

# Play Without Pause: Fuel Her Way

Low energy availability screening and nutrition adequacy  
among adolescents female athletes of Uttar Pradesh



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# About the Organisations

This study was conducted through a collaborative partnership between three organisations committed to the health, development, and equitable participation of female athletes in India.

## Simply Sport Foundation

Simply Sport Foundation (SSF) is a non-profit organisation working to strengthen athlete welfare systems, particularly at the grassroots level. The foundation focuses on inclusive athlete development through structured programs, policy engagement, and research-based interventions, ensuring that athletes regardless of gender or socio-economic background receive access to appropriate health education, screening, and support. Under this mandate, SSF runs the Women's Health Initiative across three core verticals: Menstrual Health Literacy, Female Athlete Nutrition, and Mental Health and emotional resilience.



## Capri Global Capital Limited

Capri Global Capital Limited is part of Capri Global Holdings and operates across multiple sectors including a Non-Banking Financial Company, Housing Finance Company, and sports ventures. CGCL is listed on the BSE and NSE and is part of the NIFTY Smallcap 250 Index. Through its operations across Northern and Western India, CGCL works with unbanked and underserved populations, aligning business operations with financial inclusion goals.



## UP Warriorz

UP Warriorz is a professional women's cricket team based in Uttar Pradesh competing in the Women's Premier League. Owned by Capri Global, the team debuted in the inaugural WPL season in 2023. Through its impact mission, Beyond the Scorecard, UP Warriorz supports initiatives focused on women's inclusion in sport, mental health awareness, and access to opportunities. UP Warriorz has been recognised as India's only sports team acknowledged as a Generational Equality Ally by UN Women.



# Acknowledgements

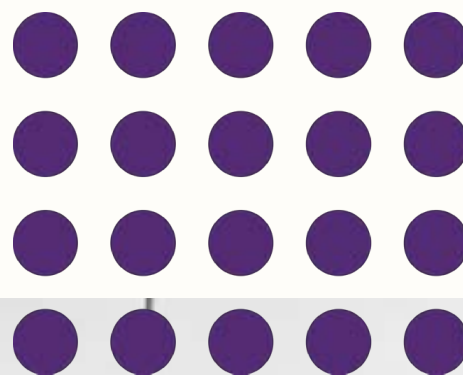
We sincerely acknowledge the invaluable contributions of our partners, stakeholders, and team members whose continued support made this Women's Health Initiative possible. Their collaboration and commitment have played a critical role in advancing health awareness and physiological safety among adolescent female athletes across Uttar Pradesh.

We extend a special thanks to the Uttar Pradesh Sports Department for their assistance in coordination and for providing access to regional sports stadiums and hostels, which were instrumental in the program's implementation. Their support was essential in ensuring the successful execution of workshops and outreach initiatives.

The successful execution of this initiative reflects a shared vision to strengthen athlete health systems and ensure that performance development is supported by informed, evidence-based care.

## Key Team Members

- Aditi Mutatkar – Head, Athlete and Women Initiative
- Renu Yadav – Lead, Female Athlete Nutrition
- Richie Kirwan – Lecturer in Nutrition and Exercise Physiology, Liverpool John Moores University (LJMU)
- Ritika Parate – Women's Health Physiotherapist & Period Facilitator
- Shifra Varadkar – Sports Nutritionist & Nutrition Facilitator
- Sivanuja Peddada – Sports Psychologist & Mental Health Facilitator
- Varsha Valdamani – Data Analyst
- Hamsini Ravi – Report Writer
- Sneha J. Chhatre – Graphic Designer
- Pavithra Nanjundan – Data Analyst Intern
- Reetha Sabu - Logistical support



# Executive Summary

She is fifteen, awake before five, and training twice a day. Between sessions she goes to school. She eats what the hostel kitchen serves. She has not had her period in two months and has not told anyone. She competes at national level and wants to represent India. Across the four centres this study visited, her situation was not unusual.

This report presents findings from a cross-sectional assessment of Low Energy Availability (LEA) risk among 169 adolescent female athletes across four training centres in Uttar Pradesh: Agra, Ayodhya, Lucknow, and Gorakhpur. The study used validated LEAF-Q screening, two-day dietary recall, body composition analysis, and aerobic fitness testing, alongside qualitative interviews with athletes, coaches, and kitchen staff across 12 sports disciplines. In a second phase, structured workshops were delivered to 169 athletes and 8 coaches, with pre and post knowledge assessments completed by 107 athletes.



**169**

Athletes assessed

**15.4** yrs

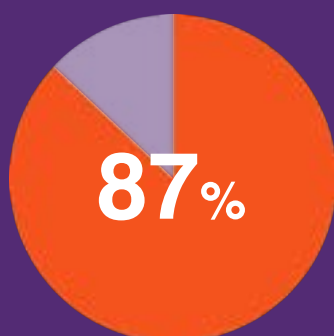
Average age

**12**

Sports disciplines

**4**

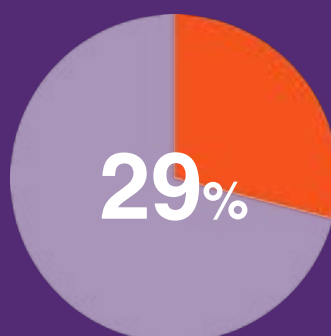
Training centres



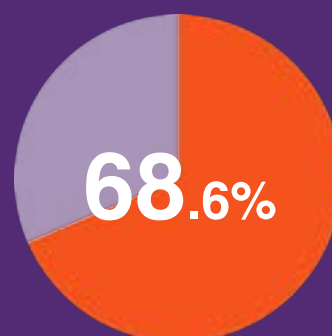
Less than 35  
Kcal/Kg BW/  
Day of Energy  
Intake



Below protein  
standard



Clinically at risk  
of Low energy  
availability



One or more  
warning signs of  
low energy  
availability (LEA)

## What the Data Shows

Dietary intake was below recommended standards across the entire cohort : Mean energy intake was 26.5 kcal/kg/day, with 87% of athletes falling below the 35 kcal/kg threshold. All athletes fell below the minimum protein standard of 1.4 g/kg/day, with a mean intake of 0.8 g/kg, comparable to sedentary adult recommendations. Protein intake showed a declining trend with age, from 1.08 g/kg in athletes under 13 to 0.89 g/kg in the 16 to 19 age group.

LEAF-Q screening identified 29% of athletes as high risk for LEA : A further 68.6% showed at least one risk indicator across injury history, menstrual dysfunction, and gastrointestinal symptoms. Approximately 31% reported menstrual irregularities and 38% showed signs of injury risk. These patterns are consistent with LEA-related physiological stress, though causal relationships cannot be established from this cross-sectional design. Athletics, Judo, and Volleyball showed the highest sport-specific risk profiles.

