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A Qualitative Description of Graduate Students' Perceived Decline in Physical Activity from Undergraduate School

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ABSTRACT

International Journal of Exercise Science 17(5): 1038-1055, 2024. Many university students, especially graduate students, are experiencing poor physical and psychological health. Thus, universities are initiating programs like Exercise is Medicine-On Campus (EIM-OC) to promote positive physical activity behavior to improve physical and mental health for primarily undergraduate university students. However, the influences on physical activity when transitioning from an undergraduate to a graduate student are unknown. To explore perceptions of if and how the physical activity levels of graduate students changed from their time as undergraduate students while considering environmental and lifestyle factors. METHODS: Using a qualitative, phenomenological research design, a convenience sample of current graduate students enrolled at a large, mid-South university completed a 20-minute interview. Questions included inquiring on current household, occupational, active transportation, leisure time, and overall physical activity during the graduate and past undergraduate programs. All interviews were transcribed, and major themes were derived using thematic analysis. Twenty-one (62% female; 52% master's students) participants completed interviews. Overall, participants perceived their physical activity decreased, including occupational, active transport, and leisure-time physical activity. Major themes discussed by participants included: increased academic and occupational responsibilities, changes in the physical and social environment, increased awareness of health and activity, and life transitions. The decline in physical activity once individuals enter their graduate program necessitates an intervention, like EIM-OC, during or after undergraduate studies to promote the initiation or continuation of regular physical activity to improve graduate students' overall health.

KEY WORDS: Student wellness, college, movement, higher education, sedentary behavior, walking, health promotion, stress, anxiety

INTRODUCTION

Emerging adulthood, between ages 17 and mid-to-late 20s, is a key life transition where individuals become more independent, form their identity, and set lifelong habits and behaviors (53). Individuals may also pursue post-secondary education to gain the experience, knowledge, and skills potentially necessary for entering the workforce. However, students often struggle with their mental health and well-being while managing academic, work, social, and personal

responsibilities (35), not to mention the additional negative mental health effects of the COVID-19 pandemic (11). Graduate students, more specifically, report a staggering rate of mental health issues in part due to the demanding requirements of being a graduate student (16). Evans et al. also found that graduate students are over six times more likely to have depression and anxiety than the general population (16). Graduate students are an important population as these individuals are typically employed in higher-level positions in more specialized careers with the increased ability to affect change as key decision-makers. Therefore, strategies are needed to promote mental health among graduate students for their current health and as future influential employees in the workforce.

One strategy that has been shown to improve mental and physical health is physical activity. Physical activity is known to have positive effects on body composition, glucose homeostasis, insulin sensitivity, and cardiac function (49). Similarly, physical activity can have a positive effect on mental health. In a cross-sectional analysis of over 1.2 million U.S. individuals, researchers found that those who were regularly active were found to report 43.2% fewer days of poor mental health than those who were not (9). The current literature on undergraduate students shows similar trends, especially for reducing depressive symptoms (14, 19, 45). However, evidence of the physical activity of graduate students, as well as its relationship with mental health is sparse (21). One study found undergraduate nursing students (n = 233) participated in significantly more regular exercise than graduate school nursing students (n = 230) (21). Concerningly, among these nursing students, significantly more graduate students reported an obese BMI compared to undergraduate students. However, factors influencing the change in physical activity from undergraduate to graduate studies are unknown.

Even with the creation of physical activity guidelines (40), physical activity levels appear to decline among emerging adults (48), and programs, such as Exercise is Medicine On Campus (EIM-OC), have been implemented to primarily increase undergraduate student physical activity. EIM-OC, created by the American College of Sports Medicine, is a national initiative to assess and promote college student physical activity (3). To adapt the implementation of such programs to include graduate students, a socioecological approach, such as the physical activity-specific method proposed by Sallis et al., may be useful for capturing the various influences of graduate student physical activity (42). Currently, this approach has been utilized to acknowledge domain-specific (i.e., active recreation, active transport, household activities, and occupational activities) differences in physical activity and their health outcomes (4, 10, 25, 46). There is a lack of studies using this methodology for college student physical activity, which may contribute to intervention strategies being unsuccessful long-term (28).

