Environment and Social Psychology (2026) Volume 11 Issue 1 ISSN: 2424-8975 (O)
doi: 10.59429/esp.v11i1.4345 2424-7979 (P)

RESEARCH ARTICLE

Evaluation of environmental support systems and their social psychological effects on weight management for combat sports student-athletes in higher education institutions

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ABSTRACT

Combat sports are defined by strict weight classification systems, rendering weight management a pivotal factor influencing athletes' competitive performance and long-term health outcomes. College student-athletes in combat sports confront unique predicaments stemming from their dual roles as students and athletes, navigating the competing demands of academic workloads, intensive athletic training, and ongoing physical development. While environmental support systems and socio-psychological factors are widely acknowledged as key determinants of health-related behaviors, their integrated impacts on weight management within this specific population remain underexplored. This study aimed to evaluate the current state of environmental support systems for weight management among college combat sports student-athletes and unpack the socio-psychological mechanisms through which these systems shape weight management behaviors and effectiveness. A mixed-methods research design was employed, combining quantitative questionnaires and qualitative in-depth interviews. Quantitative data were collected from 278 college combat sports student-athletes across 10 higher education institutions and analyzed using SPSS and AMOS for descriptive statistics, correlation analysis, and structural equation modeling. Qualitative data were gathered through in-depth interviews with 18 student-athletes and 6 coaches, processed via thematic analysis with Nvivo. The findings identified three core dimensions of environmental support systems (interpersonal, resource, and institutional support), with an overall moderate level of support ($M=3.21$, $SD=0.58$); interpersonal support was the strongest dimension ($M=3.54$, $SD=0.62$), while resource support was the weakest ($M=2.87$, $SD=0.71$), particularly in terms of access to specialized nutrition counseling and weight management-specific facilities. Correlation analysis confirmed positive relationships between environmental support systems, socio-psychological factors, and weight management effectiveness ($r=0.38–0.57$, $p<0.001$). Structural equation modeling revealed that environmental support systems had a direct positive effect on weight management effectiveness ($\beta=0.28$, $p<0.001$) and that self-efficacy (indirect effect=0.17, 95% CI=[0.12, 0.23]) and group norms (indirect effect=0.10, 95% CI=[0.05, 0.15]) served as significant mediators, while behavioral motivation did not exhibit a significant mediating role. Qualitative results complemented the quantitative findings, highlighting an uneven distribution of environmental support (strong coach and peer support alongside limited resource access), the role of self-efficacy as a key enabler of weight management behaviors, and the

ARTICLE INFO
Received: 14 November 2025 | Accepted: 17 December 2025 | Available online: 30 January 2026

CITATION
Li Y.L., Ali S.K.S., Razak A.Z.A. Evaluation of environmental support systems and their social psychological effects on weight management for combat sports student-athletes in higher education institutions. *Environment and Social Psychology* 2026; 11(1): 4345 doi:10.59429/esp.v11i1.4345

influence of team norms in either discouraging or normalizing risky rapid weight loss practices. This study enriches interdisciplinary research at the intersection of environmental psychology, sports psychology, and public health, while providing actionable implications for colleges and coaches to optimize weight management support strategies for student-athletes.

Keywords: combat sports; college student-athletes; weight management; environmental support systems; socio-psychological factors; self-efficacy; group norms

1. Introduction

1.1. Research background

Combat sports—encompassing disciplines such as boxing, wrestling, judo, and taekwondo—require athletes to compete within predefined weight classes, making weight management an integral component of their training and competitive preparation[1]. Effective weight management not only ensures eligibility for specific weight divisions but also directly influences physical performance parameters, including strength-to-weight ratio, agility, and endurance [2]. However, the extreme weight control strategies frequently adopted by combat sports athletes—such as rapid dehydration, restrictive caloric intake, and excessive training loads—pose substantial risks to physical health, including electrolyte imbalances, muscle catabolism, metabolic dysregulation, and compromised immune function[3].

College student-athletes in combat sports face distinct challenges compared to their professional counterparts. As dual-role individuals, they must reconcile academic responsibilities (e.g., coursework, examinations, and academic deadlines) with rigorous athletic training schedules, often leading to time scarcity, psychological stress, and limited access to specialized weight management resources [4]. Unlike professional sports organizations, which typically employ dedicated nutritionists, sports psychologists, and strength and conditioning coaches, many college athletic programs lack comprehensive weight management support systems. This gap often leaves student-athletes reliant on informal guidance from coaches or self-adopted strategies, which may be unscientific or unsustainable[5].

Ecological systems theory emphasizes that individual behaviors are shaped by multiple interconnected environmental layers, ranging from interpersonal relationships to organizational policies and resource availability [6]. In the context of weight management, environmental support systems—encompassing interpersonal support (e.g., coach guidance, peer cohesion), resource support (e.g., nutrition counseling, fitness facilities), and institutional support (e.g., structured training plans, weight management policies)—play a critical role in facilitating healthy behaviors[7]. Concurrently, socio-psychological factors such as self-efficacy, behavioral motivation, and group norms act as key intermediaries between environmental inputs and behavioral outcomes, as posited by social cognitive theory [8]. Despite the well-documented importance of these factors, few studies have systematically examined their integrated effects on weight management among college combat sports student-athletes. Most existing research focuses either on professional athletes or general student populations, overlooking the unique contextual pressures and needs of this specific group.