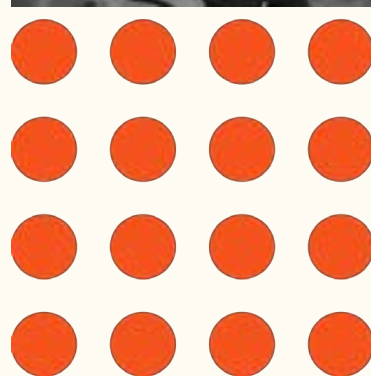
Educational workshops produced measurable knowledge gains : Pre- to post-workshop assessments highlight a clear improvement in knowledge among both athletes and coaches. Athlete scores rose from 5.07 to 7.17 (an increase of 2.1 points), while coach scores increased from 8.3 to 9.0 (a gain of 0.7 points) .

## Implications

The data collectively points to a population operating under chronic nutritional stress, with energy and protein intake that does not meet the basic demands of athletic training. The fact that deficits deepen with age suggests this is not a gap that corrects itself over time, but a structural issue that worsens as training intensity increases.

The co-occurrence of LEA risk, menstrual irregularities, and injury indicators across sports points to systemic rather than individual-level factors. Sport-specific clustering in Athletics, Judo, and Volleyball further suggests that targeted, sport-informed approaches are likely to yield the greatest impact.

The measurable knowledge gained from educational workshops demonstrate that athletes and coaches are responsive to structured interventions. This is an important foundation. Building on it through routine screening, menstrual health monitoring, and access to appropriate nutrition support within the athlete development system offers a realistic and scalable pathway to meaningful change.



# Background and Rationale

## 3.1 What is Low Energy Availability?

Energy availability (EA) refers to the amount of dietary energy remaining for normal physiological functions after accounting for the energy expended during exercise, expressed relative to fat-free mass (kcal/kg FFM/day). When this value falls below approximately 30 kcal/kg FFM/day, the body enters a state of Low Energy Availability (LEA), in which energy is conserved by downregulating processes not essential to immediate survival.<sup>[1,2,3]</sup>

LEA is recognised as the underlying mechanism of two related clinical frameworks. The Female Athlete Triad describes the interrelationship between energy availability, menstrual function, and bone mineral density. The broader Relative Energy Deficiency in Sport (REDs) model, updated by the International Olympic Committee, extends this to include impairments across reproductive, skeletal, endocrine, immune, metabolic, cardiovascular, and psychological health.<sup>[2,4]</sup>

The physiological consequences associated with LEA may include:

- Menstrual dysfunction, including irregular cycles and amenorrhoea, arising from suppression of the hypothalamic-pituitary-ovarian axis<sup>[2,4]</sup>
- Reduced bone mineral density and elevated risk of stress fractures<sup>[1,3]</sup>
- Impaired muscle protein synthesis and reduced capacity for inter-session recovery<sup>[5]</sup>
- Decreased immune function and increased susceptibility to illness<sup>[4]</sup>
- Measurable decrements in endurance capacity, strength, and sprint performance<sup>[5,9]</sup>
- Psychological effects including elevated fatigue, irritability, and reduced concentration<sup>[10]</sup>

Importantly, LEA does not always present with visible weight loss or a clinically underweight body composition. Physiological disruption may occur across a range of body sizes, including in athletes who appear to have a healthy or above-average body weight.<sup>[1,3]</sup> This makes LEA particularly difficult to identify through routine physical assessments alone and underscores the need for multi-dimensional screening.



## 3.2 Prevalence and Risk in Female Athletes

LEA is no longer considered a rare or elite-sport-specific condition. Global prevalence estimates suggest that 30 to 60% of female athletes across endurance, aesthetic, weight-category, and team-based sports may be affected to varying degrees. <sup>[1,2,3]</sup> When assessed using validated screening tools such as the Low Energy Availability in Females Questionnaire (LEAF-Q), studies consistently classify 40 to 60% of female athletes as at risk. <sup>[3,6,7]</sup> When energy availability is calculated directly, LEA has been identified in 22 to 67% of female athletes across different sport types and competition levels. <sup>[6,7]</sup>

Adolescent athletes represent a particularly vulnerable group. The teenage years are a period of heightened nutritional demand, during which the body requires adequate energy not only to support training but also to sustain puberty, bone mineralisation, hormonal development, and growth. <sup>[2,4]</sup> When energy intake is insufficient during this developmental window, the consequences may extend beyond immediate performance to affect long-term bone health and reproductive function. The risk is compounded in athletes who begin competitive training during early adolescence, as nutritional habits may not keep pace with escalating training demands.

Qualitative research indicates that under-fuelling is often normalised within sporting environments, with menstrual irregularities, fatigue, and recurrent injuries treated as expected consequences of hard training rather than as warning signs warranting clinical attention. <sup>[10]</sup> Athletes may be reluctant to disclose symptoms, particularly in contexts where menstrual health is stigmatised or where body weight is closely linked to performance expectations.

## 3.3 The Evidence Gap in India

Despite a growing global evidence base, the majority of LEA and RED-S research has been conducted in North American and European contexts. <sup>[1,2,3,8,9]</sup> These settings differ substantially from India in terms of dietary patterns, food systems, access to sports nutrition professionals, and the cultural and institutional environments within which athletes train.

Indian female athletes, particularly those in residential training systems, frequently train within environments characterised by cereal-dominant diets, limited protein diversity, and restricted access to nutrition guidance. Menstrual health remains a sensitive topic in many sporting environments, and athletes may face barriers to disclosure even when symptoms are present.

Emerging evidence from Indian studies suggests that LEA risk is relevant and measurable in local populations. Research among Bharatanatyam dancers identified approximately 33% showing risk indicators consistent with the Female Athlete Triad, with notable rates of menstrual disturbance and injury. <sup>[13]</sup> A study of collegiate athletes under Sports Authority of India systems found substantial LEA risk patterns using LEAF-Q screening, alongside low baseline awareness of Triad-related concepts. <sup>[17]</sup> However, these studies remain limited in scope and sport specificity.

There is currently no large, multi-sport dataset assessing LEA risk among adolescent female athletes in India. This represents a significant gap for evidence-based policy and intervention planning at the state and national level. <sup>[14,15]</sup>



### 3.4 The Uttar Pradesh Context

In 2025, the Play Without Pause report, led by Simply Sport Foundation in collaboration with Capri Sports and UP Warriorz, surveyed 1,205 female athletes and coaches across 12 districts of Uttar Pradesh. <sup>[18]</sup> The findings revealed that menstrual health and nutrition were deeply interconnected barriers to participation and performance. A significant proportion of athletes reported missing training due to menstrual discomfort, and the majority identified inadequate nutrition support within their training environments. While educational interventions demonstrated improvements in attendance and awareness, persistent fuelling gaps remained evident.