Understanding physical activity trajectories from undergraduate to graduate schooling will provide the insight needed to guide intervention strategies, such as EIM-OC or others, for establishing and maintaining active lifestyles in graduate students. The purpose of this study was to examine the perceived changes in physical activity of current graduate students from their undergraduate studies by domain, including household, occupational, active transport, and leisure-time physical activity, along with an overall impression of physical activity changes. Additionally, this study sought to identify the perceived context and circumstances surrounding

their physical activity changes. A qualitative approach with supporting frequencies of themes was chosen to capture the context of changes in physical activity, allowing for a richer analysis of the circumstances and environments that shape physical activity from undergraduate to graduate schooling.

METHODS

Participants

This study utilized a qualitative, phenomenological design with quantitative measures reporting the frequency of themes as the methodological approach. Phenomenology investigates a particular event or phenomenon that may be better understood through the inner subjectivity of human experiences (18) and is appropriate for the exploratory nature of the study (47). This approach was chosen to gather a better understanding of the transition from undergraduate to graduate schooling and the differences between them, from the perspective of the individuals experiencing it. Based on the pragmatic aims of this study, this understanding may yield resolutions or practical applications that can improve the physical activity of graduate students. The numerical data presented in this study were intended to provide additional support for and enhance the potential impact of the study's qualitative findings. Although this study may appear to have been a mixed-methods study, the current terminology for mixed methodologies (12) does not capture the data reported in this study. However, the quantitative data in this study are consistent with previous research by Sandelowski, proposing the reporting of frequencies to support codes in qualitative research (43).

A convenience sample of graduate students actively enrolled at a large, mid-south university in the U.S. was recruited. Recruitment procedures included the university's online newsletter, social media fliers, and word of mouth. Eligible participants for the study were those who were 18 years or older, English-speaking, and enrolled in a graduate-level program at the university. All participants provided informed, verbal consent to participate. This study was approved by the Institutional Review Board (IRB protocol number 2210426856) prior to data collection. This research was carried out in accordance with the ethical standards of the International Journal of Exercise Science (34).

Protocol

Interviews utilized a semi-structured framework to obtain a deeper understanding of each individual's experience (22). Semi-structured interviews were conducted by two interviewers and recorded virtually. A total of 5 research assistants, who were all graduate students in a health-related graduate program, conducted interviews. Random combinations of two interviewers were used to provide consistency between interviews. All interviewers underwent semi-structured interview training facilitated by KMJ and EKH prior to data collection.

At the beginning of the interview, participants were asked demographic questions, including graduate program, completion of other graduate degrees, details about their undergraduate program, where their undergraduate degree was completed, and if participants took any breaks between their schooling. Next, guided by the socioecological model (42) to explore intra- and

interpersonal factors of one's physical activity, participants were asked about the four domains of physical activity: household, occupational, active transport, and leisure-time physical activity. This model demonstrates how the perceived environment, the behavior setting, and the policy environment impact an individual's physical activity behavior (42). Participants were asked to describe their current perceived physical activity for each domain qualitatively, then compare their current physical activity to their experience during their undergraduate program to investigate perceptions of if and how each individual's physical activity might have evolved during a critical transition from undergraduate studies to graduate studies. Because physical activity behavior is affected by many variables within a person's life (5), participants were asked to examine and describe perceptions and attitudes about how each physical activity domain might have been impacted by changes in the individual's environment (e.g., living arrangements, presence of social support, course load, etc.) from their time as an undergraduate to graduate student. For example, students were asked to describe their current living arrangement and the household tasks they typically do and then asked their perceptions of how and why these have changed or remained the same since they were in their undergraduate program. Questions about each physical activity domain were structured in a similar format. Finally, participants were asked about their overall impression of whether their physical activity as a whole changed or remained the same while transitioning from undergrad to graduate studies. Questions from the semi-structured interviews are provided in the supplemental material of this manuscript. Interviews lasted no longer than 20 minutes, and participants were compensated for their time. All interviews were completed in November and December of 2022.

