THE RELATIONSHIP BETWEEN DIET AND SLEEP QUALITY IN COLLEGIATE CROSS-COUNTRY AND TRACK AND FIELD ATHLETES

By

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Bachelor of Science in Applied Exercise Science

Oklahoma State University

Stillwater, Oklahoma

May, 2023

Submitted to the Undergraduate Honors College of

Oklahoma State University in partial fulfillment of

the requirements for

The Honors Degree

May, 2023

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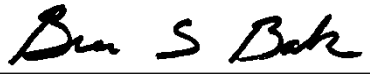

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ACKNOWLEDGEMENTS

I would like to express a great appreciation to Dr. Baker for serving as my advisor but also for her devoted mentorship. I would also like to thank Dr. Dinyer-McNeely for serving as my second mentor in my thesis. I could have not done any of this without them and am continuously thankful.

I am grateful to my MAAX lab members for their mentorship, guidance, reviewing skills, and helpful advice. With a special thanks to Shawn Allen, Allen Redinger, and Olivia Anderson for all of the hours they took to teach and mentor me throughout my time in the lab.

Least I do not forget my mom Mindy, my dad Aaron, and my brothers Gator and Crew for supporting me though my educational journey.

A special thanks to all the present and future participants that sacrificed their time in order to participate in the MAAX lab research projects.

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CHAPTER I

Introduction

Sleep is defined as a complex reversible behavioral state where a person is disengaged from and unresponsive to the environment around them (1). There are different types of sleep that the body goes through during rest. Type one is non-rapid eye movement (NREM) sleep which is "a relatively inactive yet actively regulating brain in a moveable body" (1). NREM sleep is then further divided into three different stages- N1(stage 1), N2(stage 2), and N3(deep sleep). Furthermore, type 2 is rapid eye movement (REM) sleep. This type is associated with muscle paralysis and episodes of rapid eye movement (1). Throughout a typical sleep cycle, all of these stages will occur at different times during the night in order to allow the body to truly rest. While all of these stages occur in a night, the quality of sleep that an individual is getting a night varies from population to population. Good sleep is characterized by satisfaction, adequate duration, high efficiency and sustained alertness throughout waking hours (1). On the contrary, poor quality sleep affects the body in a multitude of negative ways. Glucose metabolism and neuro-endocrine function are both negatively affected meaning that carbohydrate metabolism, appetite, energy intake and protein synthesis are all negatively impacted as well (1). All of these negative effects compound and impact performance during waking hours.

One large factor that can contribute to improved sleep quality and wellness, is diet. When the body consumes food, it impacts the circadian rhythm of the body which alters the hormones that are released into the blood stream. Different hormones that are put out into the body will impact sleep and waking hours different. For example, if food with a high caffeine level is consumed, then the caffeine will work by reversibly antagonizing the adenosine (a sleep-inducing agent) receptors (3). There are many different types of micro- and macro- nutrients that

can impact sleep quality both positively and negatively. High glycemic index (GI) meals have shown to be linked to increased levels of insomnia. A high GI meal results in high insulin levels that induce the release of hormones including adrenaline, cortisol, and glucagon, all which contribute to insomnia (4). Furthermore, a deficiency in vitamin D has also been linked to a higher risk of sleep disorders. All of this shows the massive impact that diet has on the quality of sleep that people have.

There are a multitude of studies that cite sleep as an extremely important factor in the lives of athletes. Juliff et al., (2015) states that sleep is an essential component for athlete preparation and is suggested to be the single best recovery strategy available to an athlete. Furthermore, it states that one night of compromised sleep significantly reduces reaction times, anaerobic performance, and cognitive processing (2). For athletes, these factors are extremely important to produce the highest level of performance, which it what each and every athlete strives for. A multitude of studies have discussed the impact of sleep on performance rates in athletes. A study of 42 adult netball athletes used wrist actigraphy and sleep journals before, during and after a national tournament to evaluate the relationship between sleep and competition success. It showed that the two teams with the highest overall ranking had significantly greater sleep duration and sleep quality compared to the last two ranked teams (6). To add, sleep deprivation and minimal sleep restriction have consistently shown that athletic performance is impaired greatly and has been shown to improve after sleep extension (6). Sleep loss has also demonstrated impaired vigilant attention performance, resulting in increased lapses of attention and slowed response times (7) which could result in injury or decreased performance. All of these studies highlight the importance of sleep and athletic performance rates, further proving its importance in the lives of athletes. In addition, multiple