These findings raised the possibility that the menstrual disruption and performance concerns observed were not isolated issues but part of a broader pattern consistent with LEA. The present study was designed to examine that possibility through systematic screening, dietary evaluation, and body composition analysis across four regional training centres.

### 3.5 Rationale for a Multi-Dimensional Assessment

LEA cannot be reliably identified through a single indicator. Body weight and BMI alone are insufficient, as physiological disruption may occur across a wide range of body compositions. <sup>[1,3]</sup> Dietary recall alone cannot capture the full clinical picture without reference to training load and body composition. Menstrual status, while a sensitive indicator of energy adequacy, may be influenced by factors beyond nutrition. A robust assessment therefore requires the integration of multiple data sources.

For this study, a multi-dimensional framework was adopted, combining the following components:

- LEAF-Q screening to identify physiological risk patterns associated with LEA in field settings <sup>[6,12]</sup>
- Two-day dietary recall to evaluate energy and macronutrient intake within Indian dietary contexts
- Body composition analysis to quantify fat-free mass and assess lean mass development across age groups <sup>[1,2,3]</sup>
- Field-based aerobic capacity testing to explore associations between nutritional risk and physical performance <sup>[9]</sup>
- Qualitative interviews and focus group discussions to understand contextual and environmental factors shaping nutrition and health outcomes <sup>[10]</sup>

This integrated approach enables the identification of concealed risk in athletes who may appear clinically stable based on body weight alone, and provides the contextual depth needed to translate findings into actionable recommendations.



# Methodology

## 4.1 Goal

To assess the risk of Low Energy Availability among adolescent female athletes across four districts of Uttar Pradesh through structured screening, dietary evaluation, body composition analysis, and educational intervention, and to generate centre-level evidence to inform nutritional support and athlete health systems.

## 4.2 Strategic Objectives

### 1. Identify and Quantify LEA Risk

To systematically assess the prevalence of Low Energy Availability among young female athletes using the LEAF-Q, anthropometric measurements, body composition analysis, and dietary recall assessments.

### 2. Evaluate Dietary Adequacy

To assess athletes' dietary intake patterns in relation to training demands and examine food availability and environmental factors influencing nutritional adequacy across residential training centres.

### 3. Strengthen Health Literacy

To design and deliver structured education sessions focusing on female athlete nutrition, menstrual health awareness, recovery practices, and mental well-being for both athletes and coaches.

### 4. Provide Centre-Level Recommendations

To develop data-driven insight reports for each sports centre, offering practical recommendations to improve nutrition support systems and promote optimal energy availability and athlete well-being.

## 4.3 Study Design

This was a cross-sectional, location based assessment followed by an educational intervention was conducted in two phases. Phase 1 comprised baseline screening and data collection across all four centres. Phase 2 comprised structured workshops delivered across three centres, with pre and post knowledge assessments to measure the impact of the intervention. The two phases involved different but overlapping participant groups, as described in the methodology below.

## 4.4 Data collection methods

Phase 1 was conducted across four residential training facilities for adolescent athletes in Uttar Pradesh. Prior to assessments, a one-day orientation was held with the facilitating team to align on the implementation plan and standardise data collection techniques, ensuring consistent execution across all four sites.

## Phase 1: Baseline Screening and Assessment

### LEAF-Q Screening

The Low Energy Availability in Females Questionnaire (LEAF-Q) is a validated screening tool used to identify female athletes at risk of LEA and its associated health consequences. The tool assesses physiological symptoms across four domains: Injury History, Gastrointestinal Function, Hormonal and Contraceptive Use, and Menstrual Function. A cumulative score is calculated from 25 items, with a clinical cut-off of 8 or above used to classify athletes as at risk. The LEAF-Q was translated into Hindi and adapted for contextual relevance prior to administration.

### Dietary Assessment

A structured two-day 24-hour dietary recall was conducted with each athlete. Data were analysed to estimate total energy intake, macronutrient distribution, and alignment with recommended standards for active athletes. Portion estimation was adapted to Indian household measures to improve accuracy of recall.

### Anthropometry and Body Composition

Height and body weight were measured using standardised procedures. Body composition was assessed using Omron Karada Scan to evaluate fat-free mass and body fat percentage. Internal distribution analysis was conducted to evaluate body composition patterns beyond BMI classification.



### **Aerobic Capacity Testing**

Field-based aerobic capacity testing using the 20-metre multi-stage shuttle run (beep test) was conducted to assess aerobic fitness.

### **Qualitative Data Collection**

Semi-structured interviews were conducted with coaches and kitchen staff at each centre. Focus group discussions (FGDs) were held with athletes to explore shared experiences related to nutrition knowledge, dietary practices, menstrual health, training pressures, injury management, and body image. All discussions were facilitated in Hindi. Data were transcribed and thematically analysed to identify recurring patterns across centres.



## Phase 2: Workshops and Knowledge Assessment

Drawing on the data collected during Phase 1, individual Athlete Health and Nutrition Reports were developed for each academy and shared prior to the workshop phase. These reports gave academy staff a clear, evidence-based picture of their athletes' health status and formed the foundation for the educational intervention that followed.

Workshops were conducted separately for athletes and coaches across three locations: Lucknow, Ayodhya, and Gorakhpur.

### Athlete Workshop

Duration: 2 Hours

Key Topics Covered:

- Menstrual cycle basics
- Normal vs abnormal symptoms
- Menstrual tracking
- Talking to your coach
- Body image in sport
- Self-talk and confidence
- Responding to body shaming
- Female Athlete Triad and RED-S
- Energy needs for athletes
- Pre, during, post-training fuelling
- Hydration monitoring
- Athlete's Plate model

### Coach Workshop

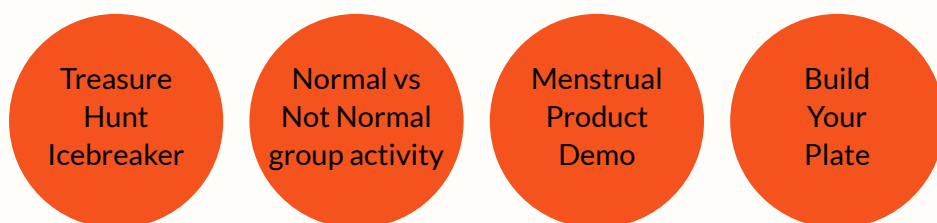
Duration: 1.5 Hours

Key Topics Covered:

- Menstrual cycle and red flags
- Training modifications during periods
- Communication with female athletes
- Body shaming and weight comments
- Low Energy Availability and RED-S
- Early warning signs of LEA
- Fuelling and hydration basics
- Activities
- Problem-based scenario discussions
- Case-based athlete support scenarios
- Red flag identification exercise
- Monitoring system discussion

The coach workshop aimed to shift perspectives from performance-only monitoring toward integrated health and performance planning.