Statistical Analysis

Interview recordings were transcribed by the co-authors (KMJ, MB) to begin familiarization and immersion in the data. Perceptions of changes in each of the physical activity domains were tabulated. Each interview was carefully read through to obtain a sense of the interviewee as a whole. Descriptive statistics of participant demographics were calculated first. Second, KMJ and MB met to calculate and discuss the number of students indicating an increase, decrease, or no change in their physical activity for each domain. This was done in the event a participant did not explicitly answer with increase, decrease, or no change and to allow the authors to examine the context of each participant's response and deduce what the participant was indicating. The authors met to compare results and discuss unclear responses. Thematic analysis was conducted on the remainder of each interview to identify themes using an inductive approach (7). This data-driven approach was chosen to identify overarching latent themes across physical activity domains. Under the supervision of BTD, initial codes were generated in an iterative process (KMJ, MB). KMJ and MB independently identified participant statements potentially relevant to the research objectives. These statements were labeled with a code – a short phrase that depicted the analytic relevance. The two researchers met to compare codes and discuss agreements or disagreements. This was repeated several times until a consensus was reached for the final list of codes. In addition, participant responses to each structured question were gathered and organized to further examine question-specific patterns in codes. Codes were then collated into potential themes (KMJ and MB). The frequency of codes was also noted during this process to provide quantitative data supporting the themes. As the analysis progressed, transcripts were

revisited, and themes were refined until a systematic narrative was achieved. Then a third co-author (EKH) reviewed the systematic narrative, allowing for the finalization of the themes.

RESULTS

A total of 21 graduate students were recruited and completed interviews (62% female; 52% master's students) when saturation of responses was reached. The participants' mean age was 27.1 years (range = 20–35). Thirteen students completed their undergraduate degree at a university in the U.S., and thirteen students took a break from school between their undergraduate and graduate schooling. All participants who took a break worked during this time with an average break length of 3.75 years (range = 0.5–8; see Table 1.).

Table 1. Participant demographics.

Demographic Category		*n* (%)
Sex	Males	8 (32%)
	Females	13 (62%)
Graduate Program	Master's	11 (52%)
	Doctoral	10 (48%)
Graduate Program College	Arts & Sciences	6 (28%)
	Engineering	5 (24%)
	Education & Health Professions	5 (24%)
	Agricultural, Food, & Life Sciences	5 (24%)
Undergrad Location	United States	13 (62%)
	International	8 (38%)
Presence of Breaks Between Undergrad and Grad	No Breaks	9 (43%)
	Break of 1–3 Years	5 (24%)
	Break of 4+ Years	7 (33%)
Total		21 (100%)

Changes in perceived physical activity for each domain from undergraduate to graduate school are represented in Table 2. Over half of the participants (57%) perceived an increase in household physical activity. For each remaining domain (occupational, active transport, leisure-time, and overall impression of physical activity), the majority of participants perceived a decrease in physical activity: 71%, 81%, 62%, and 67% respectively.

Supportive quotes by participants, as indicated by P#, are presented for each domain. For household physical activity, participants indicated an increase in the frequency of household tasks (e.g., "I wasn't cleaning as much as I would see myself cleaning today" [P18]) or not doing household tasks at all in their undergraduate (e.g., "I wasn't doing them at all in undergrad, and now I am the only person taking care of my household tasks" [P14]).

Table 2. Changes in perceived physical activity by domain from undergraduate to graduate school.

Perceived Change in PA[a]	Household PA	Occupational PA	Active Transport PA	Leisure-Time PA	Overall PA
Increase	12 (57%)	3 (21%)	2 (9.5%)	7 (33%)	7 (33%)
Decrease	4 (19%)	10 (71%)	17 (81%)	13 (62%)	14 (67%)
No Change	5 (24%)	1 (7%)	2 (9.5%)	1 (5%)	0 (0%)

[a]PA = physical activity

In describing changes in occupational physical activity, all 21 participants were employed in their graduate program. Twenty participants were employed as graduate assistants, either teaching-only, research-only, or a combination, and some were funded through the university or through outside funding. All but one participant described their job as mostly sedentary and requiring some light-intensity physical activity (i.e., frequent walking or standing). The remaining participant noted that their job required more moderate-to-vigorous intensity physical activity (e.g., carrying moderate-to-heavy loads, working in fields and greenhouses). Fourteen participants were employed during both their undergraduate and graduate programs. Ten (71%) of them perceived a decrease in physical activity, mentioning a shift in the physical and mental demands of their jobs between programs (e.g., "They were more physically demanding…With my [graduate assistantship], it's more cognitively demanding" [P12]).

