

Food insecurity among Division I student-athletes at a California State University: A mixed methods study

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Abstract: According to the 2020 Hope Survey, 38% of two-year college students and 29% of four-year college students experienced food insecurity. The distinct lifestyle of student-athletes may place them at an even greater risk for experiencing food insecurity and its consequences as compared to non-student-athletes. Therefore, this study assessed the prevalence of food insecurity among 98 student-athletes at California State University, Northridge (CSUN), and explored its impact on their athletic and academic performances and emotional well-being. The current study utilized a mixed-methods, cross-sectional design. An online survey was used to assess food security status, fruit and vegetable intake, reliance on athletic department fueling stations, and other sociodemographic variables. Semi-structured interviews were conducted to explore the impact of food insecurity on athletic performance, academic performance, and emotional well-being. Of the 98 student-athletes, 34.7% were food insecure. Reliance on the fueling station as a primary source of food for the day and reduced fruit and vegetable intake were identified as significant predictors of food insecurity. Results from eight semi-structured interviews revealed that food intake impacts energy levels during class and athletic events, and in the overall quality of athletic performance. Additionally, unequal access to resources within the fueling station was seen as a barrier to their success. Future research should investigate the prevalence of food insecurity among student-athletes and assess the use of the athletic department fueling station as an intervention to mitigate food insecurity among this population.

Keywords: College student-athletes, food insecurity, diet, higher education, mixed methods

Background

The United States Department of Agriculture (USDA) defines food security as having access to enough food for an active, healthy life by all people at all times (Coleman-Jensen et al., 2020). Levels of food security are divided into four categories: (a) high food security, (b) marginal food security, (c) low food security, and (d) very low food security (Coleman-Jensen et al., 2020). The first two categories are considered food secure, whereas the latter two are considered food insecure. In 2020, approximately 10.5% of United States (U.S.) households were food insecure, with 6.6% considered as low food insecure and 3.9% considered as very low food secure (U.S. Department of Agriculture, Economic Research Service [USDAERS], 2022). Despite the improvements on a national level, there are certain groups of people who experience food insecurity at a higher rate, such as college students.

Food Insecurity among Student-Athletes

College students are among the most vulnerable individuals to experience higher and more severe forms of food insecurity in the United States. According to the 2020 Hope Survey, 38% of two-year college students and 29% of four-year college students experienced food insecurity (The Hope Center, 2021). Student-athletes are a unique subgroup of college students who often have busier schedules, more time constraints, and higher energy and nutrient needs than the general college student population. The distinct lifestyle of student-athletes may place them at an even greater risk for experiencing food insecurity and its consequences as compared to non-student-athletes.

Despite being an at-risk population, there are a limited number of studies that have assessed the prevalence of food insecurity among college student-athletes. In 2019, data for student-athletes from the Hope Survey were published for the first time (Goldrick-Rab et al., 2020). Among the 3,506 student-athlete respondents, results indicated varying rates of food insecurity by NCAA division and college type. Similar rates of food insecurity exist among Division I, Division II, and Division III student-athletes at rates of 24% (10% low food-security, 14% very low food security), 26% (10% low food-security, 16% very low food-security), and 21% (10% low food-security, 11% very low food-security), respectively. Higher rates of food insecurity among student-athletes are reported at 2-year institutions (39%) compared to those at 4-year institutions (23%). Brown and colleagues (2021) also found a high rate of food insecurity among NCAA Division III student-athletes across the nation (14.7%).

Previous studies have identified alarming rates of food insecurity at the state- and conference-levels. In a study examining food insecurity among student-athletes at a public university in Connecticut, Anziano (2020) found that approximately 61% were food insecure. In the northwestern United States, a higher prevalence of food insecurity was found in collegiate athletes (60%) compared to the general university population (42%; Reader et al., 2022). Of the 60% of food insecure student-athletes, more than half (37%) were classified as very-low food secure. Compared to female student-athletes, male student-athletes had a higher prevalence of food insecurity at 83% and 52%, respectively. Experiences of food insecurity included: sometimes not getting enough food to consume a balanced diet, worrying about food running out, and food running out before acquiring funds to replace it. Mayeux et al. (2020) assessed food insecurity

among student-athletes at a public university in East Texas and found that 39.6% of student-athletes were food insecure. Using the same data, Douglas et al. (2022) examined food insecurity among female collegiate athletes and found that although 90% of respondents were receiving some form of scholarship and 80% had some form of meal provision, 32% still experienced food insecurity. Among NCAA Division I male collegiate athletes from a Southeastern Conference university, 13.5% were food-insecure, with 7.2% in the low food security category and 6% in the very low food security category (Poll et al., 2017). Altogether, the current research suggests that college student-athletes are a high-risk but understudied group for food insecurity and highlights the need to prioritize research on this population.

Health Implications of Food Insecurity

Health implications of being food insecure include micronutrient deficiencies, undernourishment, inflammation, increased stress, and poor sleep – all of which may be detrimental to a student-athlete’s academic performance, athletic performance, and emotional well-being (Martinez et al., 2019; Morris et al. 2016; Wall-Bassett et al., 2017).

Among student-athletes, food insecurity has been found to adversely impact personal health, including insufficient sleep, poor mental health (i.e., anxiety, depression), poor diet quality, unplanned weight gain, and unplanned weight loss (Brown et al., 2023). Additionally, food insecurity is associated with reduced fruits and vegetables, which are key sources of the micronutrients necessary for recovery from exercise-related muscle damage, i.e., Vitamin A and B (Close et al., 2019). Given that student-athletes are at an increased risk of the detrimental health implications of food insecurity, it is essential to identify factors associated with food insecurity among this population to develop effective interventions.

Other Risk Factors Associated with Food Insecurity

Few studies exist examining the risk factors that drive rates of food insecurity among student-athletes. Brown et al. (2021) found that the risk of food insecurity was higher among Hispanic students, Black students, those without a meal plan, recipients of a Pell Grant, first-generation college students, and those experiencing food insecurity prior to enrolling in college. Another study found that fewer student-athletes living on campus were food insecure compared with those residing off campus (Reader et al., 2022). Similar risk factors for food insecurity have also been identified among the general college student population.