Activities:



### Knowledge Assessment and Resource Distribution

Pre and post knowledge assessments were administered to athletes across the three locations, covering menstrual health, nutrition, energy availability, and body image. Eight coaches participated in workshops, of whom six completed post-workshop assessments.

As part of the intervention, 225 copies each of the Meri Khel Yatra Athlete Health Tracker and the Simply Period educational handbook were distributed to athletes across all three locations, supporting continued self-monitoring and menstrual health literacy beyond the workshop setting.

# Reach & Impact

Athletes Screened (Phase 1)	23	73	31	49
No. Of Athletes (Phase 2)	-	59	30	80
	Agra	Ayodhya	Lucknow	Gorakhpur

**107**

completed pre and post workshop assessment

**200+**

Meri khel yatra diary and Simply periods handbooks distributed

**8**

Coaches attended workshops

**8**

Workshops delivered

## Project Timeline

START

END



### November 2025

- Tool adaptation
- Hindi translation of LEAF-Q
- Protocol development

### December 2025

Phase 1 baseline data collection  
*Lucknow · Ayodhya · Agra*

### January – February 2026

Phase 2 data collection – Gorakhpur  
Women's Health Workshop delivery  
*Lucknow · Ayodhya · Gorakhpur*



## Meri Khel Yatra – Athlete Tracker Handbook

As part of the intervention, the Meri Khel Yatra Tracker Handbook was developed and distributed to strengthen the long-term impact of the workshops conducted with female athletes.

During field interactions across centres, it became evident that while athletes were highly dedicated to training, there was limited structured tracking of nutrition, recovery, menstrual health, and emotional well-being. Many athletes were unaware of how irregular fuelling, poor sleep, unmanaged fatigue, or menstrual symptoms were influencing their performance. Conversations around periods were often normalised in silence rather than addressed proactively.

The Tracker Handbook was conceptualised as a practical bridge between awareness and action. Rather than limiting learning to a one-time workshop session, the diary was designed to integrate key concepts into the athletes' everyday routines. It functions as a structured self-monitoring tool that allows athletes to record their training load, sleep duration, hydration, food intake, energy levels, mood, and menstrual cycle details. By bringing these variables together in one place, the handbook encourages athletes to observe patterns between how they train, how they fuel, how they feel, and how they perform.

A key purpose of the tracker is to normalise menstrual health within the sporting ecosystem. By integrating menstrual cycle tracking alongside training logs, the handbook reinforces the message that periods are not a weakness or disruption, but a natural physiological process that influences energy, recovery, and performance. Tracking flow intensity, symptoms, and emotional changes empowers athletes to better understand their bodies and communicate more confidently with coaches and support systems.

Beyond monitoring, the handbook incorporates guided reflection prompts that encourage athletes to think about weekly progress, challenges, and goals. This reflective element supports habit formation, builds discipline, and fosters a healthier relationship with food, recovery, and body awareness.

A total of 200+ Meri Khel Yatra Tracker Handbooks were distributed to female athletes across Ayodhya, Lucknow, and Gorakhpur. The intended outcome is sustained behaviour change. Through regular tracking and reflection, athletes are expected to develop improved eating habits, better recovery management, enhanced body literacy, and greater confidence in navigating menstrual health within sport.

The diary includes sections for:

- Menstrual tracking
- Nutrition practices
- Mental well-being indicators
- Training load and sleep duration
- Energy levels, mood, and hydration
- Weekly reflection prompts
- Weekly learning section



## Simply Period – Educational Handbook

The Simply Period handbook was provided to female athletes as a structured educational resource on menstrual health in sport. During the intervention, it was observed that many athletes had limited understanding of puberty, menstrual cycle phases, common symptoms such as cramps and PMS, heavy bleeding, iron deficiency, and conditions like PCOS or Low Energy Availability. There was also uncertainty around menstrual product usage during training and competition, particularly for athletes involved in swimming and high-intensity sport.

While workshops introduced these topics, the handbook was developed to ensure continued access to accurate information beyond the session. It serves as a reference document that athletes can revisit when needed and use to clarify doubts related to menstrual health and performance.

The content links menstrual cycle phases to training load and recovery considerations, helping athletes understand how hormonal fluctuations may influence energy levels and performance. Practical recommendations are included for symptom management, iron intake, hydration, rest, and seeking professional guidance when required.

A total of 200+ Simply Period handbooks were distributed across Ayodhya, Lucknow, and Gorakhpur. The objective of this distribution was to improve menstrual literacy among female athletes, support informed health decisions, and encourage structured communication between athletes and coaches regarding menstrual health. The handbook functions as an educational support tool within the program, reinforcing workshop content and providing consistent, accessible information for long-term reference.

### The handbook covers:

- Puberty and physical changes
- The menstrual cycle and its phases
- PMS and period pain management
- Menstrual products (pads, tampons, cups, period underwear)
- Hygiene practices for athletes
- Heavy bleeding and when to seek medical help
- Anaemia, PCOS, RED-S and Female Athlete Triad
- Nutrition considerations during different phases
- Training adjustments across the menstrual cycle
- Communication guidance for athletes and coaches

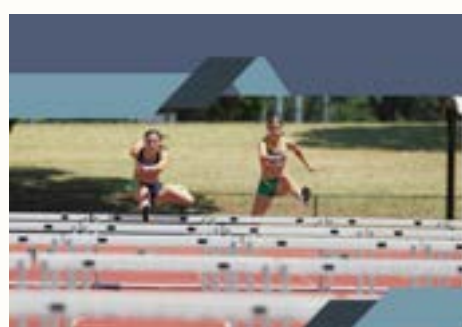


## Centre-Level Athlete Health and Nutrition Reports

From the data gathered during Phase 1, individual Athlete Health and Nutrition Reports were prepared for each centre. Each report provided a screening-based overview covering body composition, dietary intake, and LEAF-Q risk indicators, with high-risk athletes profiled individually. A colour-coded system allowed centre staff to identify priority cases at a glance and plan appropriate nutrition and recovery support. The reports were designed as practical monitoring tools, intended to translate assessment data into actionable, centre-specific guidance.

The response from centres affirmed the value of this approach. The Regional Sports Officer at Ayodhya shared:

*“Simply Sport Foundation’s team screened the children over several days, covering their diet and menstrual health concerns, and prepared a report for us. This will help us understand the gaps and work towards improving their health and training.”*



### ATHLETE HEALTH & NUTRITION REPORT

AGRA CENTRE



### ATHLETE HEALTH & NUTRITION REPORT

AYODHYA CENTRE



### ATHLETE HEALTH & NUTRITION REPORT

LUCKNOW CENTRE



# Social Media Reach & Engagement

**7**

**Social media  
posts**

**45k +**

**Instagram  
Views**

**3k +**

**LinkedIn  
Impression**



simplysportfoundation and caprisports

simplysportfoundation 4 w  
 We sat with female athletes and talked about the things that are rarely talked about.

