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Diet Habits, Hydration Practices, Perceived Fatigue, and Motivation in Adolescent Swimmers

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Abstract:

The purpose of this study is to examine diet habits, training hydration practices, perceived fatigue, and motivation in 109 adolescent competitive swimmers. Analyses used Chi-square tests and Spearman correlations to assess associations among nutrition knowledge, sweets intake, fast-food/industrial meals intake, hydration during training, fatigue and motivation. Low training hydration was strongly associated with high fatigue (χ^2=21.36, p <0.001) and hydration frequency was very strongly inversely correlated with fatigue severity (r_s=−0.829, p <0.001). Higher nutrition knowledge was associated with better training hydration (χ^2=4.40, p <0.05) and correlated with lower fatigue (r_s=−0.275, p <0.01). A diet-habits and hydration summary score (SQA) was associated with high fatigue (χ^2=12.75, p <0.01) and low motivation (χ^2 =8.28, p <0.05), and correlated with both fatigue (r_s=−0.527, p <0.001) and motivation (r_s=0.396, p <0.001). These findings highlight training hydration routines and overall behavior patterns as practical targets for youth swimming programs. In adolescent swimmers, training hydration and overall diet quality were consistently associated with perceived fatigue and motivation, supporting the value of simple diet-quality indices.

Keywords: Adolescent swimmers; Diet habits; Hydration; Fatigue; Motivation.

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1. INTRODUCTION

Adolescence is characterized by rapid growth and increased nutritional requirements, and these demands can be amplified when adolescents participate in competitive sport (Everett, 2025). In youth athletes, diet habits and hydration practices are modifiable behaviors that may influence training tolerance, recovery, and perceived readiness, even though daily choices are constrained by school schedules, family routines, and food availability (Purcell, 2013). As a swimming coach, I began noticing several concerning behaviors among my swimmers. Initial reflections following discussions with them primarily revealed inadequate hydration and significant consumption of sugary foods before and after training sessions, which led to a loss of appetite for a balanced evening meal essential for muscle recovery. Although multiple factors are involved such as insufficient sleep, stress, and technique issues, this prompted us to launch this study on a larger sample to determine if the problem extends to other swimmers of the same age. Based on Cazorla (1993) classification, this age group corresponds to the beginning of the specialization stage, which is the most favorable period for developing aerobic capacity, with a significant increase in training volume and intensity, requiring a parallel increase in energy expenditure , rich and varied diet.

According to Djemaa et al., (2023) peers and social pressure play a central role in adolescents' food choices, with a high frequency of fast food and sugary drink consumption during meals eaten outside the home. Furthermore, easy access to processed foods and fast food offers solutions perceived as convenient but nutritionally unbalanced, rich in empty calories, saturated fats, and sugars. Dietary habits acquired in childhood are often carried over into adolescence, reinforced by a lack of interest, knowledge, or awareness from parents regarding healthy eating for their children (Hulland, & Alcock, 2023). These dietary habits have direct consequences on the performance and health of young athletes. Insufficient carbohydrate intake, the primary energy source, leads to reduced muscle glycogen reserves, causing premature fatigue and lack of endurance. Blood glucose fluctuations due to unbalanced nutrition impair concentration and motivation, thereby reducing attention during training. Poor nutrition can hinder progress or even lead to a decline in athletic performance (Everett, 2025). Furthermore, muscle recovery slowed by insufficient protein intake delays adaptation to training. Relative Energy Deficiency in Sport (RED-S), caused by inadequate energy intake, affects overall health, including muscle mass, bone mass, and hormonal function (Mountjoy, & al., 2023).

Perceived fatigue and motivation are relevant outcomes in adolescent swimmers because they may influence training engagement, adherence, and well-being (Purcell, 2013). Although fatigue and motivation are influenced by multiple determinants, hydration and diet routines remain modifiable targets that clubs can address through simple structures and education. Competitive swimming provides a relevant context to examine these behaviors because training is often frequent and time-consuming, and drinking opportunities during sessions can be inconsistent or poorly structured (Marinier & Buxeraud, 2024). Applied literature emphasizes that hydration status can influence perceived exertion, performance, and recovery, making hydration routines a particularly actionable target in club settings (Deshayes, & al., 2022)). Under these constraints, it is useful to analyze specific behaviors (e.g., frequent sweets, frequent fast-food/industrial meals, low training hydration) and also to compute a transparent summary indicator that reflects an overall pattern of habits.