studies have discussed the impact of sleep and recovery in mental health in athletes and college aged students to further promote healthy sleep. Supartini et al. 2016 states that prolonged sleep latency (8), short, and long sleep durations were associated with an increased risk of depression (9). Furthermore, it is stated that disturbances in sleep may show an increased risk in depressive episodes through its impact on emotion regulation and emotion reactivity through physio-psychological mechanisms (10). Mental health is a factor that is extremely important in the lives of all athletes and understanding the impact of sleep in aiding against depression and anxiety is a key factor in improving the lives of athletes.

On the other hand, when discussing athletes' diets, many studies discuss the benefits of consuming certain foods. Finding and consuming foods that have been shown to have anti-inflammatory properties could aid in combating against the inflammatory cytokines that are linked to poor sleep quality and muscle recovery that athletes face every day (1). It has also been discussed that diets high in carbohydrates may result in shorter sleep latencies, diets high in protein may result in improved sleep quality, and high fat diets negatively impact total sleep time (11). Thus, diet quality is an aspect of athletes' lives that should be monitored closely to make sure that their food selections are aiding their lifestyles.

While many studies look at the impact of diet and sleep separately in athletes, there is little literature on the relationship between how diet influences sleep quality and how certain foods can improve or harm sleep. There is also less research on the influence of diet and sleep in collegiate cross country and track and field (XC+T&F) athletes.

Purpose

The purpose of this study was to understand how dietary consumption is related to sleep quality in NCAA Division I XC+T&F athletes by comparing athletes' dietary quality between poor and normal sleepers.

Research Questions

Our aim is to characterize dietary quality between athletes who report normal and poor sleep quality.

Hypotheses

We hypothesize that a wholistic diet that includes multiple micro- and macro-nutrients will result in increased sleep quality in track and field and cross-country athletes.

CHAPTER II

Methodology

Participants

For this study, 25 (male n=5; female n=20) OSU XC+T&F athletes participated in May, 2022 data collection. Participants were informed of the risks and benefits before providing voluntary written consent prior to testing. All procedures were approved by the Institutional Review Board at Oklahoma State University (IRB #22-113-STW).

Inclusion Criteria for XC+T&F

1. Participants were aged between 18-26 years old.
2. Participants were members of the Oklahoma State University XC+T&F teams.
3. Participants weighed less than 500 lbs.
4. Participants were willing to provide a urine sample for hydrating testing and pregnancy status (if applicable).

Exclusion Criteria for XC+T&F

1. Participants were not pregnant or planning on becoming pregnant.
2. Participants were not receiving any type of radiation treatment.

Research Design

This cross-sectional study (Figure 1) included assessments of general health, training and injury status, current and past menstrual cycle characteristics, body composition, bone health, muscle performance, active range of motion, diet, and sleep quality. It is important to note that there were multiple different aspects assessed, this thesis will only discuss the relationship between dietary intake and sleep quality in these athletes.

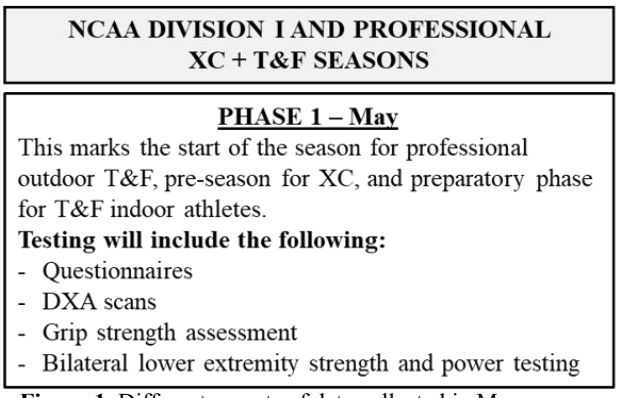

Figure 1. Different aspects of data collected in May.