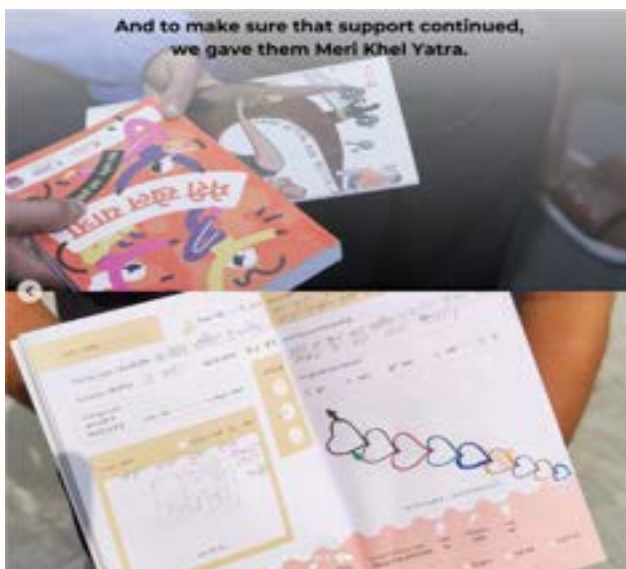
How food affects performance. How their cycle affects their body. How their emotions affect everything.

Not in a clinical way but in a way that made them feel seen, understood, and equipped.

Structured assessments helped them reflect on their own patterns. Real conversations replaced the silence around periods, nutrition, and mental health. And for many, it was the first time these topics had ever been addressed together, in the context of their sport and their lives.

Because female athletes deserve

24  
 1 March  
 Log in to like or comment.



simplysportfoundation - Follow  
 Original audio

simplysportfoundation 5 w  
 A strong athlete needs a strong support system. And more often than not, that support system begins with the coach.

In many centres across Uttar Pradesh, there isn't always a sports scientist or health expert available. So the coach becomes the first point of guidance for everything.

That's why we focused on making coaches & administrators more confident about female athletes health.

We spoke openly about menstrual health, nutrition gaps, low energy availability, mental health signs, and what to actually look for before performance starts dropping. Not theory. Real situations. Real solutions.

17  
 21 February  
 Log in to like or comment.



simplysportfoundation - Follow  
 NSQ - Strong & Motivated

simplysportfoundation 11 w  
 Before we step into the field, we step into alignment.

Ahead of assessing female athletes across four districts of Uttar Pradesh, we began with a team orientation in Lucknow. This session brought our three-member nutrition intervention team together to align on purpose, process, ethics, and responsibility.

The orientation marked the first step of the nutrition intervention phase under the Women's Health Initiative. It focused on project objectives, ethical considerations, assessment tools, and individual role; ensuring clarity, consistency, and preparedness before field assessments and data collection begin.

Romna Feldwork is built on thoughtful

58  
 8 January  
 Log in to like or comment.



simplysportfoundation - Follow  
 Original audio

simplysportfoundation 6 w  
 With the second phase of our program, we were back at our centres in Ayodhya, Lucknow, and Gorakhpur, this time with solutions.

With the support of @caprisports and @supwarriorz we brought together menstruation, nutrition, and mental health to help girls understand their bodies in a practical and holistic way.

After completing our baseline data collection, we moved into action and introduced Meri Khel Yatra, our Health Tracker Diary that supports girls in tracking their cycles, reflecting on nutrition, and building awareness around their mental wellbeing.

Because real empowerment is not just awareness. It is consistent support, simple tools, and safe spaces.

57  
 12 February  
 Log in to like or comment.

# Findings

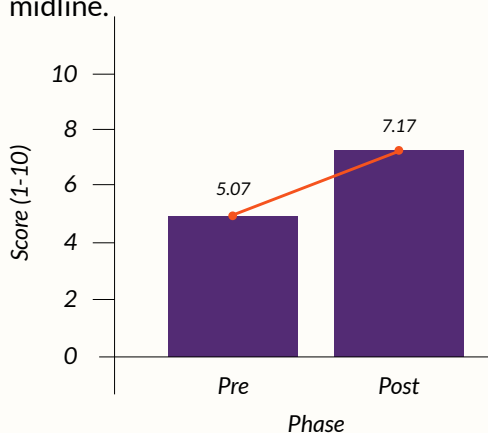
## Pre and Post Workshop Assessment: Findings

Structured workshops were delivered to 169 athletes and 8 coaches across Lucknow, Ayodhya, and Gorakhpur. Pre and post knowledge assessments were completed by 107 athletes and 6 coaches.

### Athlete Findings

Before the workshops, the average athlete knowledge score was 5.07 out of 10. Key gaps included limited recognition of abnormal menstrual symptoms (only 20% could correctly identify warning signs), poor nutrition practices around training, and low awareness of the risks of under-fuelling. Approximately 64% of athletes continued training as usual regardless of symptoms, and only 36% reported increasing food intake on hard training days.

Following the workshops, scores rose to 7.17, a gain of 2.1 points. The most significant improvements were in help-seeking behaviour, recognition of low fuelling risks, and identification of abnormal menstrual symptoms, which nearly tripled from baseline. Missed training due to menstrual symptoms dropped from 40% to 7% at midline.



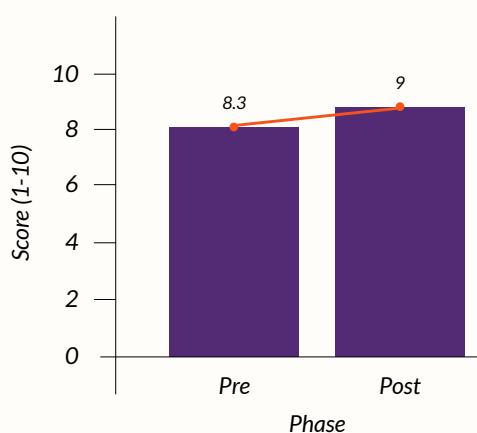
Pre vs Post Scores - Athletes

### Coach Findings

Coaches entered with a reasonable baseline score of 8.3, though understanding of menstrual health as a clinical concern and appropriate communication practices varied. Following the workshop, scores rose to 9.0, with all coaches correctly identifying missed periods and food restriction as health risks. One persistent gap remained around body and weight discussions in team settings, indicating that behavioural norms require reinforcement beyond a single session.