1.2. Research questions and hypotheses

Building on the identified research gaps, this study addresses two core research questions:

What are the key dimensions of the environmental support system for weight management among college combat sports student-athletes, and what is its current implementation status?

Through which socio-psychological pathways do environmental support systems influence the weight management behaviors and effectiveness of college combat sports student-athletes?

To address these questions, the following research hypotheses are proposed:

H1: Comprehensive environmental support systems (encompassing interpersonal, resource, and institutional support) will have a positive predictive effect on weight management effectiveness among college combat sports student-athletes.

H2: Socio-psychological factors (self-efficacy, behavioral motivation, and group norms) will mediate the relationship between environmental support systems and weight management effectiveness.

1.3. Research significance

1.3.1. Theoretical significance

This study contributes to the interdisciplinary integration of environmental psychology, sports psychology, and public health by empirically testing the "environment-socio-psychology-behavior" framework in a specific athletic context. By focusing on college combat sports student-athletes, it fills a critical research gap in existing literature, which has predominantly centered on professional athletes or general student populations. The findings will enhance theoretical understanding of the unique mechanisms underlying weight management in dual-role athletic populations and provide a foundation for future interdisciplinary research in sports health.

1.3.2. Practical significance

The empirical findings of this study offer actionable insights for college athletic departments and coaching teams to optimize weight management support systems. Specifically, the results can guide the development of targeted resources (e.g., nutrition education workshops, psychological counseling services), improve coach training programs on evidence-based weight management, and foster a supportive team environment that promotes healthy behaviors. For student-athletes, the study provides evidence-based strategies to enhance self-efficacy and behavioral motivation, supporting the adoption of healthy and sustainable weight management practices that balance athletic performance with long-term physical and psychological health.

1.4. Organization of the paper

The remainder of the paper is structured as follows. The next section presents a systematic literature review, synthesizing existing research on athlete weight management, environmental support systems, and socio-psychological mechanisms. The subsequent section details the research methodology, including the mixed-methods design, research participants, data collection instruments, and analytical procedures. The results section reports descriptive statistics, correlation analyses, and mediation effect tests, complemented by thematic findings from qualitative interviews. The discussion section interprets the results in the context of existing theories and practical applications, while acknowledging study limitations and proposing directions for future research. The final section provides a concise summary of core findings and their broader implications.

2. Literature review

2.1. Weight management in combat sports athletes

Weight management is a defining challenge for combat sports athletes, as competitive eligibility and performance are directly tied to adherence to weight class requirements [10]. Existing research has predominantly focused on two core themes: the health risks of extreme weight control and the effectiveness of weight management strategies. Studies consistently document that combat sports athletes frequently adopt rapid weight loss (RWL) methods, such as dehydration, caloric restriction, and diuretic use, to meet weight targets in the short term [10]. A recent systematic review further confirms the high prevalence of these practices across multiple combat sports, while detailing the typical magnitude of weight loss and variations in methods among different disciplines[11]. These practices are associated with a range of adverse outcomes, including impaired cognitive function, reduced muscle strength, electrolyte imbalances, and increased risk of injury during competition[12,13]. While some research highlights the potential benefits of gradual weight loss and personalized nutrition plans, the pressure to compete in lower weight classes often drives athletes to adopt unsustainable and risky behaviors[14].

A critical gap in this literature lies in the focus on professional or elite athletes, with limited attention to college student-athletes. Unlike professional athletes, college combat sports athletes navigate dual demands of academic coursework and athletic training, which disrupt consistent access to weight management resources and create time constraints[15]. Additionally, college student-athletes are in a critical phase of physical and psychological development, making them more vulnerable to the long-term impacts of unhealthy weight management practices. Existing studies on student-athletes tend to focus on general population health behaviors rather than the specialized weight management needs of combat sports participants [5]. This disconnect leaves a gap in understanding how the unique contextual pressures of college life interact with athletic demands to shape weight management behaviors.

2.2. Environmental support systems and athletic health behaviors

Environmental support systems are conceptualized as multi-dimensional structures that include interpersonal, resource, and institutional components, all of which interact to influence individual behaviors[6]. In the context of sports health, interpersonal support—encompassing coach guidance, peer cohesion, and family encouragement—has been identified as a key predictor of healthy behavior adoption[7]. For example, coaches who provide evidence-based weight management advice and foster open communication are more likely to support athletes in adopting sustainable practices [1]. Similarly, team environments characterized by mutual support and shared health norms reduce the likelihood of extreme weight control behaviors[2].

Resource support, including access to nutrition counseling, fitness facilities, and educational materials, is another critical dimension. Professional sports organizations typically offer comprehensive resources, such as dedicated nutritionists and sports psychologists, but college athletic programs often lack such specialized support[5]. Studies show that limited access to nutrition information and personalized guidance leads student-athletes to rely on informal or unreliable sources, increasing the risk of unhealthy weight management [3]. Institutional support, such as structured training plans, weight management policies, and academic-athletic balance initiatives, further shapes athletes' ability to engage in healthy behaviors[15]. However, few college athletic departments have formalized weight management policies tailored to combat sports athletes, leaving athletes without consistent guidelines.

Despite the documented importance of environmental support, existing research in sports health has focused on discrete components (e.g., coach support or resource access) rather than comprehensive systems.