For the perceived decline in active transport physical activity, participants indicated that they walked to places more in their undergraduate program than in their graduate program (e.g., "It was a lot different for sure because I walked everywhere in [undergrad]" [P15]). The primary reason for this perception was having multiple on-campus destinations in their undergraduate (e.g., "I didn't have to do research in one place, so I was walking way more between classes" [P3]). The decline in leisure-time physical activity was indicated by exercising more frequently in their undergraduate, either at the gym (e.g., "I did a lot more, like I would just go to the rec and workout" [P7]), going for runs (e.g., "I just focused on running and walking…and running half marathons" [P10]), or participating in intramural sports (e.g., "In undergrad, I played organized sports often…that's kind of lacking in my life right now" [P19]).

Finally, the majority of participants perceived an overall decline in their physical activity. Reasonings for this decline varied, but a consistent response was that physical activity was unintentionally incorporated into their daily life during undergraduate studies:

> I would say that I make more time for physical activity, like specific time…But I feel like I'm less active somehow…all that going out and drinking and dancing, I guess, added up to something.
> [P14]

Four themes emerged from the participants' responses: 1) increased academic and occupational responsibilities, 2) changes in physical and social environment, 3) increased awareness of health and activity, and 4) life transitions. Table 3 summarizes the main findings and supporting subthemes.

Table 3. Themes with supporting subthemes.

Theme	Most Prevalent Subtheme	*n* (%)
Increased academic and occupational responsibilities	Fewer responsibilities outside of class in undergrad	11 (52%)
	Grad school is overwhelming/mentally exhausting	11 (52%)
	Graduate job is more cognitively demanding	3 (14%)
	Busier schedule of graduate job lessens leisure time	6 (29%)
	Juggling numerous tasks in graduate job	3 (14%)
	Total	16 (76%)
Changes in physical and social environment	Physical Environment:	
	• Urban design of undergraduate favors walking	1 (5%)
	• Smaller space to clean in undergrad	5 (24%)
	• Lived closer to campus in undergrad	7 (33%)
	• Lack of access to exercise facilities in undergrad	2 (10%)
	• Intensity of walking grad school is greater due to hills	2 (10%)
	• Layout of university prompted more walking	6 (29%)
	• More likely to be active in warmer months	7 (33%)
	Total	14 (67%)
	Social Environment:	
	• Only performs leisure activity when others are present	2 (10%)
	• Previously had social support for active hobbies	2 (10%)
	• Participated in active hobbies for social interaction	3 (14%)
	Total	7 (33%)
Increased awareness of health and activity	Unintentionally active in undergrad/more intentional in grad school	12 (57%)
	Aware that walking on campus was higher in undergrad	6 (29%)
	Leisurely walks to make up for lack of walking transport	4 (19%)
	More conscious of health	4 (19%)
	Exercise for leisure-time PA in graduate school*	14 (67%)
	Total	12 (57%)
Life transitions	Taking care of others now (kids, significant other, pets)	11 (52%)
	Only person responsible for household tasks/living alone in grad school	5 (24%)
	Walks with pet	5 (24%)
	Created more consistent routines in grad school	4 (19%)
	Cleanliness was not a priority in undergrad	3 (14%)
	Peers are in different life circumstances in grad school	2 (10%)
	Take grad school more seriously	3 (14%)
	Total	18 (86%)

*Not all 14 participants who indicated that they exercise mentioned increased awareness of health and activity

Sixteen (76%) students perceived greater academic and occupational responsibilities in their graduate program. Participants acknowledged that having these higher academic and occupational loads contributed to their perceived decrease in physical activity. One student stated, "I could play any given day as an undergrad, but now I could do Friday or the weekend because of the nature of the work…I mean research is much more demanding" (P17), and another described, "I got to be in grad school, and I got way busier, and things just kind of fell off" (P13). This was also noted for the decrease in active transport because although many stated that they took more courses (e.g., "I definitely was commuting from class to class a lot more" [P14]), many of them (*n* = 13; 62%) now are confined to one building for their classes and work (e.g., "It's just walking in the same building upstairs, downstairs, and back to [my office]" [P18]).