For instance, Hispanic and Black students are at a higher risk for experiencing food insecurity compared to White students (Bruening et al., 2016; Coleman-Jensen et al., 2020; Mirabatur et al., 2016; Morris et al., 2016; Patton-López, 2014). Furthermore, college students qualifying for the Pell Grant and receiving financial support, including student loans, tend to be more food insecure compared to students not requiring additional financial aid (Bruening et al., 2016; Morris et al., 2016). Access to transportation also plays an important role in the ability to obtain food; specifically, college students without car access are more likely to experience higher rates of food insecurity compared to students with car access (Mirabatur et al., 2016). Place of residence may also be associated with food insecurity, as students who live off-campus with parents or guardians tend to experience higher food security compared to students who live off-

campus without their parents (Chaparro et al., 2009; Morris et al., 2016). Similarly, students living in housing situations with food provision – defined as a housing situation that provides food to students, such as a dormitory, sorority, or fraternity – are more likely to be food secure compared to students in housing situations without food provision (Mirabatur et al., 2016). Maintaining employment as a college student can help decrease financial stress and potentially provide eligibility for the Supplemental Nutrition Assistance Program (SNAP). However, eligibility criteria can be difficult for a student to meet, as those who are enrolled in school at least half-time must also work 20 hours per week in order to qualify for SNAP benefits (Freudenberg et al., 2019). Although researchers continue to investigate the relationships between these variables and food insecurity among the general college student population, the lack of research on collegiate athletes makes it unclear if these same variables apply to the student-athlete population, especially since they have different lifestyles, needs, and access to alternative resources.

Fueling Stations in College Athletics

In addition to the unique schedules and obligations student-athletes have compared to the general student population, they also have access to different resources, such as the athletic department fueling station. Fueling stations are a campus resource for student-athletes which provide them with nutrient and calorie-dense foods intended to meet their dietary needs, fuel their bodies for athletic performance, and assist with muscle recovery. Student-athletes have been found to replace traditional meals with food provided by the fueling station due to their time constraints with classes (Minsinger, 2020). Ensuring adequate access to adequate quantities and quality foods is important, as a lack of access has led student-athletes to eat less often than they felt they should or not eat for an entire day (Reader et al., 2022).

Division III student-athletes who were surveyed about food access reported that having more access to food and snacks would improve their academic performance (57%), athletic performance (69%), and overall health (67%); (Brown et al., 2023). Nearly three-fourths (74%) agreed that their campus needs more resources to help with food insecurity for athletes, and 70% agreed that athletes on their campus would benefit from a place on campus that provides free food for people in need (e.g., a food pantry). However, 62% reported that they would occasionally or never use a food pantry. Therefore, food access alternatives to food pantries are warranted. Given the accessibility and ability to provide nutrient-dense food at no cost to student-athletes, fueling stations may be a more effective intervention to mitigate food insecurity among student-athletes. However, no research exists assessing the relationship between food insecurity among student-athletes and the use of athletic department fueling stations.

Although previous studies identify college student-athletes as a high-risk group experiencing food insecurity, there is a dearth of research on this population. Therefore, the present study sought to expand the limited literature available on food insecurity among student-athletes. Specifically, the study had the following aims: (a) identify the prevalence of food security status among student-athletes; (b) identify sociodemographic and lifestyle characteristics associated with food insecurity such as race/ethnicity, year in college, car access, place of residence, GPA, fruit and vegetable intake, and reliance on fueling stations; and (c) understand how food insecurity affects college student-athlete academic performance, athletic performance, and emotional well-being.

Methods

Study Design

This study used a cross-sectional, mixed methods design to identify the prevalence of food insecurity among student-athletes at California State University, Northridge (CSUN) during the Spring 2020 semester. Participants completed an online survey assessing sociodemographic and lifestyle characteristics, food security status, and reliance on fueling stations. Informed consent was obtained from participants prior to participating in the survey. Upon completion of the survey, participants were entered into a raffle for a chance to win a \$100, \$50 or \$25 gift card. At the end of the online survey, respondents were given the option to participate in semi-structured interviews. For those who were interested, they were contacted by email to schedule an online interview via Zoom. This study was approved by an institutional review board.

Participants and Recruitment

A total of 298 student-athletes at CSUN were invited to participate in this study. Inclusion criteria for participation were: (a) current CSUN student-athlete; (b) at least 18 years of age; and (c) the ability to read and write in English. Convenience sampling methods were used to recruit student-athletes through posted flyers in the athletic department and the assistance of athletic department staff members.

Measures

Food Security Status

Food security status was measured using the validated United States Department of Agriculture 10-item Adult Food Security Survey Module (USDAERS, 2012). Consistent with the USDA Economic Research Service (ERS) categorizations, food insecurity was dichotomized into food secure (high and marginal food security) and food insecure (low and very low food security; USDAERS, 2012).

Fruit and Vegetable Intake

Fruit and vegetable intake was measured using the validated National Cancer Institute (NCI) All-day Fruit and Vegetable Intake Screener (NIH: National Cancer Institute, Division of Cancer Control & Population Sciences, n.d.). The screener included questions about portion size and frequency of fruit and vegetable intake over the last month. The average number of servings of fruits and vegetables each participant consumed daily was calculated using the NCI's scoring system (NIH: National Cancer Institute, Division of Cancer Control & Population Sciences, n.d.). For analysis, a two-cup minimum value was applied to dichotomize fruit and vegetable intake into those who consumed less than two cups of fruit and vegetables per day and those who consumed two or more cups per day. Two cups were chosen as the minimum to represent at least one serving of fruits and one serving of vegetables daily.

Reliance on Fueling Station

To determine student-athlete use of the CSUN fueling station, participants were asked, “Have you ever relied on the fueling station as your primary source of fuel for the day?” Answer options included “yes,” “no,” or “maybe.” The choices “yes” or “maybe” were coded as an affirmative answer. The term *fuel* has been understood by this population as nutritious, energy and protein-dense foods to help optimize athletic performance and aid in athletic recovery, and will be used throughout this paper with this meaning. The fueling station was run by a registered dietitian and therefore had the capacity to provide energy and protein-dense foods such as protein smoothies, sandwiches, oatmeal, fresh fruit and vegetables, protein bars, chocolate milk, Greek yogurt, and trail mix. Since the fueling station at CSUN was still expanding and funding was being established at the time of data collection, not all student-athletes had the same access to this service.