2. MATERIALS AND METHODS

2.1 Objective

This study aimed to describe diet habits, training hydration practices, perceived fatigue, and motivation in adolescent competitive swimmers and to explore their relationships using Chi-square tests, Spearman correlations, and a diet-habits and hydration summary score (SQA).

2.2 Study design

This research follows a descriptive and analytical cross-sectional design. This design was selected because it allows for the collection of data from a specific population at a single point in time to describe characteristics and analyze associations between variables.

2.3 hypotheses

Main Hypothesis :

Poorer nutritional knowledge and behaviors, particularly lower hydration frequency and higher sugary food consumption, are associated with increased perceived fatigue, reduced motivation, and suboptimal recovery among adolescent swimmers.

Secondary Hypotheses:

(H1) Lower training hydration frequency is associated with higher perceived fatigue;

(H2) Higher nutrition knowledge is associated with better hydration and lower fatigue;
(H3) A higher SQA (more favorable overall pattern) is associated with lower fatigue and higher motivation.

2.4 Participants

The target population for this study consists of competitive adolescent swimmers from clubs in Eastern Algeria. The final sample included 109 participants (77 boys and 32 girls) aged 13 to 15 years. To select this sample, a two-stage cluster sampling design was employed. In the first stage, swimming clubs were randomly selected as primary sampling units. In the second stage, swimmers were randomly drawn from these clubs to participate in the survey. This method was chosen for its logistical efficiency, as it allowed for a representative data collection across a wide geographical area where a complete registry of individual swimmers was unavailable.

Table 1. Average age of swimmers.

	N	$\bar{x} \pm SD$ (years)
Boys	77	13.86 ± 0.79
Girls	32	13.88 ± 0.75
Overall	109	13.86 ± 0.76

2.5 Data Collection Methods

The paper-based questionnaires were distributed from March 24 to 31, 2025, prior to the start of training sessions. To ensure data confidentiality, only one anonymous copy was completed per selected participant.
The questionnaires utilized a 5-point Likert-type frequency scale (1 = never, 5 = always), adapted to specific response options, to measure the prevalence of key nutritional behaviors such as hydration practices and sugary food consumption among adolescent competitive swimmers.

- Food Questionnaire

A self-administered food questionnaire was used to gather information on general eating habits, intakes before, during, and after training, hydration

practices, as well as the frequency of consumption of certain food groups (fruits, vegetables, sweets, fast food, beverages). This questionnaire was adapted to the participants' age to ensure the clarity and relevance of the questions.

Diet habits were assessed using frequency response categories (Never/Rarely/Sometimes/Often/Always) for key food groups and items. For targeted analyses, “high sweets intake” and “high fast-food/industrial meals intake” were defined as Often/Always. Hydration during training was assessed using the same frequency scale, and “low training hydration” was defined as Never/Rarely.

- Nutritional Knowledge Questionnaire

The swimmers' nutritional knowledge was assessed using a standardized questionnaire, including multiple-choice questions on the basics of sports nutrition, recommended intakes before and after exercise, the importance of hydration, and the recognition of balanced foods. Nutrition knowledge was recorded using ordinal categories, and “high nutrition knowledge” was defined as high/very high.

- Self-Assessment Scales

Participants also self-evaluated their levels of fatigue and motivation using visual numerical scales from 1 to 10. These self-assessments aimed to explore possible links between their daily sensations, eating habits, and sports performances.

The fatigue scale is inspired by the Hooper Index, a validated and widely used tool in sports monitoring to assess daily fitness status (Hooper & al., 1995).

Perceived fatigue was recorded using ordered response categories; “high fatigue” was defined as fatigue ≥ “important”.

The motivation scale draws on principles from the simplified Sport Motivation Scale (SMS) (Pelletier, & al., 2013), adapted for adolescents and translated to the arabic form.Motivation was recorded using ordered response categories; “low motivation” was defined as motivation ≤ “little motivated”.