*After the workshop I understood that what I was feeling was not normal. I wish someone had told us this before.*

**Athlete**



Pre vs Post Scores - Coaches

## Overall

The intervention produced meaningful knowledge gains across both groups. Structural barriers around menstrual hygiene infrastructure remained unresolved and warrant attention alongside educational efforts

## Knowledge Environment and Structural Context

The quantitative findings gain fuller meaning when examined alongside the environment athletes and coaches described. The gaps identified are not products of individual motivation or discipline but reflect a setting where the infrastructure for adequate athlete nutrition is largely absent.

Athletes demonstrated general awareness of nutritious foods, commonly identifying eggs, paneer, dal, milk, fruits, and vegetables. However, this did not extend to sport-specific understanding of how much to eat, when to eat relative to training, or why energy and protein requirements differ for an athlete. Nutrition information was sourced primarily from coaches, senior athletes, family members, and online platforms including social media.

*We know eggs and paneer are good. But we don't know how much, or when. Nobody has told us.*

*Athlete*

Coaches acknowledged the importance of nutrition and reported observing signs of fatigue and underfuelling in their athletes. However, none had received formal training in sports nutrition or LEA, and responses to athlete fatigue, weight changes, and menstrual concerns were guided by personal experience rather than evidence-based frameworks.

*I can see when a girl is struggling. But I don't always know what to do about it. I need proper guidelines.*

*Athlete*



## Baseline assessments findings

The findings presented in this section draw on data collected across four components: LEAF-Q screening, two-day dietary recall, body composition analysis, aerobic capacity testing, and qualitative interviews and focus group discussions with athletes, coaches, and kitchen staff. Quantitative and qualitative data are presented together throughout, so that numbers and lived experiences inform each other rather than sit in separate silos.

All associations reported are descriptive. Given the cross-sectional design of this study, causal inferences cannot be drawn from the data. Where patterns are noted between variables, they are presented as associations that warrant further investigation.

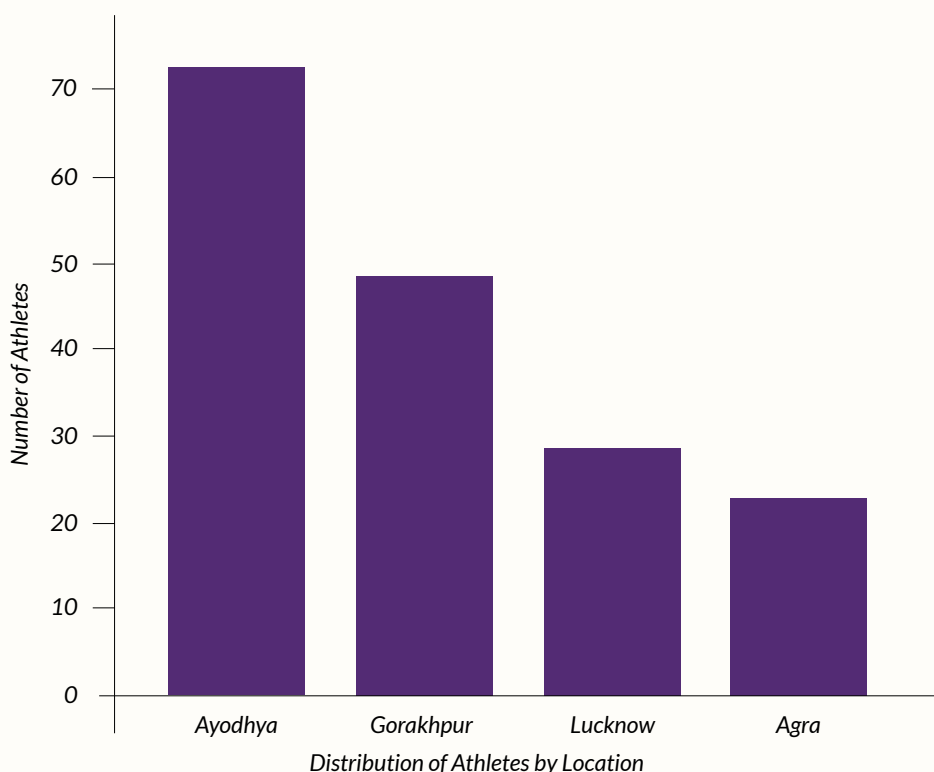
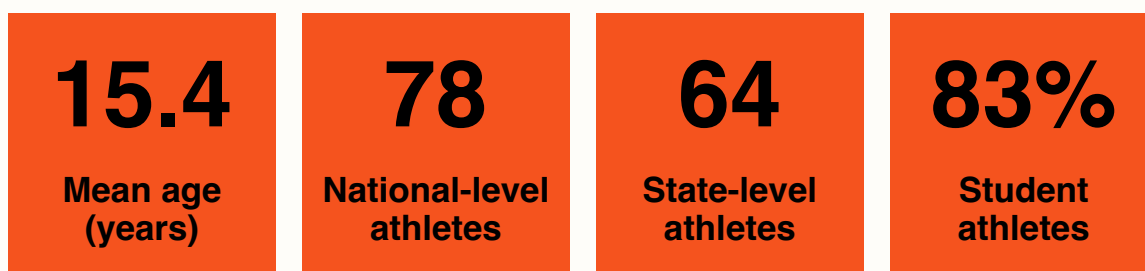


# Cohort Profile

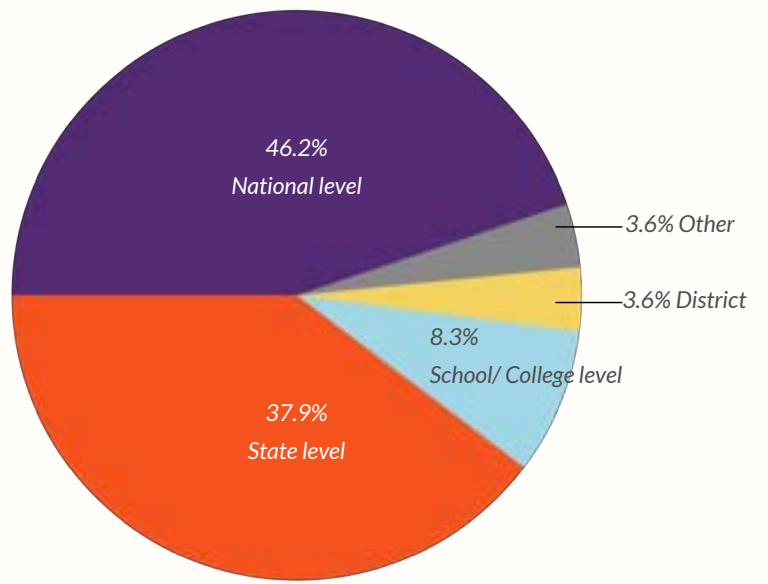
Understanding who these athletes are is essential context for interpreting the findings. The 169 athletes assessed across four centres represent a cohort that is young, competitive, and carrying a level of daily demand that is easy to underestimate.