In addition, 11 (52%) emphasized that graduate school was more mentally exhausting than their undergraduate since it requires several tasks besides coursework alone. Overall, participants said that having to juggle the many tasks of being a graduate student has decreased their motivation to be physically active:

> I was a lot less stressed out [in my undergrad]. It was like, 'yeah, I can go on a walk. No big deal.' And now I'm like, 'oh, I can't even think about that. I just have so much I have to do'…I just feel a lot more stressed out, and whenever I have time to do things, I just want to sit on the couch.
> [P21]

Participants stated that the physical environments of their undergraduate program were more conducive for active transport physical activity and less favorable for household physical activity. Fourteen (67%) students mentioned walking or biking more as a means of transport both on and off-campus during their undergraduate, due to not owning a car (n = 9; 43%) or living closer to campus (n = 7; 33%) (e.g., "I lived closer to campus and also…[specific] Street and restaurants. I could even walk to Walmart" [P10]). Many also mentioned that their physical living space in their undergraduate required fewer household tasks, either from less personal space to clean (n = 5; 24%) or splitting tasks with roommates (n = 5; 24%). When asked why they perceived an increase in their household physical activity, one student said, "Because I guess smaller space, and so I didn't have to devote much energy to it" (P8). Apart from the physical living space and its proximity to on- and off-campus destinations, the weather was another commonly discussed (n = 7; 33%) part of the environment that influenced physical activity. Participants noted that they were more willing to partake in outdoor physical activities during warmer months than in colder months (e.g., "Sometimes I bike when it's summer, now it's too cold" [P3]).

Seven (33%) also talked about their social environment changing from undergraduate to graduate school and this playing into their leisure-time physical activity. One participant mentioned, "I usually played volleyball…but not anymore because my friends are not playing anymore"(P5). Participants mentioned performing leisure-time physical activity with others (e.g., "I like to go biking with my friends" [P2]) or even preferring it (e.g., "Before was always by myself, and now I don't want to exercise on my own anymore" [P8]).

Participants discussed how they were more aware of their health as graduate students than they were as undergraduates, as well as understanding the importance of physical activity for health. One student said, "I realized that it's very important to check one's health…I think I'm more conscious of making sure I make time" (P11). Many participants (n = 12; 57%) recognized that they were more physically active as an undergraduate unintentionally and that they are now more intentional about being active (e.g., "I used to stay healthy, you know, naturally. But since I'm not moving, I feel like I need to do some physical activity" [P20]). These participants mentioned that their physical activity in their undergraduate was part of their daily social activities, which is lacking in their current graduate program (e.g., "I never worked out in my undergrad, but I was out a lot more. I was out walking around, walking to friends' houses, or

walking to classes." [P14]). One participant admitted that they felt guilty for not being as active, "[In] my undergrad, it was very active all the time…I'm kind of embarrassed because I wish I was more active" [P21].

Eighteen (86%) participants acknowledged that their physical activity has changed from being in a different stage in their life as graduate students. From prioritizing household tasks, taking graduate school more seriously, living alone for the first time, taking care of others, or having a significant other, participants realized that their life circumstances as graduate students are different than they were in their undergraduate studies; or as one participant simply said, "I'm a more mature adult now" (P1). One participant indicated that the diversity of graduate students has impacted their preferred physical activity of intramural sports, "I don't really have any kind of organized sport at the moment…There are different dynamics in graduate programs and undergraduate programs with regards to who might want to join as a team" (P19). Participants perceived that these differences in lifestyles and life circumstances from their undergraduate and graduate programs played into their perceived decline in physical activity:

> There's always something trying to take my time, it's either kids or research. Anymore, I'm so overwhelmed. I'm too tired, I barely do any exercise. I think I did more as an undergrad, but it was unintentional. But now it's trying to be intentional about it.
>
> [P4]

Further analysis was done to compare differences in perceived physical activity based on the participants' demographics (see Table 4). When analyzing males and females, seven of the eight (87.5%) males perceived a decline in their leisure-time physical activity, while only six of the twelve (50%) females perceived the same. Males and females had similar perceptions of physical activity changes for the remaining categories. In examining master's students and doctoral students, a majority of the ten (70%) doctoral students perceived an increase in household physical activity; however, less than half of the eleven (45%) master's students perceived the same. Those who took a break between undergraduate and graduate school differed in their responses for overall physical activity. Six of the nine (67%) who did not take a break and all five (100%) who took a break between one and three years perceived a decrease in their overall physical activity. However, the majority of those who took a break of four years or more (57%) perceived an increase in their overall physical activity. Responses between those who completed their undergraduate at a university in the U.S. and at a university outside of the U.S. were similar across all domains except occupational physical activity. All but one participant (92%) in the U.S. undergraduate group were employed, with eight of the twelve (67%) perceiving a decrease in their occupational physical activity. However, in the outside of U.S. undergraduate group, only two of the eight participants (25%) were employed, both perceiving a decrease in occupational physical activity, as well.