- Diet habits and hydration summary score (SQA)

A transparent summary score (SQA) was computed to capture overall patterns with frequency-only data. Positive components were assigned for favorable behaviors and negative components were assigned for frequent sweets

and frequent fast-food/industrial meals. Higher SQA values indicate a more favorable overall pattern.

A simple Diet Quality Score was constructed using 9 components compatible with frequency-only data, a common approach in diet quality measurement when portion sizes are not available.

Positive components scored +1 if "Often/Always":fruits, vegetables, whole grains, meat/poultry/fish, dairy; +1 if training hydration was ≥ "Sometimes"; +1 if meals/day ≥3. Negative components scored −1 if "Often/Always": sweets and industrial/fast-food meals.

SQA was computed as (sum positive) − (sum negative), with higher scores reflecting a more favorable nutritional profile.

2.6 Statistical analysis

Analyses used a two-step approach: targeted bivariate tests (Chi-square tests for binary indicators; Spearman correlations for ordinal associations) and SQA analyses by tertiles (Chi-square) and continuously (Spearman). Statistical significance was set at $p<0.05$.

3. RESULTS

3.1 Descriptive results

Table 2 summarizes the key indicators. Frequent sweets intake (61.5%) and low training hydration (67.0%) were common in this sample. High fatigue (28.4%) and low motivation (50.5%) were also prevalent

Table 2. Key indicators in adolescent competitive swimmers (N=109)

Indicator	N	%
High nutrition Knowledge (≥ High)	21	19,3
High sweets intake (Often/Always)	67	61,5
High fast-food/ industrial meals (Often/Always)	44	40,4
Low training hydration (Never/ Rarely)	73	67,0
High fatigue ≥ Important	31	28,4
Low motivation (≤ Little motivated)	55	50,5

3.2 Targeted associations (Chi-square)

Table 3 presents the main Chi-square analyses. Low training hydration was strongly associated with high fatigue (χ^2=21.36, $p < 0.001$). High nutrition knowledge was associated with low training hydration (χ^2=4.40, $p < 0.05$), while high nutrition knowledge was not significantly associated with high sweets intake.

Table 3. Targeted Chi-square (χ^2) associations among key behaviors and outcomes (N=109)

Analysis	χ^2	P-value	Effect size
High knowledge x High sweets	2,11	> 0.05	0.139
High knowledge x Low hydration	4,40	< 0.05	0.201
Low hydration x High fatigue	21,36	< 0.001	0.443
High sweets x Low motivation	0,22	> 0.05	0.045
Sex x High fast-food	4,44	< 0.05	0.202
Age x high sweets	8,65	< 0.05	0.282

Sex was associated with high fast-food/industrial meals intake (χ^2 =4.44, p < 0.05), and boys show nearly the double the rate of girls

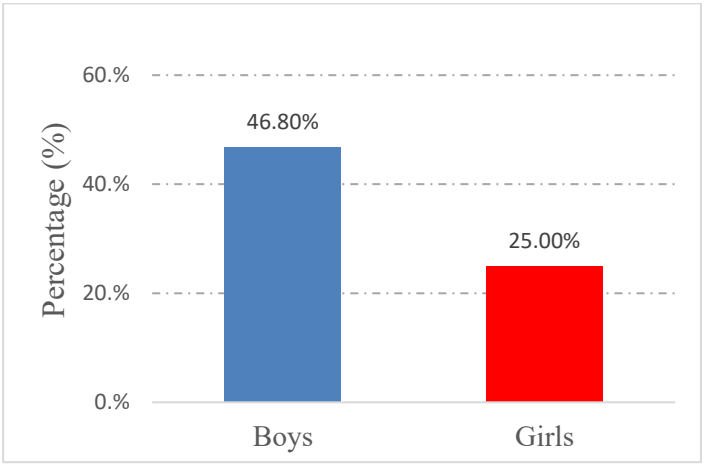

Fig.1. Hight fast-food consumption by sex

Age group (13–15 y) was associated with high sweets intake (χ^2=8.65, p < 0.05). hgih sugar intake rising with age, consumption nearly doubles from youngest to oldest swimmers.