Sociodemographic Characteristics

The remaining survey questions obtained information on sociodemographic and lifestyle variables, including gender, sport, ethnicity, year in college, grade point average, place of residence, employment, car access, and use of financial support. Gender and sport were determined by participants selecting the athletic team they belonged to at the university, for example, “Men’s basketball” or “Women’s softball.” Ethnicity was assessed by asking, “How do you usually describe yourself?” to which answer options included “white,” “Black or African American,” “Hispanic or Latino,” “Asian or Pacific Islander,” “American Indian or Alaska Native” or “other.” Participants identified their year in college as “first-year undergraduate,” “second-year undergraduate,” “third-year undergraduate,” “fourth-year undergraduate,” “fifth or more year undergraduate,” or “graduate student.”

Financial support was assessed by asking, “Do you receive financial support from any of the following?” to which participants could select any of the following that applied to them: “athletic scholarship,” “grant not requiring repayment,” “student loan requiring repayment” or “none of the above.” For data analysis, financial aid was categorized into forms requiring repayment, not requiring repayment, or no use of financial support. Those who indicated they received an athletic scholarship or grant not requiring repayment were considered forms of financial support not requiring repayment, student loans were considered financial support requiring repayment, and none of the above indicated no use of financial support. Employment was assessed by asking participants, “Do you work? If so, how many hours?” with the response options of “no” or “yes.” Those who answered “yes” were given a free response section to state the number of hours worked per week.

Lifestyle Characteristics

Grade point average was assessed through selection of the ranges “4.0,” “3.00-3.99,” “2.00-2.99,” or “0.00-1.99.” Place of residence was assessed by asking, “Where do you currently live?” with the response options “on campus,” “off campus with parent/guardian,” “off campus without parent/guardian,” or “off campus alone.” Responses were dichotomized into those with food provision versus those without food provision. Food provision was defined as a situation in which food may be more accessible. Therefore, those who were living on campus or off campus with a parent/guardian were considered living with food provision, and those living off campus without a parent/guardian or off campus alone were considered to be living without food provision.

Car access was determined by asking, “Do you currently own or lease a car that you can depend upon to get you places you need to go?” with response options as “yes” or “no.” For those who responded “no,” a follow-up question asked, “If you needed to use a car, for example, to get to the grocery store, how difficult would it be to find someone you could borrow one from or who could give you a ride?” Response options were “extremely easy,” “somewhat easy,” “neither easy nor difficult,” “somewhat difficult,” or “extremely difficult.” Those who owned or leased a car and those indicating it would be easy or somewhat easy to borrow/find a ride were considered to have car access. Those who reported borrowing a car or finding a ride would be neither easy nor difficult, somewhat difficult, or extremely difficult were considered not to have car access.

Semi-structured Interview Guide

A semi-structured interview guide was developed by members of the research team who had experience working within the fueling station at CSUN. Previous qualitative studies were used to direct the development of the interview guide due to a lack of prior research assessing food insecurity among student-athletes (Leung et al., 2020; Meza et al., 2019). Questions from prior qualitative studies were adapted to pertain to student-athletes specifically, and new questions were developed to answer the research questions specific to this study. Follow-up questions and additional prompts were developed to get participants to describe details of a lived experience associated with food security status and explore emotions brought on by these experiences. The interview guide contained open-ended questions inquiring about the following topics: student-athlete lifestyle; experiences with personal food security status during college; barriers and facilitators to student-athlete athletic and academic success; and the impact food security status has had on athletic performance, academic performance, and emotional well-being.

Data Analyses

Descriptive statistics and chi-square analyses were used to describe participant characteristics and the prevalence of food insecurity among survey respondents. Multivariate logistic regression was used to model the probability of food insecurity among student-athletes controlling for sociodemographic variables. All analyses were conducted using IBM SPSS Statistics software (SPSS, 2007).

Interviews were recorded and transcribed verbatim with consent from participants. The transcripts were coded line-by-line, first identifying significant statements and then organizing the statements into themes that represent the clusters of meaning developed by two independent coders. Hand coding was done to organize interview content into 14 formulated meanings that were clustered to form themes that provided a textural and structural description. The qualitative portion of this study used a phenomenological research approach. A phenomenological study attempts to find common meaning in several individuals’ lived experiences of a concept or phenomenon (Creswell & Poth, 2016). Thus, in the context of this study, the phenomenon of interest was *experiences with food insecurity among student-athletes*.

Bracketing is a component of phenomenological research in which the interviewer acknowledges their own experiences with the phenomenon of interest to prevent them from interfering with the interpretation of participants’ described experiences (Creswell & Poth, 2016).

As a former student-athlete with personal experiences with food insecurity and as a previous intern within the athletic department fueling station at this university, it was necessary for the researcher to acknowledge and attempt to bracket these prior experiences. The textural descriptions explain what happened as it related to food insecurity, while the structural description explains how the food insecurity experience happened. Themes that emerged were shaped by the topics addressed within the interview guide and the shared experiences among the participants.

Results

Quantitative Results

Of the 298 student-athletes invited to participate in the study, a total of 98 completed the online survey (32.8% response rate). Table 1 provides a description of the sociodemographic and lifestyle characteristics of the sample. Of the 98 participants, 66.3% were female and 33.7% were male. White student-athletes made up the majority of the sample at 55.1%, while 23.4% were Latinx, 10.2% were African American, and 11.3% were other. According to year in college, 25.5% were freshman, 25.5% were sophomores, 27.6% were juniors, and 21.4% were seniors or higher. Responses were obtained from 15 of the 17 different athletic teams at this university, the majority of which were women's teams. 34.7% of the sample was categorized as food insecure, half of which reported low food security (17.3%), and the other half reported very low food security (17.3%) (with the missing 0.1% attributed to rounding).