The prevalence of different themes between groups was similar except for those who completed their undergraduate in the US and outside of the US. Although perceived changes in active transport physical activity were similar between groups, six of these eight (75%) students also

noted that their undergraduate university's campus was more spread out compared to their current graduate university (e.g., "In our university back there, it was like the buildings are very far from each other…It was a lot of walking" [P16]). In addition, all eight (100%) students mentioned using walking or biking as their main mode of transportation. One participant said, "Biking was the best option for me to move around. Stores are closer to the university or houses…It was easier to just walk…So that has changed here because public transportation is not that good either, but affording a car is easier, and stores are not that close. So, you actually need a car" (P9). Two of the students in this group also mentioned not having access to as many recreational facilities in their undergraduate program (e.g., "In my undergrad, we didn't have [a recreational center], so we didn't have volleyball courts and stuff like that" [P3]).

Table 4. Differences in perceived physical activity by demographic group.

Demographic Group		Domain	Perceived Change *n* (%)	Supporting Quote
Sex	Males	Leisure-Time PA[a]	Decrease 7 (88%)	"We have less time for all those planned, conscious activities like…exercise, playing games, or sports." [P11]
	Females		Decrease 6 (50%)	"I'm more focused on health and wellness and nutrition and activity." [P8]
Graduate Program	Master's	Household PA	Increase 5 (45%)	"I didn't stay on top of it cause I was lazy, and I was younger." [P1]
	Doctoral		Increase 7 (70%)	"It's a lot harder now because with family, you get more work." [P4]
Undergrad Location	United States	Occupational PA	Decrease 8 (67%) *12 of 13 employed in UG	"We were only standing for our whole shifts. And now I barely ever stand. I'm sitting at a desk all day every day." [P13]
	International		Decrease 2 (100%) *2 of 8 employed in UG	"I didn't used to do any other thing…here I need to be very strategic about how I divide my time." [P20]
Presence of Breaks Between Undergrad and Grad	No Break	Overall PA	Decrease 6 (67%)	"It's just harder for me to run nowadays because I don't have to prove anything… Also too I'm still fit." [P12]
	Break of 1–3 Years		Decrease 5 (100%)	"Given the limited time I have, my physical activities have drastically reduced." [P17]
	Break of 4+ Years		Increase 4 (57%)	"I think leaving school and then having to work for the period after undergrad, my patterns changed a lot…I had to try to readjust again." [P15]

[a]PA = Physical Activity

DISCUSSION

This retrospective, qualitative study aimed to identify graduate students' perceived changes in physical activity across domains from their undergraduate to graduate programs. To our knowledge, this is the first study to examine perceived changes in physical activity from undergraduate to graduate schooling. The major finding in this study was that graduate students perceived a decrease in their physical activity in all domains except for household physical activity, which was perceived to have increased. Current published studies have investigated cross-sectional differences in graduate and undergraduate students' self-reported overall physical activity (21,36). Graves and colleagues found that graduate nursing students self-reported significantly lower levels of physical activity than undergraduate nursing students. However, another study found differing results in Russia, finding that graduate female students reported higher job-related and total physical activity on the International Physical Activity Questionnaire but tested lower for cardiorespiratory fitness than undergraduate female students. Previous studies have found that on-campus physical activity interventions have improved mental health and well-being in university students (mean age = 23 years) (23), thus interventions for improving overall physical activity for graduate students could improve daily physical activity and mental health.

In the present study, this overall change in physical activity included: 1) increased academic and occupational responsibilities, 2) changes in physical and social environment, 3) increased awareness of health and activity, and 4) life transitions. The first theme revealed that graduate students felt mentally taxed by their schooling and work, which influenced their lack of motivation to be active. Another study had similar findings with graduate students reporting high levels of stress from their schoolwork and assistantships (37). Interestingly, 63% of graduate students reported watching TV to cope with stress, a sedentary activity that is likely displacing more active choices. Almost all participants in the present study characterized their work as mostly sedentary, and many reported a decrease in their occupational physical activity. Previous literature does suggest that workers who sit for their occupation are more likely to compensate by participating in leisure-time physical activity, but those who frequently stand or have higher physical demands for their occupation are less likely to be active outside of work (8). Some participants in the current study were aware of their low occupational physical activity, but only few reported compensating for it in their leisure time. Thus, it is important to examine multiple domains of physical activity. There are no current publications measuring occupational physical activity in graduate students nor the changes in occupational physical activity from undergraduate to graduate school. Potential interventions to increase occupational physical activity, and decrease prolonged sitting, for graduate students might include promoting walking breaks or designating walking paths on campus that can be used for walking meetings, which can also serve the greater university population to promote physical activity.