Moreover, studies rarely examine how these systems operate in the college context, where institutional constraints and dual-role pressures create unique challenges. This lack of systemic analysis limits understanding of how environmental factors collectively influence weight management in college combat sports student-athletes.

2.3. Socio-psychological mechanisms in weight management

Socio-psychological factors act as critical intermediaries between environmental inputs and weight management behaviors, as outlined in social cognitive theory [8]. Self-efficacy—defined as an individual's belief in their ability to execute a behavior—has emerged as a key predictor of successful weight management. Athletes with high self-efficacy are more likely to adhere to healthy nutrition and training plans, even in the face of challenges such as academic stress or competitive pressure [7]. Research shows that environmental support, such as positive coach feedback and peer encouragement, directly enhances self-efficacy by providing athletes with evidence of their capabilities [1].

Behavioral motivation is another central construct, with intrinsic motivation (e.g., desire for long-term health) associated with more sustainable weight management than extrinsic motivation (e.g., fear of disqualification;[14]). Environmental factors shape motivation by influencing athletes' perceived autonomy and competence: access to personalized resources and opportunities for input in weight management plans fosters intrinsic motivation, while restrictive or punishment-based approaches increase extrinsic motivation and risk of burnout[12]. Group norms—shared beliefs about acceptable behaviors within a team—also play a role: teams that prioritize health over extreme weight loss create norms that reinforce sustainable practices[2].

While these socio-psychological factors have been studied in general weight management contexts, their specific roles in the combat sports college student-athlete population remain underdeveloped. Existing research often examines individual factors in isolation rather than exploring how they interact to mediate the relationship between environmental support and weight management outcomes[3]. This gap limits understanding of the complex psychological pathways through which environmental support influences behavior in this unique group.

2.4. Research gaps

The synthesis of existing literature reveals three critical research gaps. First, most studies on combat sports weight management focus on professional athletes, overlooking the unique challenges of college student-athletes who balance academic and athletic demands. Second, research on environmental support systems tends to examine discrete components rather than comprehensive systems, failing to capture the cumulative influence of interpersonal, resource, and institutional factors. Third, while socio-psychological factors are recognized as important, few studies have empirically tested their mediating role in the relationship between environmental support and weight management outcomes among college combat sports student-athletes.

Together, these gaps justify examining environmental support as a multi-level construct and testing self-efficacy, behavioral motivation, and group norms as mediating mechanisms in college combat sports athletes.

This study addresses these gaps by adopting a holistic approach that integrates environmental support systems, socio-psychological mechanisms, and weight management effectiveness in a specific, understudied population. By employing a mixed-methods design, the research provides both quantitative evidence of relationships and qualitative insights into the lived experiences of student-athletes, filling a critical void in interdisciplinary sports health research.

3. Methodology

3.1. Research design

A sequential explanatory mixed-methods design was adopted to address the research questions, combining quantitative and qualitative approaches in a complementary manner[16]. This design was selected for its ability to first quantify the relationships between environmental support systems, socio-psychological factors, and weight management effectiveness (quantitative phase), then explore the underlying mechanisms and lived experiences through in-depth interviews (qualitative phase). The sequential approach ensured that qualitative findings could elaborate on and interpret quantitative results, enhancing the depth and validity of the research. This mixed-methods framework aligns with interdisciplinary research standards, as it integrates numerical evidence with contextual insights to unpack complex health behavior dynamics.

3.2. Participants

3.2.1. Quantitative participants

A convenience sampling method was used to recruit college combat sports student-athletes from 10 higher education institutions across three regions. Eligibility criteria and sample size determination are detailed in **Table 1**. A total of 320 questionnaires were distributed, with 278 valid responses (response rate = 86.9%) included in the final analysis. Key demographic characteristics (e.g., gender, sport type, academic year) are presented in the Results section to contextualize the sample.

3.2.2. Qualitative participants

Purposive sampling was employed to select qualitative participants from the quantitative sample, ensuring maximum variation in core attributes (**Table 1**). A total of 18 student-athletes (10 male, 8 female) and 6 coaches (4 male, 2 female) were recruited. Student-athletes represented all target sports and academic years (freshman to graduate), while coaches had 3–15 years of experience working with college combat sports teams. Data collection ceased when theoretical saturation was reached—no new themes emerged from additional interviews[17].

Table 1. Sampling criteria and characteristics.

Sample Type	Eligibility Criteria	Sample Size	Key Variation Factors
Quantitative	1. Enrolled in undergraduate/graduate program; 2. Active in combat sports (≥1 year); 3. Experience with competitive weight management; 4. Voluntary consent	278 (valid)	Gender, sport type (boxing/wrestling/judo/taekwondo/MMA), academic year, training hours/week
Qualitative (Athletes)	Selected from quantitative sample; meets quantitative eligibility criteria	18	Gender, sport type, academic year, weight management success (self-reported)
Qualitative (Coaches)	1. Currently coaching college combat sports; 2. ≥3 years of coaching experience	6	Gender, coaching sport, years of experience, prior weight management training

3.3. Research instruments

All quantitative instruments were adapted from validated scales and modified to fit the college combat sports context, with reliability confirmed via Cronbach's alpha. Detailed dimensions, sample items, and psychometric properties are summarized in **Table 2**.

Table 2. Quantitative instruments: Dimensions, sample items, and reliability.