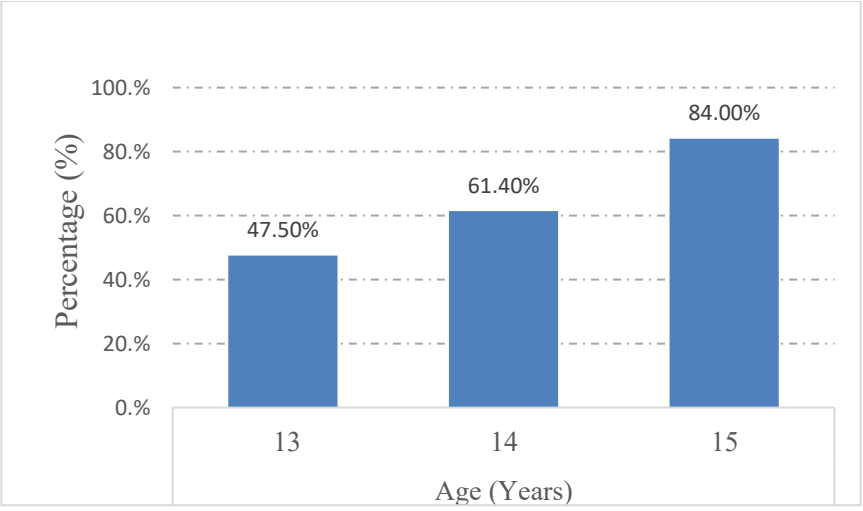

Fig.2. High sweets by age

3.3 Ordinal associations (Spearman)

Table 4 shows ordinal correlations. Hydration frequency was very strongly inversely correlated with fatigue severity (r_s =−0.829, p < 0.001). Nutrition

knowledge correlated positively with hydration (r_s =+0.228, $p < 0.05$) and negatively with fatigue (r_s =−0.275, $p < 0.01$).

Table 4. Spearman correlations (r_s) among ordinal variables (N=109)

Indicator	r_s	P-value
Knowledge ↔ Sweets	- 0.318	< 0.001
Knowledge ↔ Hydration	+ 0.228	< 0.05
Knowledge ↔ Fatigue	- 0.275	< 0.01
Hydration ↔ Fatigue	- 0.829	< 0.001
Sweets ↔ Motivation	- 0.133	> 0.05
Age ↔ Sweets	+ 0.248	< 0.01

3.4 SQA pattern results

SQA tertiles were associated with both high fatigue (χ^2=12.75, p= < 0.01) and low motivation (χ^2=8.28, $p < 0.05$).

Table 5. Associations between SQA tertiles and outcomes (N=109).

Analysis	χ^2	P	Effect size
SQA tertiles x High fatigue	12.75	< 0.01	0.342
SQA tertiles x Low motivation	8.28	< 0.05	0.276

When treated continuously, SQA correlated with fatigue (r_s =−0.527, $p < 0.001$) and motivation (r_s =+0.396, $p < 0.001$).

Table 6. Spearman correlations (r_s) between SQA (continuous) and outcomes (n=109).

Pair	r_s	p
SQA (continuous) ↔ Fatigue (ordinal)	- 0.525	< 0.001
SQA (continuous) ↔ Motivation (ordinal)	+ 0.396	< 0.001

The nutrition profile (based on 3 simple markers) shows that a majority of respondents accumulate at least 2 risk markers, and this profile is associated with more high fatigue and more low motivation.

Calculations Nutrition profile

Markers (prevalence)

Markers used (1 point each): high sweets intake (often/always), high fast-food intake (often/always), low hydration (never/rarely).

High sweets intake: 67/109 = 61.5%.

High fast-food intake: 44/109 = 40.4%.

Low hydration: 73/109 = 67.0%.

Number of accumulated markers

0 marker: 13 swimmers (11.9%).

1 marker: 26 swimmers (23.9%).

2 markers: 52 swimmers (47.7%).

3 markers: 18 swimmers (16.5%).

Profile (3 levels)

Favorable profile (0): 13 (11.9%).

Intermediate profile (1): 26 (23.9%).

At-risk profile (≥2): 70 (64.2%).

Distribution of the nutrition profile (3 levels) based on 3 markers (high sweets intake, high fast-food intake, low hydration), N=109.

