was conducted in accordance with UAB's Assurance of Compliance approved by the Department of Health and Human Services.

Type of Review: Exempt
Exempt Categories: 2, 4
Determination: Exempt
Approval Date: 02-Feb-2021
Approval Period: No Continuing Review

Documents Included in Review:

- IRB EPORTFOLIO
- IRB PERSONNEL EFORM

To access stamped consent/assent forms (full and expedited protocols only) and/or other approved documents:
1. Open your protocol in IRAP.
2. On the Submissions page, open the submission corresponding to this approval letter. NOTE: The Determination for the submission will be "Approved."
3. In the list of documents, select and download the desired approved documents. The stamped consent/assent form(s) will be listed with a category of Consent/Assent Document