Instrument	Dimensions	Number of Items	Sample Item	Cronbach's Alpha	Source
Environmental Support System Scale	Interpersonal Support	5	"My coach provides personalized weight management advice tailored to my needs"	0.87	Adapted from Green et al. (2022)[7]
	Resource Support	5	"I have easy access to nutrition counseling services at my university"	0.84	
	Institutional Support	5	"My university has formal policies guiding combat sports weight management"	0.82	
Total Scale	-	15	-	0.89	
Socio-Psychological Factors Scale	Self-Efficacy	6	"I am confident in maintaining healthy weight management despite academic stress"	0.85	Bandura (1986)[8]
	Behavioral Motivation	7	"I manage my weight to support my long-term athletic health"	0.83	Ryan & Deci (2000)[22]
	Group Norms	5	"My team values healthy weight management over rapid weight loss"	0.81	Ajzen (1991)[18]
Weight Management Effectiveness Questionnaire	-	6	"My weight management practices help me perform consistently in competitions"	0.84	Adapted from Artioli et al. (2019)[9]

3.3.1. Qualitative instrument

A semi-structured interview guide was developed to explore participants' experiences with environmental support, socio-psychological processes, and weight management practices. Core questions included: "What types of support have you received for weight management from your university, coach, or team?" "How has this support influenced your confidence and motivation to manage your weight?" and "What challenges do you face in balancing academic demands with weight management?" The guide was pre-tested with 2 student-athletes and 1 coach, with minor revisions made to clarify ambiguous questions.

3.4. Data collection procedures

Quantitative data were collected between March and May 2023. Questionnaires were distributed via online platforms (e.g., Qualtrics) with the assistance of college athletic departments and coach networks. Participants were provided with a brief introduction to the study, and informed consent was obtained prior to questionnaire completion. Reminder emails were sent twice to improve response rates. Invalid questionnaires (e.g., incomplete responses, consistent extreme ratings) were excluded during data cleaning.

Qualitative data collection occurred between June and July 2023, following the quantitative phase. Interviews were conducted face-to-face or via video conferencing, lasting 30–45 minutes each. All interviews were audio-recorded with participants' permission and transcribed verbatim within 48 hours. Transcripts were reviewed for accuracy by two researchers, with discrepancies resolved through discussion.

3.5. Data analysis

Quantitative data were analyzed using SPSS 26.0 and AMOS 24.0. Descriptive statistics (mean, standard deviation, frequency) were used to characterize the sample and key variables. Pearson correlation analysis was conducted to examine bivariate relationships between environmental support systems, socio-psychological factors, and weight management effectiveness. Structural equation modeling (SEM) was employed to test the mediating effects of socio-psychological factors, with model fit evaluated using chi-square/df (≤ 3), CFI (≥ 0.90), TLI (≥ 0.90), RMSEA (≤ 0.08), and SRMR (≤ 0.08)[19].

Qualitative data were analyzed using thematic analysis[20] with Nvivo 12. The analysis followed six steps: familiarization with the data, generation of initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the final report. Two researchers independently coded the transcripts, with an inter-coder reliability of $\kappa = 0.87$, indicating high consistency. Disagreements were resolved through consultation with a third researcher. Triangulation between quantitative and qualitative results was used to enhance the credibility of findings.

4. Results

4.1. Sample demographic characteristics

The demographic profile of the quantitative sample (n=278) reflects the diversity of college combat sports student-athletes, with key characteristics summarized in **Table 3**. Gender distribution was relatively balanced, with 156 male athletes (56.1%) and 122 female athletes (43.9%). Among the combat sport disciplines, wrestling (28.8%) and taekwondo (26.6%) were the most represented, followed by boxing (20.9%), judo (15.1%), and mixed martial arts (MMA, 8.6%). Academic year distribution included freshmen (22.3%), sophomores (25.9%), juniors (24.5%), seniors (18.3%), and graduate students (9.0%), ensuring coverage of different stages of college athletic and academic careers. Most athletes (73.4%) reported training 10–20 hours per week, while 18.7% trained more than 20 hours weekly, reflecting the intensive time commitment required for combat sports.

Table 3. Demographic characteristics of the quantitative sample (n=278).

Characteristic	Category	Frequency (n)	Percentage (%)
Gender	Male	156	56.1
	Female	122	43.9
Sport Type	Boxing	58	20.9
	Wrestling	80	28.8
	Judo	42	15.1
	Taekwondo	74	26.6
	MMA	24	8.6
Academic Year	Freshman	62	22.3
	Sophomore	72	25.9
	Junior	68	24.5
	Senior	51	18.3
	Graduate Student	25	9.0
Weekly Training Hours	<10 hours	22	7.9
	10–20 hours	204	73.4
	>20 hours	52	18.7

4.2. Current status of environmental support systems

Descriptive statistics for the three dimensions of the environmental support system are presented in **Table 4** and visualized in **Figure 1**. Overall, the mean score for environmental support was 3.21 (SD=0.58), indicating a moderate level of support. Interpersonal support received the highest score (M=3.54, SD=0.62), driven primarily by coach guidance and team peer support. Resource support scored the lowest (M=2.87, SD=0.71), with particularly low ratings for access to specialized nutrition counseling (M=2.63, SD=0.84)

and weight management-specific fitness facilities (M=2.75, SD=0.78). Institutional support fell in the middle (M=3.22, SD=0.65), with formal weight management policies and academic-athletic balance initiatives rated lower than training structure support.