The second theme highlighted three perceived changes in the physical environment: graduate students' classes and work were often centralized in one building; graduate students' living spaces were often not within walking distance to on and off-campus destinations; and graduate students' physical living space promoted household physical activity. Previous research has

examined how metropolitan development patterns influence active transport physical activity (17), and how the university environment promotes active transport and leisure-time physical activity in undergraduate students (26, 38) but not among graduate students. Another notable subtheme from this study was decreased active transport when the weather is colder, which is consistent with other findings in college students (52). At this university from 1991 to 2020, the coldest average daily temperatures were in January at 36.4 degrees Fahrenheit and the warmest in July at 77.9 degrees Fahrenheit, while the rainiest seasons occurred in May and June and the greatest snowfall in February (33). More research on university campuses as physical workplace environments and their potential effects on physical activity will not only provide insight into the role of the physical work environment on graduate student physical activity, but it can also evaluate its effects on faculty and staff physical activity.

Apart from the physical environment, responses described how the social environment influenced graduate student physical activity. Students preferred to participate in leisure-time physical activity with friends or peers, and the absence of friends or peers resulted in a decrease in leisure-time physical activity. This reflects the theory of peer support in which individuals share an experience, make a mutual agreement, and hold each other accountable (32). Peer support, along with community-based social support, is effective in increasing physical activity (27, 51). Social support, and specifically peer support, should be considered when developing physical activity interventions for graduate students. Interventions that provide opportunities for graduate students to be active may be more successful if they are done in groups, such as walking groups or group activity classes.

The third theme that emerged from the current study emphasized how graduate students were more aware of their health and activity levels as graduate students, more specifically how they are more intentional in their efforts to be active for their health compared to during their undergraduate programs. This is consistent with findings from Longfield et al. in that graduate students struggle to plan physical activity in their daily schedule but consider it as beneficial for their health (29). Since many of the students reported a general awareness of their activity and health, graduate students may benefit from learning specific strategies and time management approaches to incorporate physical activity into their daily lives. This may be a different intervention strategy than for undergraduates, as they may be less concerned or intentional with their physical activity due to a lack of awareness of the benefits and recommendations of physical activity (50). Physical activity seminars may be useful to guide larger groups of students, and physical activity counseling can be useful for individual assistance. Motivational interviewing (MI) is a type of counseling strategy that promotes behavior change through a client-centered approach (24). MI has been used as part of exercise referral schemes to improve physical activity behavior and has been shown to sustain gains in physical activity longer than standard exercise prescription programs in middle-aged to older adults (15). Although there are few studies on the effects of MI on physical activity behavior in university students, a relatively novel tool that universities can consider is EIM-OC, as previously mentioned. EIM-OC advocates for campus cultures that promote physical activity, assess physical activity at student health visits, provide students with resources to improve physical activity, and utilize exercise referral systems (3). Although most EIM-OC initiatives focus on undergraduate students,

providing resources like exercise referral schemes and individualized physical activity counseling may be a necessary tool to support graduate students to live a more active lifestyle.

The fourth theme discussed by participants recognized how graduate students are at a different stage in their lives compared to their time as undergraduates. The U.S. Census Bureau found that U.S. graduate students are more likely to be full-time employees, older than the age of 25, a parent, or married than U.S. undergraduate students (6). A qualitative study investigating school-work-life balance in doctoral students found similar themes to those in the current study (31). Students mentioned the struggles of managing their coursework, graduate assistantships, research, and family responsibilities, which interestingly appeared easier for those with children and spouses than those who were single. Although it may not directly impact physical activity in graduate students, the reorganization of priorities and increased responsibility for oneself may perceptually make it more difficult for graduate students to consider physical activity as a priority. In the previously mentioned qualitative study, time management is crucial for graduate students to maintain a balance between school, work, and home life but also personal well-being.