Table 1

Study Sample Characteristics and Relationships to Food Insecurity (N = 98)

Characteristic	Food Insecure	Food Secure	χ^2	df	P-value
	(n=34)	(n=64)			
	n (%)	n (%)			
<i>Gender</i>			.48	1	.48
Female	21 (61.8)	44 (68.8)			
Male	13 (38.2)	20 (31.3)			
<i>Ethnicity</i>			1.49	3	.68
White	19 (55.9)	35 (54.7)			
Hispanic/Latino(a)	7 (20.6)	16 (25.0)			
Black or African American	5 (14.7)	5 (7.8)			
Asian or other	3 (8.8)	8 (12.5)			

<i>Year in College</i>			3.74	3	.29
1st year undergraduate	6 (17.6)	19 (29.7)			
2nd year undergraduate	7 (20.6)	18 (28.1)			
3rd year undergraduate	11 (32.4)	16 (25.0)			
4th year undergraduate or higher	10 (29.4)	11 (17.2)			
<i>Residence</i>			.647	1	.42
Living with food provision	11 (32.4)	26 (40.6)			
Living without food provision	23 (67.6)	38 (59.4)			
<i>Employment</i>			2.72	1	.09
Employed	8 (23.5)	7 (10.9)			
Unemployed	26 (76.5)	57 (89.1)			
<i>Car Access</i>			1.02	1	.31
Yes	24 (70.6)	51 (79.7)			
No	10 (29.4)	13 (20.3)			
<i>Financial Support</i>			6.30	2	.04*
Requiring repayment	12 (35.3)	12 (18.8)			
Not requiring repayment	22 (64.7)	45 (70.3)			
No use of financial support	0 (0)	7 (10.9)			
<i>Fruit and Vegetable intake</i>			5.05	1	.02*
Less than 2 servings per day	25 (73.5)	32 (50.0)			
2 or more servings per day	9 (26.5)	32 (50.0)			
<i>Reliance on Fueling Station</i>			11.69	1	.001*

Yes	24 (70.6)	22 (34.4)
No	10 (29.4)	42 (65.6)

Note: *Chi-square test statistical significance at $P < .05$

Table 2 includes the results from the multivariate logistic regression estimating the association between food insecurity and sociodemographic (e.g., race/ethnicity, year in college, car access, place of residence, and GPA) and lifestyle variables (e.g., fruit and vegetable intake, and fueling station). First-year undergraduates were 0.11 times less likely to be food insecure as opposed to those who were fourth-year undergraduates or higher (OR = 0.11, 95% CI: 0.02 - 0.72). The odds of being food insecure were 3.85 times greater for those who consumed less than two servings of fruits and vegetables per day as opposed to those who consumed two or more servings per day (OR = 3.85, 95% CI: 1.18 - 12.5). The odds of being food insecure were 7.25 times greater for those who relied on the fueling station as a primary source of food for the day as opposed to those who did not (OR = 7.25, 95% CI: 2.34 - 22.45). The association between food insecurity and all other variables tested did not show a statistically significant relationship.

Table 2

Relationship of food insecurity and sociodemographic and lifestyle characteristics among student-athletes for (N = 98)

Dependent variable	B	P-value	Odds Ratio	Confidence Interval
<i>Ethnicity</i>				
White (ref category)	-	-	-	-
Asian or other	-1.40	0.14	0.25	0.04 - 1.63
African American	0.89	0.33	2.43	0.40 - 14.6
Latinx	-0.09	0.89	0.92	0.25 - 3.29
<i>Year in college</i>				
4 th year (ref category)	-	-	-	-
1 st year	-2.21	0.02*	0.11	0.02 - 0.72
2 nd year	-1.01	0.18	0.37	0.08 - 1.62
3 rd year	-0.62	0.72	0.54	0.13 - 2.18
<i>No Residence</i>	-0.54	0.40	0.58	0.16 - 2.05

<i>No Car access</i>	0.95	0.13	2.59	0.76 - 8.85
<i>GPA</i>				
4.00 (A) (ref category)	-	-	-	-
2.00 - 2.99 (C)	-0.87	0.47	0.42	0.04 - 4.51
3.00 - 3.99 (B)	0.06	0.95	1.07	0.13 - 8.57
<i>No Fruit and vegetable intake</i>	1.34	0.03*	3.85	1.18 - 12.5
<i>Reliance on the fueling station</i>	1.98	<.001*	7.25	2.34 - 22.45

Note: *Indicates statistical significance at $P < .05$

Qualitative Results

The semi-structured interviews were conducted with eight student-athletes attending the university during the 2019-2020 academic year. Of those eight, five were female and three were male. Four participants identified as White, two identified as Hispanic or Latino/a, one identified as Asian, and one identified as Black or African American. With regard to year in college, four were fourth years, one was a third year, one was a second year, and two were first years. The eight student-athletes who participated in these interviews represented seven out of the 17 athletic teams at this university (41.2%). Five participants had high food security (62.5%), one had marginal food security (12.5%), one had low food security (12.5%), and one had very low food security (12.5%). Table 3 shows sample quotes and formulated meanings of student-athlete experiences with food insecurity.

Table 3

Significant statements of student-athletes with food insecurity and corresponding formulated meanings and themes