Table 4. Descriptive statistics of environmental support systems (n=278).

Variable	Dimension	Mean (M)	Standard Deviation (SD)
Environmental Support System	Interpersonal Support	3.54	0.62
	Resource Support	2.87	0.71
	Institutional Support	3.22	0.65
	Total Score	3.21	0.58

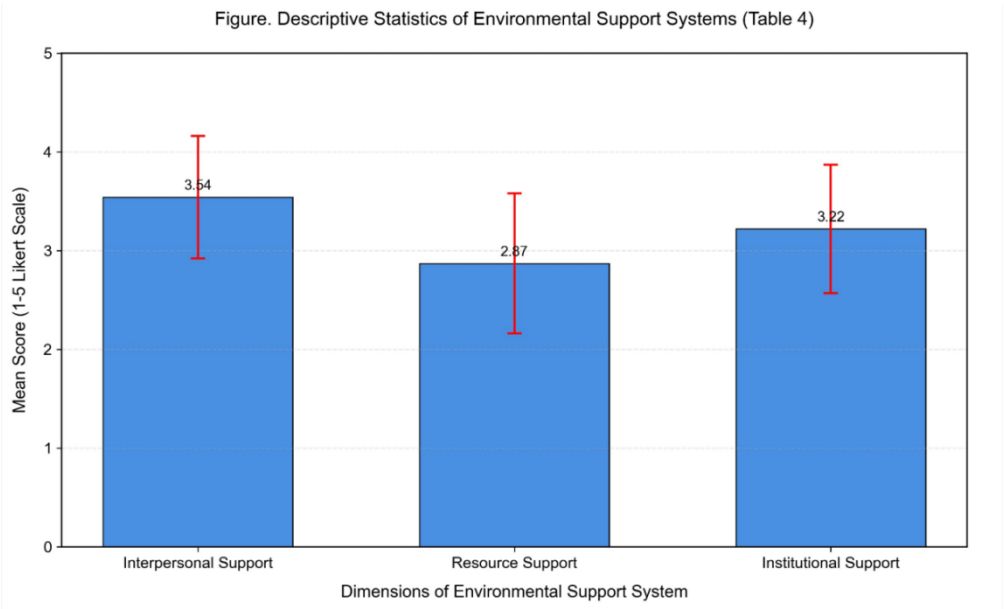

Figure 1. Descriptive statistics of environmental support systems (**Table 4**).

4.3. Descriptive results of socio-psychological factors

Socio-psychological factors exhibited varying levels of performance, as shown in **Table 5** visualized in **Figure 2**. Self-efficacy scored the highest (M=3.61, SD=0.64), reflecting athletes' confidence in executing weight management behaviors despite challenges. Group norms followed (M=3.35, SD=0.68), with most teams demonstrating a moderate emphasis on healthy weight management practices. Behavioral motivation had the lowest mean score (M=3.12, SD=0.73), with intrinsic motivation (M=3.05, SD=0.79) notably lower than extrinsic motivation (M=3.28, SD=0.71). This indicates that many athletes were more driven by external pressures (e.g., competition eligibility) than internal goals (e.g., long-term health).

Table 5. Descriptive statistics of socio-psychological factors and weight management effectiveness (n=278).

Variable	Dimension	Mean (M)	Standard Deviation (SD)
Socio-Psychological Factors	Self-Efficacy	3.61	0.64
	Behavioral Motivation	3.12	0.73
	- Intrinsic Motivation	3.05	0.79
	- Extrinsic Motivation	3.28	0.71
	Group Norms	3.35	0.68
Weight Management Effectiveness	-	3.27	0.66