Pittsburg Sleep Quality Index (12) was used to assess sleep quality. The questionnaire utilized 10 questions which included what time you have gone to bed, how long has it taken you to fall asleep, and what time have you gotten up in the morning. Answers to these questions were then scored and athletes were divided into either a poor sleep category (points ≥5) or a normal sleep category (points <5).

Automated Self- Administered 24-hour (ASA24) Dietary Assessment Tool (13) was a web-based 24-hour diet recall system. This tracked their dietary intake for 24 hours in order to determine the type and quantity of micro- and macro- nutrients that were consumed. From this analysis, we interpreted daily vitamin intake, carbohydrate, protein, and fat intake. All this data helped to create Healthy Eating Index (HEI) scores for each athlete to determine

how well their daily food intake aligns with key recommendations of the Dietary Guidelines for Americans (5).

Statistical Analyses

All statistical procedures were performed using IBM SPSS (v26, Armonk, New York), and significance was set at $p \leq 0.05$. Athletes were split into normal (n=15) and poor (n=10) sleep quality groups based on their PSQI scores. Independent *t*-tests were used to assess initial differences between XC+T&F baseline anthropometric characteristics. Cohen's effect size (*d*) was calculated and interpreted as small (*d*=0.2), moderate (*d*=0.5), and large (*d*=0.8) to better understand the magnitude of difference in dietary measures between sleep quality groups.

CHAPTER III

Results

The purpose of this study was to understand how dietary consumption impacts sleep quality in NCAA Division I XC+T&F athletes over time by comparing athletes' dietary quality in groups based on sleep quality scores. These factors were measured through the ASA24 questionnaire and the Pittsburg Sleep Quality Index questionnaire in order to determine diet and sleep quality, respectively.

Participant Characteristics

Baseline athlete characteristics are found in Table 1. Sleep scores were divided into poor (points ≥5) and normal sleepers (points <5). There was a statistically significant difference found between normal sleepers and poor sleepers. Normal sleepers demonstrated higher

Dietary Reference Intake of Vitamins A (p=0.041), K (p=0.036), B1 (p=0.033), Copper (p=0.032) and selenium (p=0.043). It is also important to note that folate (p=0.056), potassium (p=0.055) and total calories from protein (p=0.058) were all trending toward significance in athletes with good sleep quality scores and these effects sizes were moderate and large. Carbohydrate and fat intakes did not show any statistically significant difference between the normal or poor sleepers. Figure 1 shows graphical representation of HEI, Vitamin A, and Vitamin K intakes between normal and poor sleepers.

Table 1. Dietary Reference Intakes %'s between sleep groups. Data are shown as mean (SD).

Measures	Normal (n=15)	Poor (n=10)	Ind. *t*-test sig. p	Cohen's *d* effect size
HEI	68 (18)	61 (11)	0.023*	0.43
Protein (%)	46 (8)	52 (8)	0.121	0.77
CHO (%)	19 (5)	15 (3)	0.058	0.63
Fat%	37 (7)	35 (9)	0.632	0.20
Vitamin A (%)	181 (126)	88 (61)	0.041*	0.73
Vitamin K (%)	276 (252)	91 (83)	0.036*	0.51
Vit B1(%)	204 (82)	132 (70)	0.033*	0.86
Folate (%)	173 (106)	99 (56)	0.056	0.77
Copper (%)	220 (83)	143 (81)	0.032*	0.86
Selenium (%)	288 (123)	196 (66)	0.043*	0.82
Potassium (%)	82 (33)	59 (23)	0.055	0.78

Abbreviations: SD: Standard Deviation, HEI: Healthy Eating Index.