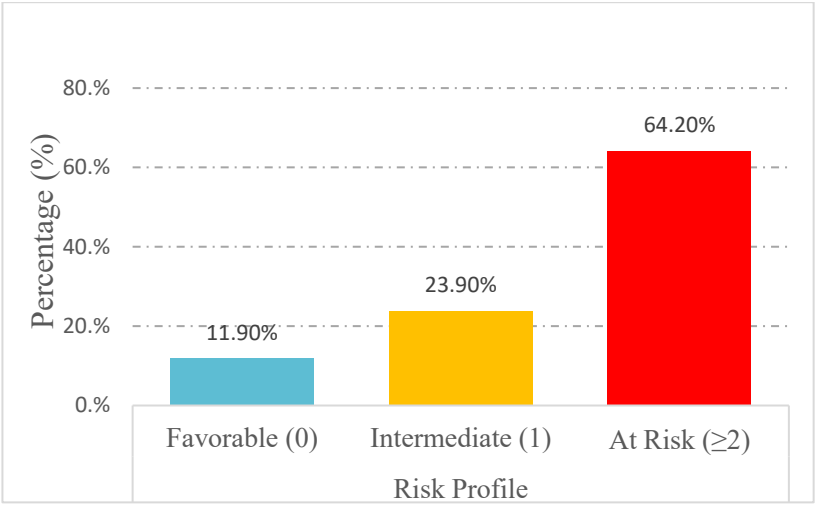

Fig.3. Distribution of SQA tertiles.

Profile vs fatigue and motivation

Contingency Profile × high fatigue
Favorable (0): 0/13 = 0.0% high fatigue.
Intermediate (1): 4/26 = 15.4% high fatigue.
At risk (≥2): 27/70 = 38.6% high fatigue.
Test: χ^2 =10.87; p<0.01.

Contingency Profile × low motivation
Favorable (0): 0/13 = 0.0% low motivation.
Intermediate (1): 14/26 = 53.8% low motivation.
At risk (≥2): 41/70 = 58.6% low motivation.
Test: χ^2 =15.20; p<0.001.

4. DISCUSSION

This cross-sectional study explored diet habits, training hydration practices, perceived fatigue, and motivation in 109 adolescent competitive swimmers using both targeted bivariate analyses and a pragmatic summary score (SQA). The central finding is that training hydration was the strongest and most consistent correlate of perceived fatigue, while the overall habit pattern captured by SQA was associated with both fatigue and motivation.

4.1 Hydration as a key correlate of fatigue

Hydration during training showed a robust relationship with fatigue across analytic approaches. Swimmers with low training hydration (never/rarely) presented a higher prevalence of high fatigue, and hydration frequency was very strongly inversely correlated with fatigue severity. This has immediate practical relevance because hydration routines can be strengthened through simple club-level structures, consistent with applied discussions emphasizing hydration as a determinant of performance and perceived exertion (Marinier & Buxeraud, 2024). Evidence in adolescent athletes indicates that fluid intake practices can be highly variable and that monitoring and education remain relevant in youth sport contexts (Bergeron, 2024) . A recent meta-analysis confirms that even mild exercise-induced dehydration increases perceived exertion (RPE) during endurance exercise, particularly relevant for prolonged activities like swimming (Deshayes, & al., 2022). However, causality cannot be inferred: inadequate hydration could contribute to fatigue, but fatigue may also reduce drinking during sessions, or both may reflect unmeasured factors such as training load, sleep restriction, illness, or academic stress. (Ceylan, 2021).

4.2 Nutrition knowledge and behavioral translation

Nutrition knowledge was associated with training hydration and correlated negatively with fatigue severity, suggesting that better-informed swimmers may adopt more effective training-related behaviors, consistent with general pediatric sport nutrition guidance (Purcell, 2013). In contrast, the dichotomized analysis did not show a significant relationship between high knowledge and high sweets intake, although the ordinal association suggested a relationship. This pattern may reflect information loss from dichotomization and the reality that adolescent food choices are shaped by home environment, convenience foods, and social influences, which can limit the translation of knowledge into behavior (Hulland, & al., 2023 ; Sahnoune, & al., 2013).