Reported changes in physical activity by domain were consistent between demographic groups with the exception of the following: males were more likely to report a decrease in their leisure-time physical activity than females; doctoral students were more likely to report an increase in their household physical activity than masters students; those who completed their undergraduate in the U.S. were more likely to report a decrease in their occupational physical activity; and those who did not take a break or took a break for one to three years were more likely to report a decrease in their overall physical activity. Previous evidence has found an age-related decline in leisure-time physical activity with a more drastic reduction seen between young adulthood and mid-life (44). In the present study, male graduate students were more likely to report a decline in leisure-time physical activity than their female counterparts, a few of which reported that this was due to a withdrawal from intramural sports participation. Similarly, research has shown that males are more likely to engage in leisure-time physical activity that has a competition aspect than females who were equally as active but opted for non-competitive exercise, like aerobics, dancing, or yoga (13). Evidence also supports that retention of intramural sports participation declines as students progress from their freshman year of undergraduate to graduate school (39). This suggests that as students progress in their schooling, their focus becomes more career-driven than socially driven. To address the differences between males and females in interventions, having graduate student-specific intramurals may increase the likelihood of male student participation, and having graduate student-specific exercise classes may increase the likelihood of female student participation. This also augments the idea of peer support, which has been discussed earlier.

Those who completed their undergraduate internationally mentioned greater accessibility to recreational facilities and physical activity opportunities, which is consistent with findings in Chinese female international students (56). To explain this, cultural views of participating in physical activity differ by place of origin. One study found that those from North America were more likely to participate in physical activity than those from other parts of the globe, especially

those from Asian or African regions (57). Another found that motivation for physical activity participation in adolescents is influenced by cultural views, many of which outside of the U.S. prioritize academic success over physical activity (55). This difference in cultural motivation may explain why international students experience higher accessibility and usage of recreational facilities while studying in the U.S. To aid in the establishment and maintenance of physical activity behaviors in international students, previous evidence has shown that social support when provided by peers or friends is beneficial for adjusting to Western culture and participation in physical activity (2). A consideration for potential interventions may be to encourage and incentivize students to attend group physical activities and bring a peer with them.

Although it was not prominently mentioned by participants in this study, participants in the current study had experienced undergraduate or graduate school during the global COVID-19 pandemic, which impacted people's ability to be physically active during lockdowns. A systematic review found that physical activity decreased and sedentary time increased in university students worldwide (30) with only one of the ten studies showing an increase in physical activity in Spain (41). Many health implications of complications from COVID-19 were associated with physical inactivity, thus prompting initiatives to promote physical activity in the general population (54). Moving forward from the pandemic, universities have adjusted to provide a variety of options for student learning in-person and off-campus, including flipped classrooms and blended learning (20). Student physical activity initiatives should consider this and offer a variety of resources for physical activity both on and off campus, especially for graduate students. As mentioned previously, graduate students have a variety of barriers due to the nature of their work, thus efforts to minimize these barriers may prompt increases in their physical activity.

Limitations of this study include its use of a convenience sample. Responses from participants in this study may not be representative of all graduate students or graduate students at other universities thus multi-campus studies are needed to confirm if these themes generalize to other universities. However, participants in this study were of different backgrounds, genders, and graduate programs from this particular university. A third limitation of this study is that physical activity was not directly measured and was reliant on the perceptions of the participants to accurately recall changes in their physical activity. Thus, responses in this study are subject to biases. However, perceptions play a key role in intentions, which has been shown to predict changes in behavior (1). This prompts the need for further longitudinal studies to examine the effects of perceptions, intentions, and objective changes in physical activity from undergraduate to graduate schooling.

This study highlights the need for physical activity interventions for graduate students and suggests specific strategies and contexts that may be more successful in promoting physical activity among graduate students. An abundance of factors related to changes in school and work responsibilities, physical and social environments, consciousness of health and activity, and personal life dynamics play into the overall decline in physical activity of graduate students. It is evident that graduate students have high mental stress and a lack of physical activity, which

can be improved through intervention strategies, especially those that target time management for activity and include group physical activity opportunities. However, there is a clear need for further research into graduate student physical activity to understand how their physical activity is shaped by their environments in the four domains of physical activity. Having this understanding is necessary for the development of physical activity interventions since graduate students may require different strategies than those targeted for undergraduate students. Graduate students will become potential leaders, educators, and mentors with the ability to impact the generations to come. Thus, helping graduate students to implement and sustain active lifestyles will not only improve their personal health but also help them encourage active lifestyles in their communities.

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