Theme	Formulated Meanings	Sample Quotes
Impact of food on athletic performance	Food intake affects energy levels	“It’s definitely something that I can see kind of when I fuel more, for some reason always during the later practices or even like the games, I just kind of felt a little more alert and energized”
	Not eating enough leads to poor	“I just remember so many times where we’d be on the baseline and a teammate would be like ‘Uh I don’t feel good, I didn’t eat this morning’ and right when they say that you

	performance	kind of know where going to be in for a long practice”
Impact of food on academic performance	Food intake affects focus	“I would say I’m definitely more focused when I’ve eaten, and I feel like it really does, I don’t wanna say like wakes up my mind, but in a way it kind of does.”
	Food intake affects energy levels	“If I didn’t snack I would honestly probably fall asleep during class because you go through just such an intense and hard workout and not eating afterwards, honestly you feel pretty like lethargic afterwards and you just want to go home”
	Time constraints make it difficult to eat before class	“One day I had four classes and the next day I had one, and on the days I had four classes, I really had to make sure I either had money or my card or something, or time in between for me to get food so it could digest before practice because I had literally class after class after class and then I had practice”
	Skipping or delaying a meal to tend to academic responsibilities	“Yeah I skipped meals a lot. Since I had 8 a.m. classes I would rarely have time in the morning to wake up and get something to eat. Or it was just fast, just grabbing a piece of fruit or a banana, and for me that’s not really enough for a breakfast meal”
	Challenges of being an international student-athlete	“Since I came to America, I have not been able to like eat food I really want. It’s really difficult, like there are markets but the food is expensive”
	Lack of transportation made grocery shopping difficult	“The biggest issue was that I don’t have a car so I went with public transportation most of the time, but it’s like I don’t really feel safe on public transportation. It’s not that I mind because in my country I was just using the bus all the time too, but here it was scary”
Facilitators to student athlete success	Adequate financial support	“We get stipend money that goes to housing and meals every month and it was a very generous amount. For me to feel like I never needed to work another job because that was always sufficient to get me through the month for food and rent”
	Receiving food support within their sport	“My team was very fortunate because we had our meal cards, whereas a lot of other teams didn’t have meal cards so they would have to pay for food out of pocket”
	Access to the fueling station	“It honestly has probably saved me a lot of money, I would say it’s saved me around, yeah 20 to 25 dollars a week”
Barriers to	Unequal access	“For my sport, access [to the fueling station] is limited. The

student athlete success	to the fueling station	other sports have access to a lot of things, but I notice for my sport we just have to pick like two things and sometimes they're not really that good"
		"So I was just confused for why we have access [to the fueling station] only once per week, I just like kept asking why?"
	High cost of healthy food options on campus	"Normally, like if you were to [the campus grill], like a salad is like I don't know, eight bucks. The sandwiches are expensive as well so I mean the only thing I really buy on campus now is coffee now if I need it"
	Lack of nutrition education and understanding	"I feel like a lot of people don't know much about nutrition, if that makes sense. Basically it took me a while to learn about like healthy fats, how much protein you need in a day, and at one point I went through like a fear of carbs. I thought they were evil and I've gotten over that obviously, um so I feel like it takes a while to like learn how to have a nutritious lifestyle"

Impact of Food on Athletic Performance

Student-athletes were asked to describe some ways they believe food has impacted their athletic performance.

Food Intake Affects Energy Levels. Several of the student-athletes described how their food choices helped their athletic performance in practices and games by increasing their energy levels. One basketball player described how she felt "a little more alert and energized" during her later practices when she had the time to consume a full meal before, versus her early morning practices when she would only eat a "yogurt and half of a protein bar." Similarly, a soccer player expressed how he "felt better" and had "much more energy" during his morning runs on the days he ate breakfast compared to the days he didn't. He concluded with the realization stating, "that just proves that food really does affect my performance. Like, I really feel so much better and I have much more energy [when I eat before workouts]."

Not Eating Enough Leads to Poor Athletic Performance. Some student-athletes also stated that not eating enough negatively affected their energy levels during athletic events, resulting in poor performance. Reasons for not eating enough or at all depended on each of the student-athlete's situations. A soccer player placed high importance on eating enough during her pre-game meals to determine the quality of her performance, but occasionally struggled to find time to eat enough before athletic events: "It's really important for me to get like all this food in as much as possible so that I can actually play well, but yeah like I definitely will not play well if I don't eat enough." A volleyball player who struggled with food insecurity described the physical sensations they experienced during practice as a result of not eating before: "There would be some days that I wouldn't eat before practice and like because my sport is like a really jumpy sport, I don't know, I just wouldn't feel comfortable around my stomach to jump so much."

Impact of Food on Academic Performance

Student-athletes were asked to describe if and how their food intake ever impacted their academic performance.

Food Intake Affects Focus. Several of the student-athletes stated that their focus in class suffered when they were not able to eat before. One volleyball player described a time when he had not eaten before a test and how it impacted his focus and his confidence: “I went into a test when I hadn’t eaten in a while, and I don’t know if I did terrible on the test but I remember just feeling like not confident the entire time, and just kind of not focused.” One soccer player mentioned that he has to work harder to focus in class to overcome his feelings of hunger: “I would have to work harder to focus in class because I was just like, ‘I’m hungry.’”

Food Intake Affects Energy Levels. Some student-athletes also reported struggling with low energy levels in class when they did not eat before. One basketball player whose food intake was primarily through snacking throughout the school day described that snacking after practice helped her maintain her energy levels and prevented her from “falling asleep during class.” She also mentioned that she would “feel pretty lightheaded during class” if she did not eat before and would frequently experience headaches when she “waited too long” to eat: “A lot of times I would be in class and just get a lot of headaches for some reason, that’s something that actually really stands out to me, you kind of feel your stomach growl.”

Time Constraints Make It Difficult to Eat Before Class. Multiple student-athletes stated that their tight schedules would frequently prevent them from being able to eat before class. Having a short time frame from when practice ended to when classes began made it challenging to eat before class. A basketball frequently had to skip lunch due to time constraints with classes: “I would find that it was pretty hard for me honestly in between classes to find time to eat because you would only have these fifteen-minute gaps in between classes.”

Food Security

Student-athletes were asked about their situations with food security and if and how it has affected them during their time in college.

Skipping or Delaying a Meal to Tend to Academic Responsibilities. Regardless of food security status, a common issue experienced by five out of the eight student-athletes was skipping or delaying meals to tend to their academic responsibilities. A soccer player explained how his busy schedule and back-to-back classes made it challenging to find time to eat dinner. As a result, he ended up delaying his dinner until he got home from his school days late at night:

This semester my schedule was just rough. I had an 8 a.m. class, and then my last class finished at 9:45 p.m., and so that was like really bad. So, I would eat lunch after practice at like 1 p.m. and then my dinner was after my 9:45 class, so I wouldn’t eat until like 10 p.m.