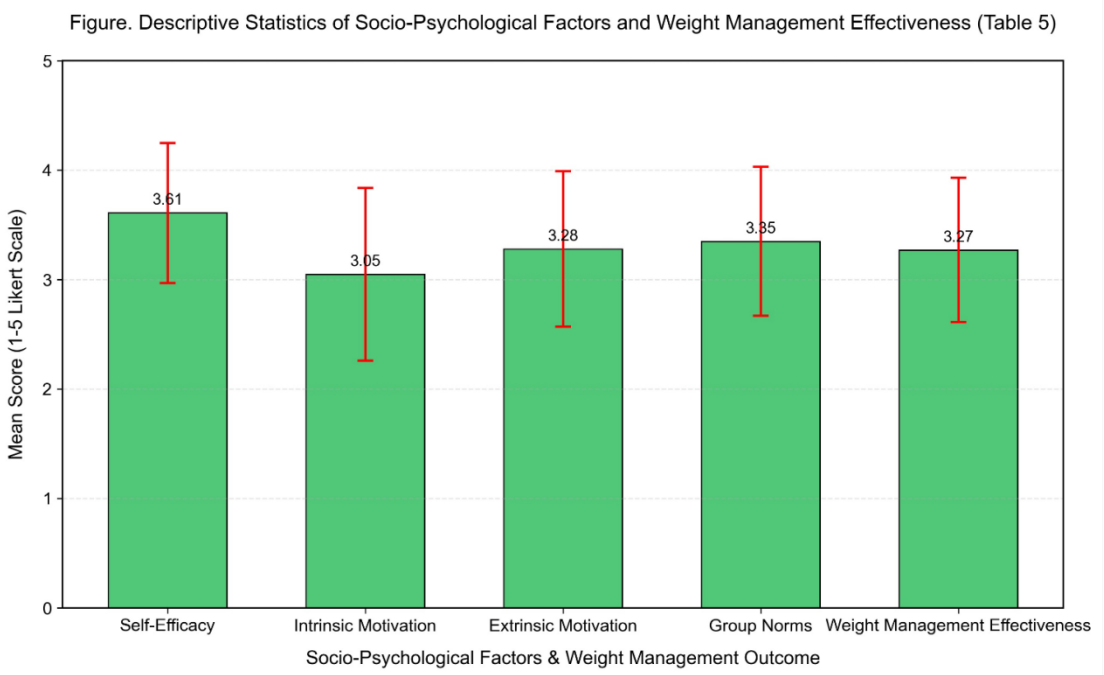

Figure 2. Descriptive statistics of socio-psychological factors and weight management effectiveness (**Table 5**).

4.4. Correlation analysis

Pearson correlation analysis revealed significant relationships between key variables (**Table 6**) and visualized in **Figure 3** (correlation heatmap). All dimensions of environmental support were positively correlated with weight management effectiveness ($r=0.38–0.52$, $p<0.001$), with interpersonal support showing the strongest correlation ($r=0.52$). Socio-psychological factors (self-efficacy, behavioral motivation, group norms) were also positively correlated with weight management effectiveness ($r=0.41–0.57$, $p<0.001$), and with environmental support dimensions ($r=0.35–0.49$, $p<0.001$). These results provide preliminary support for the proposed research hypotheses, indicating potential mediating pathways between environmental support and weight management outcomes.

Table 6. Correlation matrix of key variables (n=278).

Variable	1	2	3	4	5	6
1. Interpersonal Support	1					
2. Resource Support	0.42***	1				
3. Institutional Support	0.45***	0.40***	1			
4. Self-Efficacy	0.49***	0.38***	0.41***	1		
5. Behavioral Motivation	0.43***	0.35***	0.37***	0.51***	1	
6. Weight Management Effectiveness	0.52***	0.38***	0.43***	0.57***	0.41***	1

Note: **** $p<0.001$*

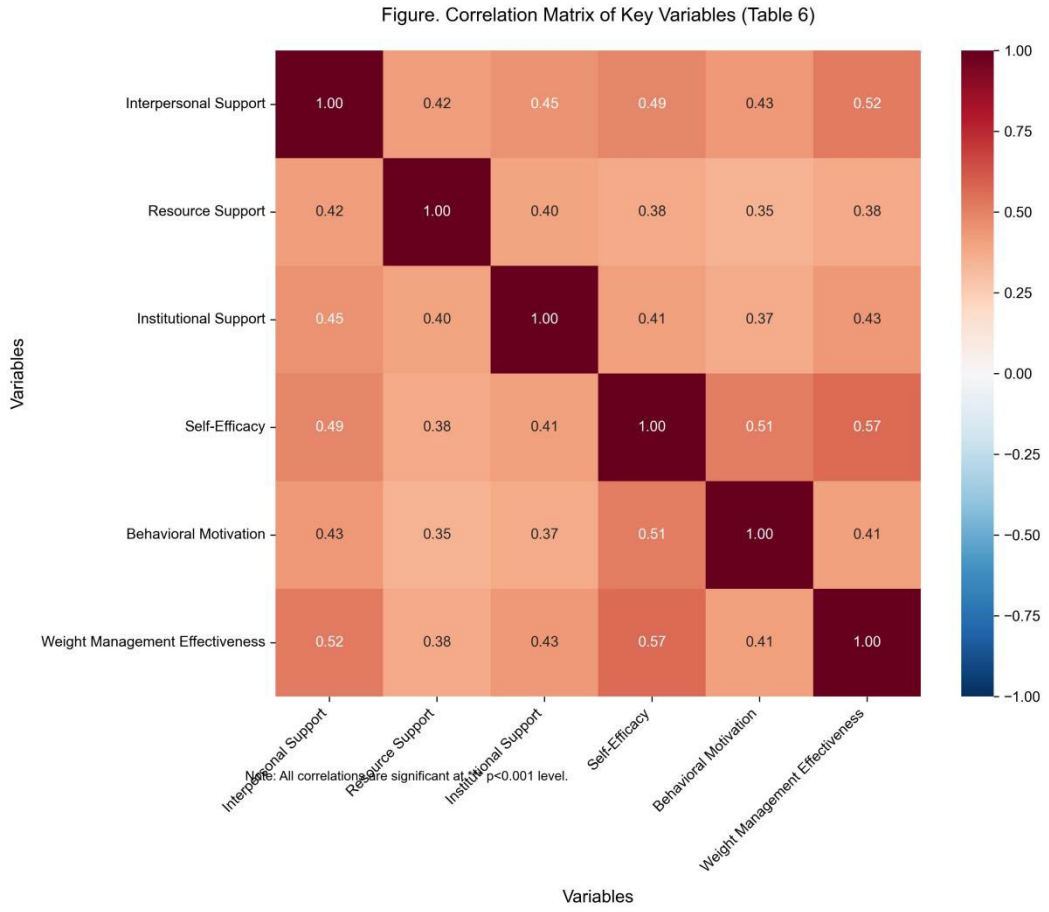

Figure 3. Correlation matrix of key variables.