The average age of the cohort is 15.4 years, with most athletes falling between 12 and 17. Despite their young age, 78 are competing at national level and 64 at state level. These are not recreational participants, they are adolescents engaged in high-intensity competitive sport while their bodies are still in active developmental phases requiring significant nutritional investment.

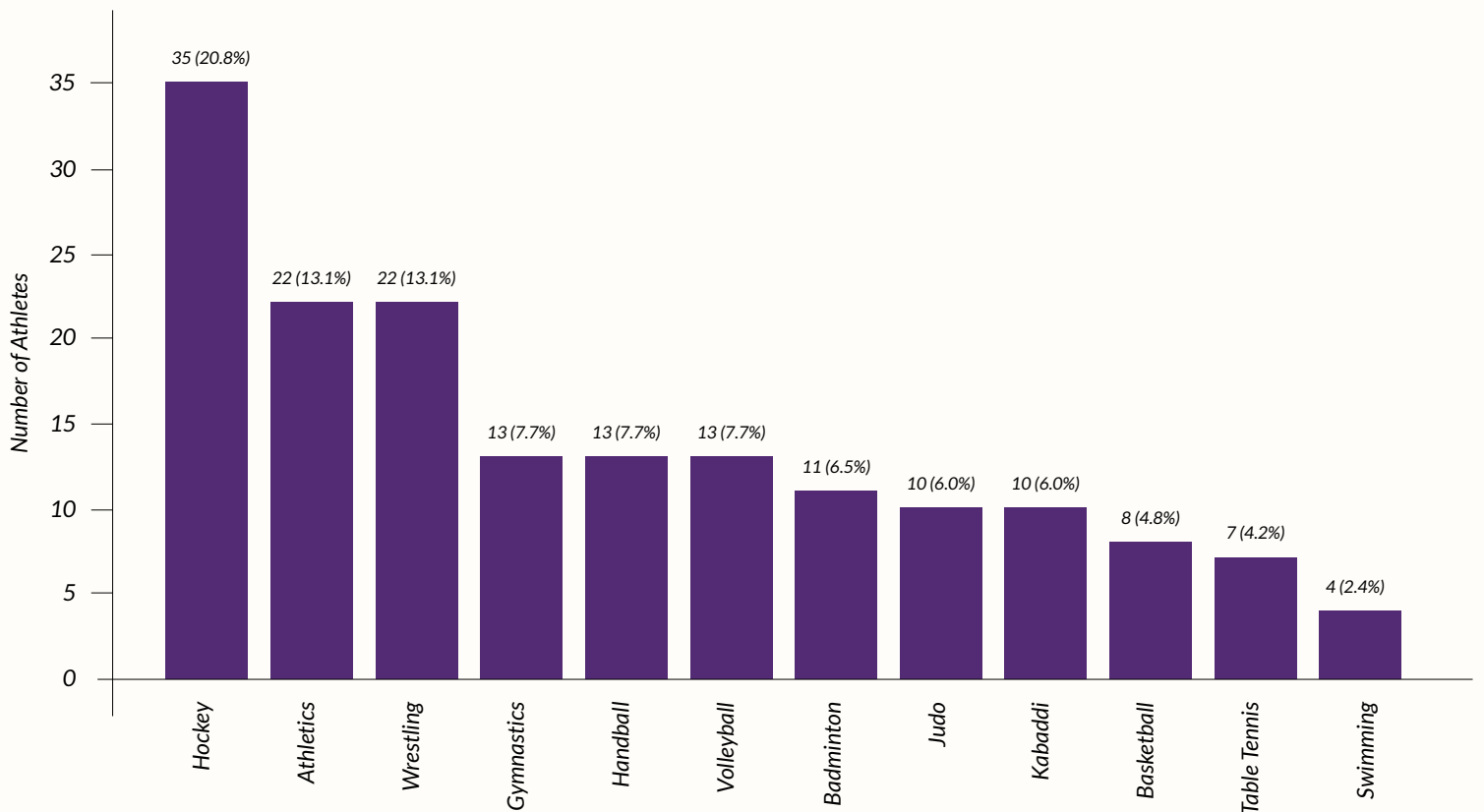
83% of athletes are students, 116 at school level and 23 at college level. Only 29 athletes (17% identify as full-time athletes. The average age at which athletes began serious competitive training was 13.2 years, meaning many in this cohort have less than two years of competitive training behind them. This dual load of academics and elite sport creates structural constraints on eating: limited meal timing flexibility, dependence on institutional food, and reduced capacity for dietary planning.



Hockey (35 athletes, 20.8% , Athletics (22, 13.1% , and Wrestling (22, 13.1% make up the three largest sport groups, collectively representing nearly half the cohort. Any health or nutritional patterns identified within these sports will significantly shape the overall picture.



Current Playing Level



Distribution of Athletes by Sport

# Body Composition and Anthropometry

Body composition findings reveal patterns that both complement and complicate the dietary and LEA risk data. The most important contribution of the body composition analysis is the demonstration that risk is not distributed according to body size, a finding with significant implications for how athlete health is monitored in practice.

## Fat-Free Mass Index

Over 72% of the cohort fell into the low FFMI category, indicating insufficient lean mass relative to height across the majority of athletes. FFMI is a meaningful indicator of physical resilience, athletes with low lean mass relative to their height have reduced capacity to absorb training loads, recover from impact, and protect the musculoskeletal system. The high prevalence of low FFMI across all four locations is consistent with the protein deficits observed in the dietary data.