A basketball player mentioned skipping lunch daily for the sake of time. Due to her time constraints, she ultimately placed higher importance on her academics over her hunger:

Honestly like skipping lunch and stuff it was never because I didn't have the money for it or I never had the resources, it was honestly just for me just kind of always a time thing, and it was something that I was just like, for some reason I prioritize my academics so much and I would just sacrifice getting food.

Challenges with Food Insecurity as an International Student-Athlete. Both international student-athletes who participated in these interviews described stressful circumstances regarding their troubles with food insecurity and how it has affected their college experience. One shared about her family financial struggles and how difficult it was adjusting to not having her family close by for support: "All my American teammates, their parents are around the corner, they can ask them for money anytime, and like my financial situation is not the best back home so like I don't even want to ask my parents for money." She mentioned that even though she was struggling to feed herself during her first months at college, her priorities were succeeding at her sport and her academics: "At first like I didn't really care if I ate, I just cared that I am at practice and classes on time, but like, whatever like comes under my hand I just eat it." She often relied on school functions as her primary source of food for the day: "I was always going to these school events, they would always have like free snacks, free pizza, free donuts, and stuff like that so I would just bring Tupperware and just stack in everything and I like put in my backpack and sometimes I was feeding myself just like that." She also used the university food pantry frequently but felt that after receiving the "same beans every time and same fish in a can," those foods were "just not okay anymore." This way of eating eventually "became normal" to her.

Lack of Transportation Made it Difficult to Get Groceries. Two freshman student-athletes discussed their challenges with obtaining food without having access to a car. One described her ongoing struggle with getting to the grocery store. She felt uncomfortable and unsafe on public transportation, could not afford repeated car rides via the Uber app, and became frustrated with trying to transport groceries on her bike. "If you want to buy a lot of groceries, like maybe a gallon of milk, a box of cereal, water and stuff like that, it's not very easy to carry either. How am I supposed to carry all that all the way back to the dorms? So, transportation was kind of a big issue."

Facilitators to Student-athlete Success.

Participants were asked to identify some of the resources that they felt helped them succeed as a student-athlete.

Adequate Financial Support. Several student-athletes who felt their financial situation was stable also stated that they received financial support from several different sources. Some of these included financial aid, athletic scholarships, stipends through athletics, parental support, programs on campus, and summer jobs. Some received more financial support than others, but all expressed that they were able to feel like they did not have to stress about money while in school.

Receiving Food Support within Their Sport. Several student-athletes discussed the benefits of receiving a meal card through their sport which allows them to buy meals on campus as opposed to purchasing food with their personal money. A soccer player stated that his meal card is able to cover most of his lunches and dinners on campus and that the extra financial support “helps a ton.” A basketball player expressed her gratitude for having access to a meal card because she knew that many of the other athletic teams were not able to provide them for their athletes. Her meal card was able to help prevent some financial stress that would have occurred as a result of using her own money to buy food at school.

Access to the Fueling Station. Multiple student-athletes also enjoyed having access to the fueling station within the athletic department. One volleyball player appreciated the fact that he was able to access “nutritious food” through the fueling station instead of having to purchase “bad, fried food” that he felt were the only options at some locations on campus. He also described how frequent access to the fueling station helps ease financial strain: “I don’t have to buy food at like, school and stuff, like when I get hungry, I just go to the fueling station, and that satisfies me throughout the day.” A soccer player commented that she wished her team could have more access to the fueling station as opposed to receiving catered meals from restaurants the coaches would often provide for their team: “I really enjoy having food from the fueling station even though we get it like three times a week or two times per week. I would love to get it more, too, it’s like healthy foods that focus on getting those proper nutrients in before and after practice.”

Barriers to Student-Athlete Success

Participants were also asked about hardships they faced as a student-athlete and any resources they felt they needed but were not able to access.

Unequal Access to the Fueling Station. Several student-athletes on teams who had less access to the fueling station compared to other teams expressed feelings of frustration and confusion around the unequal access. One athlete stated: “I wish we had access to all the foods that other teams had.” She described feelings of confusion upon learning that other teams had access to a wider variety of foods compared to her team:

My friends on [another team] said they had a sandwich bar with like lettuce and meat and I was like wondering how are you getting that? I’m only allowed to get like a piece of fruit and a protein bar. I was kind of jealous because that would be nice and fast, it just sucked that we weren’t able to get access to the same foods as other teams.

When describing the types of foods she typically eats after a practice, another athlete stated that she felt that the fueling station has these foods, but her team was just not able to access them: “The thing for track is like you can’t pick this, you can’t take this, this is for other sports. They have everything, but it’s just not for us it’s for other sports.”

High Cost of Healthy Food Options on Campus. Several student-athletes described their struggle with finding healthy and affordable foods on campus. A soccer player also described how he tries to purchase both healthy and less healthy snacks from school in order to offset the high cost of healthy food items without completely sacrificing his nutrition:

The cheaper options were always like, the less healthy stuff. So I would just like, I would try to get a balance of both because if I got like too much healthy stuff it was too expensive, but if I got too much unhealthy stuff, then I felt kind of guilty.

Lack of Nutrition Education and Understanding. Understanding general concepts of nutrition and misinterpretation of nutrition information has impeded several student-athletes' success. One soccer player described her lifelong struggle with understanding nutrition. In one experience, she shared how she had previously tried to follow the ketogenic diet by cutting out carbohydrates early on in her college career, which ultimately resulted in her having a "negative relationship with food." She has since gained a better understanding of nutrition with the help of the registered dietitian within the athletics department. Upon reflection of her learning process with nutrition, she stated:

if I would have known how to properly fuel as soon as I came in freshman year, like that would have helped me tremendously because for like two years, like I was just like, let me try the keto diet, let me try intermittent fasting, like all this bad stuff for me. So, I wish I would have known how to properly eat; that would've helped me be successful.

The results of the semi-structured interviews help provide additional context to the quantitative results to demonstrate the specific situations of these student-athletes and their efforts in coping with food insecurity.