4.5. Mediation effect test results

Structural equation modeling (SEM) was used to test the mediating role of socio-psychological factors. The proposed model demonstrated good fit to the data: $\chi^2/df=2.37$, CFI=0.92, TLI=0.91, RMSEA=0.07, SRMR=0.06, all meeting the recommended fit criteria. As shown in **Table 7**, environmental support systems had a direct positive effect on weight management effectiveness ($\beta=0.28$, $p<0.001$) and significantly predicted socio-psychological factors ($\beta=0.39–0.47$, $p<0.001$). Self-efficacy ($\beta=0.35$, $p<0.001$) and group norms ($\beta=0.21$, $p<0.01$) exerted significant positive effects on weight management effectiveness, while behavioral motivation did not ($\beta=0.08$, $p>0.05$).

The bootstrap test (5000 iterations) confirmed the mediating effects: self-efficacy (indirect effect=0.17, 95% CI=[0.12, 0.23]) and group norms (indirect effect=0.10, 95% CI=[0.05, 0.15]) served as significant mediators, accounting for 37.0% and 21.7% of the total effect respectively. Behavioral motivation did not exhibit a significant mediating role (indirect effect=0.03, 95% CI=[-0.01, 0.07]). Thus, Hypothesis 1 was fully supported, and Hypothesis 2 was partially supported.

Table 7. Results of mediation effect test.

Path	Standardized Coefficient (β)	p-value	95% Confidence Interval
Environmental Support → Weight Management Effectiveness (Direct)	0.28	<0.001	[0.19, 0.37]
Environmental Support → Self-Efficacy	0.47	<0.001	[0.39, 0.55]
Environmental Support → Behavioral Motivation	0.39	<0.001	[0.31, 0.47]
Environmental Support → Group Norms	0.48	<0.001	[0.40, 0.56]
Self-Efficacy → Weight Management Effectiveness	0.35	<0.001	[0.27, 0.43]
Behavioral Motivation → Weight Management Effectiveness	0.08	>0.05	[-0.02, 0.18]
Group Norms → Weight Management Effectiveness	0.21	<0.01	[0.11, 0.31]
Indirect Effect (Self-Efficacy)	0.17	<0.001	[0.12, 0.23]
Indirect Effect (Group Norms)	0.10	<0.01	[0.05, 0.15]
Total Effect	0.46	<0.001	[0.38, 0.54]

4.6. Qualitative thematic findings

Thematic analysis of interviews identified three core themes that complement and elaborate on the quantitative results:

4.6.1. Uneven distribution of environmental support

Athletes consistently highlighted strong coach and peer support ("My coach checks in on my diet weekly and adjusts my plan based on training load") but lamented limited resource access ("There's no nutritionist on campus— I have to look up diets online, which feels unreliable"). Coaches echoed this gap, noting institutional constraints: "We lack formal policies for weight management, so support is inconsistent across teams."

4.6.2. Self-efficacy as a key enabler

High self-efficacy was linked to personalized coach support: "When my coach praised my ability to balance study and weight control, I felt more confident sticking to the plan." Athletes with low self-efficacy cited academic pressure as a barrier: "During exams, I can't stick to my training schedule, which makes me doubt my ability to manage my weight."

4.6.3. Team norms shape behavior

Teams with health-focused norms discouraged extreme weight loss: "Our team talks about long-term health, so no one does crash diets." In contrast, teams prioritizing weight class eligibility had norms that normalized risky practices: "Everyone cuts weight quickly before competitions— it's expected."

5. Discussion

5.1. Interpretation of core findings

This study explored the current status of environmental support systems for weight management among college combat sports student-athletes and the mediating role of socio-psychological factors, yielding three key findings that align with and extend existing literature. First, environmental support for this population was moderately developed, with interpersonal support as the strongest dimension and resource support as the weakest—consistent with [5], who noted that college athletic programs often prioritize coach-led support over specialized resource allocation due to institutional funding and staffing constraints. The critical gap in resource support (e.g., limited nutrition counseling and weight management-specific facilities) means

student-athletes lack access to evidence-based professional guidance, increasing reliance on unscientific self-taught strategies[3].Such unguided practices may exacerbate the metabolic and physiological risks of repeated weight cycling—a concern recently emphasized in a narrative review on combat sports athletes[21].

Second, correlation analysis confirmed positive relationships between environmental support,socio-psychological factors, and weight management effectiveness—supporting ecological systems theory[6] and social cognitive theory [8]. Interpersonal support showed the strongest association with weight management effectiveness, underscoring the pivotal role of coach and peer interactions in shaping healthy behaviors. This is particularly salient in high-pressure combat sports contexts, where social influence is amplified[7].

Third, SEM results partially supported Hypothesis 2: self-efficacy and group norms served as significant mediators, while behavioral motivation did not. The mediating role of self-efficacy aligns with[7], as personalized coach support enhances athletes' confidence in navigating the dual demands of academics and athletics. Group norms' mediation reflects the team-centric nature of combat sports, where shared values either normalize healthy practices or risky rapid weight loss[2]. The non-significant mediating effect of behavioral motivation may stem from the sample's greater reliance on extrinsic motivation (e.g., competition eligibility) than intrinsic motivation (e.g., long-term health)—a pattern unique to student-athletes balancing multiple accountability systems(academic, athletic, institutional).