4.3 SQA as an overall pattern indicator

SQA tertiles were significantly associated with high fatigue and low motivation, and the continuous SQA measure correlated with both fatigue and motivation, alongside continuous SQA correlations, align with research linking poor diet quality to adverse perceptual responses in athletes (Matney, & al., 2025). These findings reinforce a pattern-level view where fatigue and motivation reflect cumulative dietary habits rather than single factors. Supporting studies emphasize hydration and clustered poor habits (e.g., high sweets/fast food) as key

contributors in youth and adolescent athletes . Because SQA is derived from frequency-only self-reports, it should be interpreted as a pragmatic descriptive indicator rather than a validated diet-quality index akin to tools like the Athlete Diet Index (ADI) or Healthy Eating Index (HEI) that account for athlete-specific needs (Capling, et al., 2020 ; Werner, & al., 2022) . The accumulation of markers (high sweets intake, high fast-food intake, low hydration) places 64.2% of swimmers in an "at-risk profile (≥2)," which suggests a generally unfavorable food environment and training habits in this sample. The association "at-risk profile → high fatigue" is statistically significant (χ^2 $p<0.01$) with a moderate effect size (0.316), which is consistent and aligns with studies linking clustered poor habits particularly dehydration to elevated perceived fatigue in endurance sports (Caller, et al., 2023) For instance, suboptimal carbohydrate intake and hydration deficits in runners led to reduced fatigue post-nutrition counseling, while diet quality tertiles in athletes inversely predict perceptual recovery and motivation (Matney, & al., 2025). These findings underscore how unfavorable dietary patterns, prevalent in 64-70% of young athletes, amplify fatigue through cumulative effects rather than isolated behaviors (Farina, et al., 2020).

4.4 Subgroup differences and contextualization

Age and sex differences were observed for selected behaviors, suggesting that targeted messages may be needed for different subgroups within early adolescence. According to Olzinski , & al., (2019), in adolescent swimmers, females often report lower hydration and higher fatigue, linked to hormonal and behavioral factors. Within the local context, questionnaire-based research published in Sport System Journal illustrates the feasibility of assessing nutrition-related practices in Algerian athlete groups (including swimmers), supporting the relevance of applied data collection in clubs (Djemaa, & al., 2023 ; Mimouni, & al., 2023). Additionally, Algerian evidence in school-aged children suggests that unhealthy dietary behaviors can appear early, reinforcing the value of prevention and education before adolescence (Sahnoune, & al., 2013).

4.5 Limitations and future directions

Limitations include the cross-sectional design, self-reported measures, and the lack of control for potential confounders (e.g., training load, sleep, injury/illness, and environmental conditions). Future studies should include objective hydration monitoring and intervention designs to test whether improving hydration routines reduces fatigue and supports motivation in adolescent

swimmers. Nevertheless, this study clearly demonstrated hydration deficiency and nutritional imbalances among young Algerian swimmers.

4.6 Implications for practice

Given the strong hydration ; fatigue relationship observed in this sample, youth swimming clubs should treat training hydration as a priority behavior and implement simple routines that increase drinking frequency during sessions (e.g., bringing personal bottles poolside, scheduling drink breaks, and coach reminders). Because adolescent athletes can arrive at training already insufficiently hydrated, clubs should also promote day-long hydration habits, not only “during practice”. Practical education for swimmers and parents can link hydration and food routines to perceived readiness (fatigue) and engagement (motivation), reinforcing age-appropriate guidance on what and when to eat and drink around training. Finally, monitoring can remain lightweight (brief checklists and short self-ratings), and club initiatives should be evaluated with follow-up assessments to verify whether improved routines translate into lower perceived fatigue and better motivation over time.

5. CONCLUSION

Low training hydration was strongly associated with higher perceived fatigue in adolescent competitive swimmers, and the overall SQA pattern (diet habits and hydration summary score) was linked to both fatigue and motivation. These findings support prioritizing hydration routines and overall diet-habit education in youth swimming programs, Clubs should adopt easy fixes: poolside bottles, drink breaks, coach prompts, plus daily habit education.Tailor by age/sex, engaging Algerian families and schools for lasting change.

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