Discussion

This study contributed to the limited research available on food insecurity among student-athletes by examining student-athletes' personal experiences with various levels of food security and their perception of how food intake has impacted their academic performance, athletic performance, and emotional well-being. Among the sample of student-athletes, 34.7% were food insecure, with 17.3% of student-athletes categorized as low food secure and 17.3% categorized as very low food secure. These rates approximate those identified in previous studies. Mayeux and colleagues (2020) found a similar rate of food insecurity among student-athletes at a public university in east Texas (39.6%). Comparable rates in food insecurity have also been found among student-athletes at 2-year institutions (39%), 4-year institutions (23%), and at the Division I, Division II, and Division III level (24%, 26%, and 21%, respectively). On the contrary, Anziano (2020) found a much higher prevalence of food insecurity (61.1%) among student-athletes at a public university in Connecticut. Brown et al. (2021) found a much lower prevalence of food insecurity among NCAA Division III student-athletes across the nation (14.7%). The variation in the prevalence of food insecurity within these few studies emphasizes the need for additional research to further understand the severity of food insecurity among student-athletes.

Multivariate analyses demonstrated that student-athletes relying on the fueling station were 7.25 [95% CI: 2.34 –22.45] times more likely to be food insecure compared to those who did not rely on it. Furthermore, student-athletes consuming less than two daily servings of fruits and vegetables were 3.85 [95% CI: 1.18 - 12.5] times more likely to be food insecure compared to those who were consuming more than two daily servings of fruits and vegetables. This finding is consistent with the results of another study, which found that food insecurity was associated with

reduced fruit and vegetable intake among 8,705 college students attending ten different California universities (Morris et al., 2016). In addition to reliance on fueling stations and decreased fruit and vegetable intake, first-year undergraduates were 0.11 [95% CI: 0.02 - 0.72] times less likely to be food insecure compared to fourth-year undergraduates or higher. Ultimately, the present findings suggest that using financial support, having a lower intake of fruit and vegetables, being fourth-year undergraduates or higher, and relying on fueling stations are risk factors for food insecurity among college student-athletes.

Semi-structured interviews were conducted with eight student-athletes to explore how overall food intake impacted athletic and academic performance regardless of food security status, and explore emotions brought on by these experiences. Food intake appeared to impact student-athlete energy levels during athletic events and quality of athletic performance, as well as energy levels during class and ability to focus in class. These findings further support previous research demonstrating an adverse impact of food insecurity on personal health among student-athletes (Brown et al., 2021). This is concerning, as student-athletes who may be food insecure are likely to experience a negative impact on their athletic and academic performance like what was described within the semi-structured interviews in this study.

Interview participants also identified several barriers that impeded their ability to be successful as a student-athlete, one of which was unequal access to the fueling station. While those with more access to the fueling station described how it helped increase food intake during periods of time constraints and minimized financial burden, the student-athletes with less access to the fueling station described how it limited their ability to obtain enough food throughout the day and made acquiring food more difficult during time constraints. These athletes felt that equal access to the fueling station would be beneficial for their dietary quality and ultimately benefit their athletic and academic performance.

A lack of nutrition education and understanding was another commonly repeated barrier to student-athlete success. Several student-athletes described experiences of feeling confused over how to eat to benefit their athletic performance as freshmen in college. Several felt that their athletic performances throughout their college career would have improved with early nutrition education as freshmen rather than attempting to figure it out on their own through trial and error. Likewise, student-athletes at a University in California were found to have an overall lack of nutrition knowledge, which can be harmful for elite athletes in reaching their full potential (Quintanilla, 2020). Overall, the identification of barriers to success by the student-athletes themselves is important, as it provides insight into the interventions needed within college athletic departments to support student-athletes with essential services to reach their full academic and athletic potential.

Limitations

Limitations of this study include the small sample size of 98 student-athletes, which may limit the generalizability of these results to populations at other universities. This study also included a small number of participants in the semi-structured interview due to the limited number of willing participants, which could have prevented the identification of other important topics related to food insecurity. Another limitation was the use of a categorical variable used to

determine GPA. The categorical variable did not provide enough stratification of data to accurately determine an association between food insecurity and GPA among student-athletes. Although not the focus of this study, the use of a dietary recall tool may have provided a closer look at the dietary quality of student-athletes. Regardless of these limitations, the strengths of this study included the use of validated survey tools, including the USDA food insecurity survey module and the NCI all-day fruit and vegetable screener. Additionally, the use of interviews to provide insight into personal experiences with food insecurity is currently lacking in the available literature.

Conclusion

The present findings suggest that reliance on fueling stations as a primary source of food is a risk factor for food insecurity among this population. Results also identify fueling stations as a highly valued resource among student-athletes. Given fueling stations are an important source of food and serve high-risk student-athletes, they may be an effective intervention for preventing or decreasing the severity of food insecurity among this population. Therefore, athletic directors, athletic department staff, sports dietitians, and other key stakeholders can use the findings in this study to support the implementation of fueling stations on university campuses in order to mitigate the prevalence and severity of food insecurity among student-athletes.