5.2. Theoretical implications

This study advances interdisciplinary theory in three key ways. First, it validates the "environment-socio-psychology-behavior" framework in an understudied population, extending ecological systems theory by demonstrating how multi-level environmental factors (interpersonal, resource, institutional) interact to shape weight management in dual-role student-athletes. Unlike prior research focusing on professional athletes [9], it highlights that academic constraints and institutional resource limitations uniquely modify environmental support effects in college settings.

Second, it refines understanding of socio-psychological mechanisms in sports weight management. The differential mediating roles of self-efficacy, group norms, and behavioral motivation challenge the assumption that all social cognitive factors uniformly mediate environmental effects. Specifically, behavioral motivation's lack of mediation suggests intrinsic motivation for weight management may require targeted interventions beyond general environmental support—an insight that enriches self-determination theory [22] in athletic health contexts.

Third, it strengthens the bridge between environmental psychology, sports psychology, and public health. By quantifying the environmental and psychological drivers of weight management in a high-risk athletic group, the study provides a template for interdisciplinary research on specialized health behaviors, addressing the call for more context-specific theory application[10].

5.3. Practical implications

The findings offer actionable guidance for college athletic departments, coaches, and student-athletes to optimize weight management support. For institutional stakeholders, the identified gap in resource support necessitates two key interventions: (1) allocate funding for specialized resources (e.g., on-campus nutritionists trained in combat sports weight management, weight-specific fitness equipment) and (2) develop formal weight management policies that standardize support across teams, including academic-athletic balance accommodations (e.g., exam-period training adjustments). These steps address the institutional gap identified in both quantitative and qualitative results.

For coaches, the mediating role of self-efficacy and group norms highlights the need to shift from generic guidance to personalized, norm-shaping practices. Coaches should provide specific feedback on athletes' ability to balance academics and weight management (to boost self-efficacy) and explicitly model and reinforce health-focused team norms (e.g., celebrating sustainable weight management over rapid loss). Qualitative findings indicate that such personalized, norm-based support resonates more deeply with student-athletes than one-size-fits-all advice.

For student-athletes, the results emphasize the value of engaging with available interpersonal support (e.g., coach check-ins, peer accountability) and advocating for resource access. Athletes can also proactively cultivate self-efficacy by setting incremental weight management goals aligned with academic schedules, reducing the stress of dual demands.

5.4. Limitations and future directions

This study has several limitations that should be addressed in future research. First, the convenience sampling method may limit the generalizability of results, as participants were recruited from 10 institutions across three regions. Future studies should adopt stratified sampling to include a more diverse range of colleges (e.g., Division I versus Division II, urban versus rural institutions) to enhance representativeness. Second, the cross-sectional design cannot establish causal relationships between variables—longitudinal studies tracking environmental support, socio-psychological factors, and weight management over time would better clarify directional effects. Third, the behavioral motivation scale focused on intrinsic vs. extrinsic motivation but did not capture motivation intensity or dynamic changes, which may explain its non-significant mediating role. Future research should use more nuanced motivation measures.

Future directions also include intervention studies testing the effectiveness of targeted environmental support improvements (e.g., nutrition counseling programs, coach norm-training) on weight management outcomes. Additionally, exploring gender and sport-specific differences in environmental support needs—evident in the demographic diversity of the sample—could provide more tailored guidance. Finally, integrating physiological measures (e.g., body composition, metabolic markers) with self-reported weight management effectiveness would enhance result validity.

5.5. Concluding remarks

This study contributes critical insights into the environmental and socio-psychological drivers of weight management among college combat sports student-athletes. The moderate level of environmental support, with a notable resource gap, and the mediating roles of self-efficacy and group norms highlight the need for holistic, multi-level interventions. By addressing these gaps, colleges and coaches can support student-athletes in adopting sustainable weight management practices that balance competitive performance with long-term physical and psychological health. The findings also underscore the value of interdisciplinary research in unpacking complex health behaviors in specialized populations, laying the groundwork for future advancements in sports health science.

6. Conclusion

This study investigated the environmental support systems for weight management among college combat sports student-athletes and the socio-psychological mechanisms underlying their effectiveness. The findings confirm that environmental support for this population is moderately developed, with interpersonal support (driven by coach and peer interactions) as the strongest dimension and resource support (e.g., nutrition counseling, specialized facilities) as the most critical gap. Correlation and mediation analyses demonstrate that environmental support positively predicts weight management effectiveness, with self-

efficacy and group norms serving as key mediating pathways, while behavioral motivation does not exert a significant mediating effect.

The study enriches interdisciplinary theory by validating the "environment-socio-psychology-behavior" framework in a dual-role athletic population, filling the research gap in weight management studies focused on college combat sports athletes. Practically, the results provide actionable guidance for colleges to optimize resource allocation and formalize weight management policies, and for coaches to adopt personalized support and norm-shaping strategies. Despite limitations in sampling and study design, this research advances understanding of sports health behaviors and offers a foundation for future intervention and longitudinal studies. Ultimately, the findings promote sustainable weight management practices that balance competitive performance with the long-term physical and psychological health of college combat sports student-athletes.

Conflict of interest

The authors declare no conflicts of interest.

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