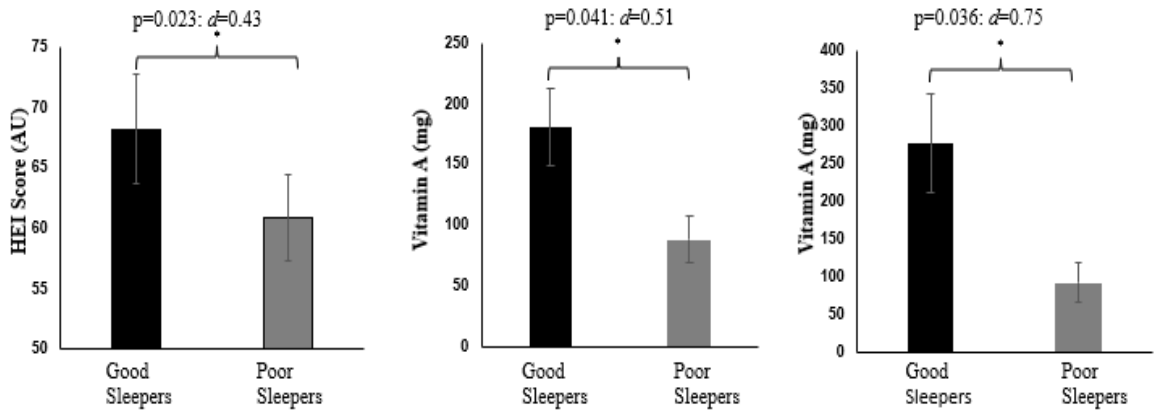

Figure 1. Those who reported good sleep quality scored significantly higher for diet quality (HEI – left panel). Additionally, they reported consuming greater % RDI of Vitamin A (middle panel)

and Vitamin K (right panel) compared to poor sleepers. These findings were moderate to large effect sizes.

CHAPTER IV
Discussion

Statistical significance was found when dietary consumptions of Vitamins A, K, B1, copper, selenium and overall HEI scores were compared between normal and poor sleepers. This data demonstrated that athletes with good sleep quality also consume a better diet. It is also important to note that protein, folate and potassium were also trending towards statistical significance and had moderate and large effect sizes suggesting a difference that is worth further investigation. These data suggest dietary intakes of certain micro- and macro- nutrients are related to sleep quality in Division I XC+T&F athletes.

There are a couple of important studies to note that discuss the impact of sleep and diet and how they impact one another. Graticke et al. (2021) discusses a study where pre-sleep protein intake increased total sleep time by 55 minutes and had a 7% increase in sleep efficiency (14). This statement differs to this study in that OSU XC+T&F athletes were not supplemented with protein before bed, but instead protein intake was examined during a 24-hour time period. Furthermore, it has been stated that increased carbohydrate consumption resulted in increased total sleep time, sleep efficiency and sleep onset latency (14) but only when consumed more than four hours before sleep (11). This was not supported when compared to the statistical findings of this study. Carbohydrate intake did not show to be statistically different between poor and normal sleepers. Condo et al. (2022) dives deeper into micronutrient consumption and their impact on sleep in elite female athletes. In this study, higher iron intake resulted in longer sleep duration and high iron and zinc intakes were shown to cause higher sleep efficiency, while low magnesium and calcium intake were associated with shorter sleep times (15). This study

looked at consumptions of different micronutrients than the ones listed in Table 1 but could provide a great direction for further research into micronutrient impact on sleep quality in XC+T&F athletes. It is also important to note that there is little to no research on the relationship that diet has on sleep quality in XC+T&F athletes, but plenty of studies look at the impact of athletes' diets and sleep in athletes, but none that discuss the impact of both simultaneously.

Several limitations should be considered when interpreting the results of this study. First, the diet recall log only takes food consumed in a 24-hour period into consideration. In order to get a better understanding of these athletes' true diet, a longer time period should be utilized to see a more wholistic view of micro- and macro- nutrient consumption. Second, the utilization of wrist actigraphy could help to give a better understanding of sleep quality by showing time spent in each stage of sleep as athletes have been found to demonstrate poor self-assessment in terms of sleep need, duration, and quality (6). In the future, matched controls should be used to compare diet and sleep quality between XC+T&F athletes and the general population. Furthermore, a longitudinal study should be conducted to compare diet and sleep quality during the different XC+T&F seasons including off-season, competitive season, and training season to understand different dietary and sleep needs for these athletes.

Data from this study suggests a relationship between dietary consumption and sleep quality in XC+T&F athletes. Larger consumptions of Vitamins A, K, B1, copper and selenium have been demonstrated to positively alter sleep quality. Based on the results of this study, there appears to be great protentional for further investigation of nutritional impact on sleep quality during different time periods of an athletic year as well as on athletic performance.

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