References

- Anziano, J. (2020). *Food insecurity among college athletes at a public university in New England*. (Publication No. 27995382) [Master's thesis, Southern Connecticut State University Master of Public Health]. ProQuest Dissertations and Theses Global. <http://dx.doi.org/10.4085/1062-6050-0660.22>
- Brown, M.L., Karpinski, C., Bragdon, M., Mackenzie, M., & Abbey, E. (2023). Prevalence of food insecurity in NCAA division III collegiate athletes. *Journal of American College Health, 71*(5), 1374-1380. <http://dx.doi.org/10.1080/07448481.2021.1942886>
- Bruening, M., Brennhofner, S., Van Woerden, I., Todd, M., & Laska, M. (2016). Factors related to the high rates of food insecurity among diverse, urban college freshmen. *Journal of the Academy of Nutrition and Dietetics, 116*(9), 1450-1457. <http://dx.doi.org/10.1016/j.jand.2016.04.004>
- Creswell, J.W., & Poth, C.N. (2016). *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications.
- Chaparro, M.P., Zaghoul, S.S., Holck, P., & Dobbs, J. (2009). Food insecurity prevalence among college students at the University of Hawai'i at Mānoa. *Public Health Nutrition, 12*(11), 2097-2103. <http://dx.doi.org/10.1017/s1368980009990735>
- Close, G.L., Sale, C., Baar, K., & Bermon, S. (2019). Nutrition for the prevention and treatment of injuries in track and field athletes. *International Journal of Sport Nutrition and Exercise Metabolism, 29*(2), 189-197. <http://dx.doi.org/10.1123/ijsem.2018-0290>
- Coleman-Jensen, A., Rabbitt, M.P., Gregory, C.A., & Singh, A. (2020). Household food security in the United States in 2019, ERR-275. *U.S. Department of Agriculture Economic Research Service*. <https://www.ers.usda.gov/webdocs/publications/99282/err-275.pdf?v=63.8>
- Douglas, C.C., Camel, S.P., & Mayeux, W. (2022). Food insecurity among female collegiate athletes exists despite university assistance. *Journal of American College Health, 1*-7. <http://dx.doi.org/10.1080/07448481.2022.2098029>
- Freudenberg, N., Goldrick-Rab, S., & Poppendieck, J. (2019). College students and SNAP: The new face of food insecurity in the United States. *American Journal of Public Health, 109*(12), 1652-1658. <http://dx.doi.org/10.2105/ajph.2019.305332>
- Goldrick-Rab, S., Richardson, B., & Baker-Smith, C. (2020). Hungry to win: A first look at food and housing insecurity among student-athletes. *The Hope Center for College, Community, and Justice, 2*-19. https://tacc.org/sites/default/files/documents/2020-06/2019_studentathletes_report.pdf

- Leung, C.W., Stewart, A.L., Portela-Parra, E.T., Adler, N.E., Laraia, B.A., & Epel, E.S. (2020). Understanding the psychological distress of food insecurity: A qualitative study of children's experiences and related coping strategies. *Journal of the Academy of Nutrition and Dietetics*, 120(3), 395-403. <http://dx.doi.org/10.1016/j.jand.2019.10.012>
- Martinez, S.M., Grandner, M.A., Nazmi, A., Canedo, E.R., & Ritchie, L.D. (2019). Pathways from food insecurity to health outcomes among California university students. *Nutrients*, 11(6), 1-11. <http://dx.doi.org/10.3390/nu11061419>
- Mayeux, W., Camel, S., & Douglas, C. (2020). Prevalence of food insecurity in collegiate athletes warrants unique solutions. *Current Developments in Nutrition*, 4(Supplement_2), 239-239. http://dx.doi.org/10.1093/cdn/nzaa043_090
- Meza, A., Altman, E., Martinez, S., & Leung, C.W. (2019). "It's a feeling that one is not worth food": A qualitative study exploring the psychosocial experience and academic consequences of food insecurity among college students. *Journal of the Academy of Nutrition and Dietetics*, 119(10), 1713-1721. <http://dx.doi.org/10.1016/j.jand.2018.09.006>
- Minsinger, E.R. (2020). *Fueling station utilization by division I athletes at the University of Pittsburgh*. (Publication No. 28370805). [Master's thesis, The University Pittsburgh Master of Science]. ProQuest Dissertations and Theses Global.
- Mirabitur, E., Peterson, K.E., Rathz, C., Matlen, S., & Kasper, N. (2016). Predictors of college-student food security and fruit and vegetable intake differ by housing type. *Journal of American College Health*, 64(7), 555-564. <http://dx.doi.org/10.1080/07448481.2016.1192543>
- Morris, L.M., Smith, S., Davis, J., & Null, D.B. (2016). The prevalence of food security and insecurity among Illinois university students. *Journal of Nutrition Education and Behavior*, 48(6), 376-382. <http://dx.doi.org/10.1016/j.jneb.2016.03.013>
- National Institutes of Health: National Cancer Institute, Division of Cancer Control & Population Sciences. (n.d.). *Fruit & vegetable screeners in the eating at America's table study (EATS): Instruments*. <https://epi.grants.cancer.gov/diet/screeners/fruitveg/instrument.html>
- Patton-López, M.M., López-Cevallos, D.F., Cancel-Tirado, D.I., & Vazquez, L. (2014). Prevalence and correlates of food insecurity among students attending a midsize rural university in Oregon. *Journal of Nutrition Education and Behavior*, 46(3), 209-214. <http://dx.doi.org/10.1016/j.jneb.2013.10.007>
- Poll, K., Valliant, M., Joung, H.W.D., & Holben, D.H. (2017). Food insecurity and food behaviors of male collegiate athletes. *The FASEB Journal*, 31, 791-792. http://dx.doi.org/10.1096/fasebj.31.1_supplement.791.2

- Quintanilla, A. (2020). *An evaluation of nutrition knowledge among NCAA collegiate athletes*. (Publication No. 28027915) [Mater's thesis, California State University, Long Beach Master of Science in Nutritional Science]. ProQuest Dissertations and Theses Global.
- Reader, J., Gordon, B., & Christensen, N. (2022). Food insecurity among a cohort of division I student-athletes. *Nutrients*, *14*(21), 4703. <http://dx.doi.org/10.3390/nu14214703>
- SPSS Inc. (2007). *SPSS for Windows* (Version 16.0) [Computer software]. <https://www.ibm.com/spss>
- The Hope Center. (2021). *#RealCollege 2021: Basic needs insecurity during the ongoing pandemic*. https://hope.temple.edu/sites/hope/files/media/document/RCSurvey_NatlOnePager_FIN_AL_3.22.2021.pdf
- U.S. Department of Agriculture Economic Research Service. (2012). *U.S. adult food security survey module: Three-stage design, with screeners*. <https://www.ers.usda.gov/media/8279/ad2012.pdf>
- U.S. Department of Agriculture Economic Research Service. (2022). *Food security status of U.S. households in 2022*. <https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-u-s/key-statistics-graphics/#foodsecure>
- Wall-Bassett, E., Li, Y., & Matthews, F. (2017). The association of food insecurity and stress among college students in rural North Carolina. *Journal of Nutrition Education and Behavior*, *49*(7), S75. <http://dx.doi.org/10.1016/j.jneb.2017.05.218>