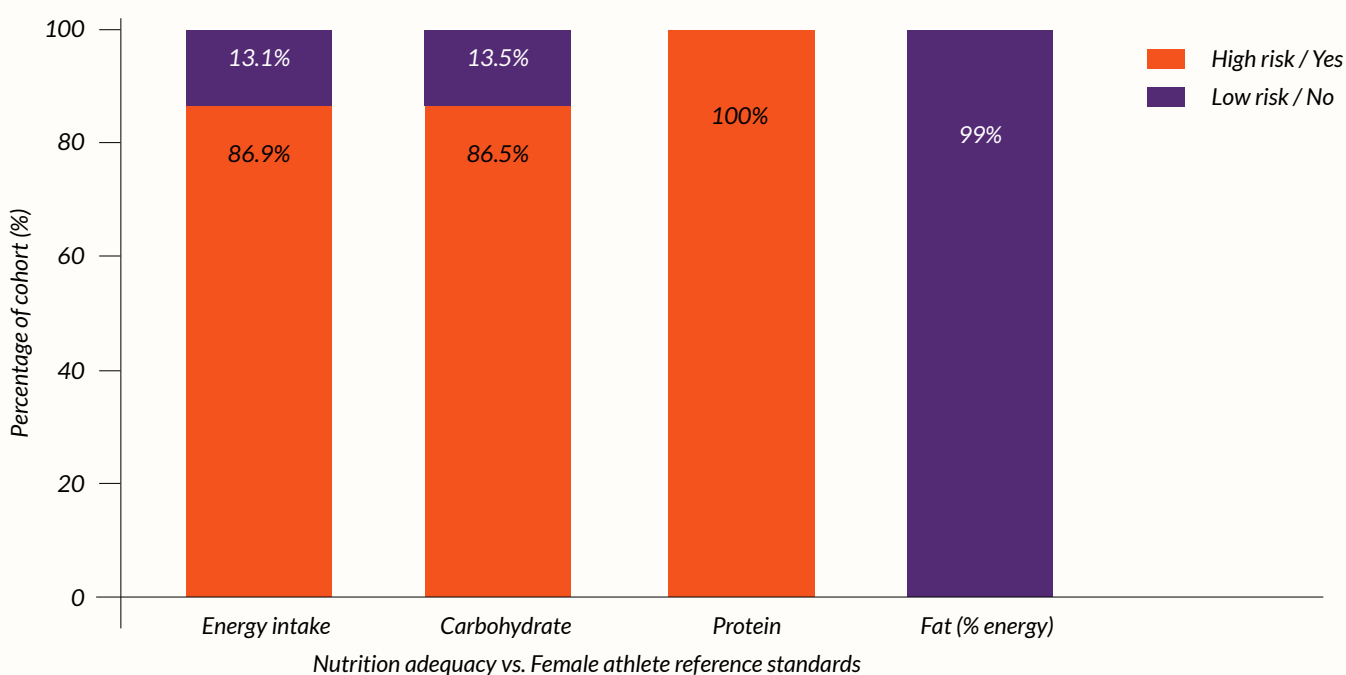
*They are training every day and working very hard, but their bodies are not getting stronger the way they should be at this age. Something is missing.*

**Coach**

# Dietary Intake and Nutritional Adequacy

Dietary assessment using two-day 24-hour recall revealed a pattern of nutritional inadequacy that is both widespread and severe. Deficits were not confined to one location or one sport, they were observed across the entire cohort, pointing to a systemic rather than individual issue.

<p><b>26.5</b></p> <p>Mean energy intake kcal/kg/day</p>	<p><b>87%</b></p> <p>Below energy standard</p>
<p><b>0.8 g/kg</b></p> <p>Mean protein intake</p>	<p><b>100%</b></p> <p>Below protein standard</p>



## Energy Intake

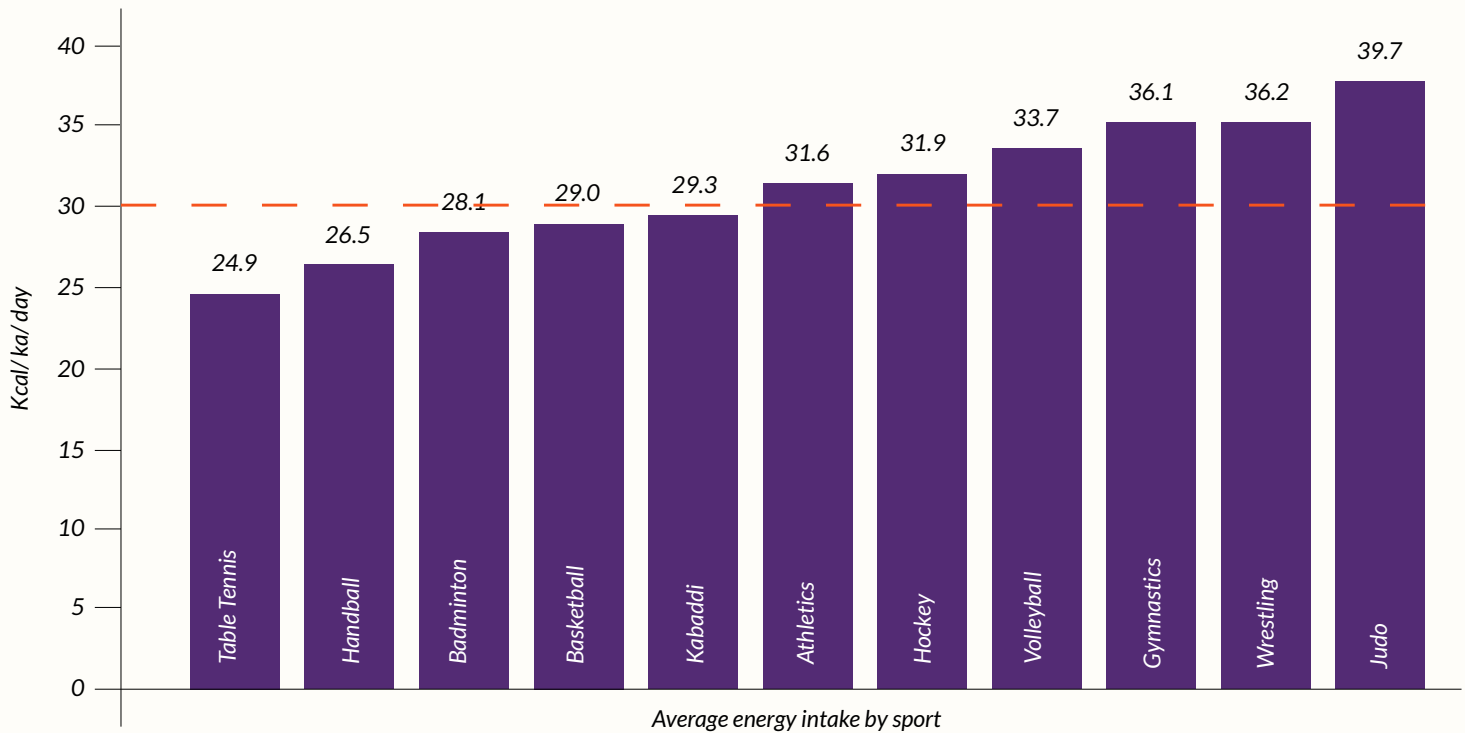
The mean energy intake across the cohort was 26.5 kcal/kg/day (SD  $\pm 9.8$ ), with 86.9% of athletes falling below the 35 kcal/kg threshold recommended for training athletes. More critically, the cohort mean sits below 30 kcal/kg, the threshold below which LEA-related physiological suppression is considered likely.

*We eat what is available.*

*Athlete, Ayodhya FGD*

*Menus depend mostly on what supplies arrive. We cook accordingly.*

*Kitchen Staff, Ayodhya*



## Protein Intake

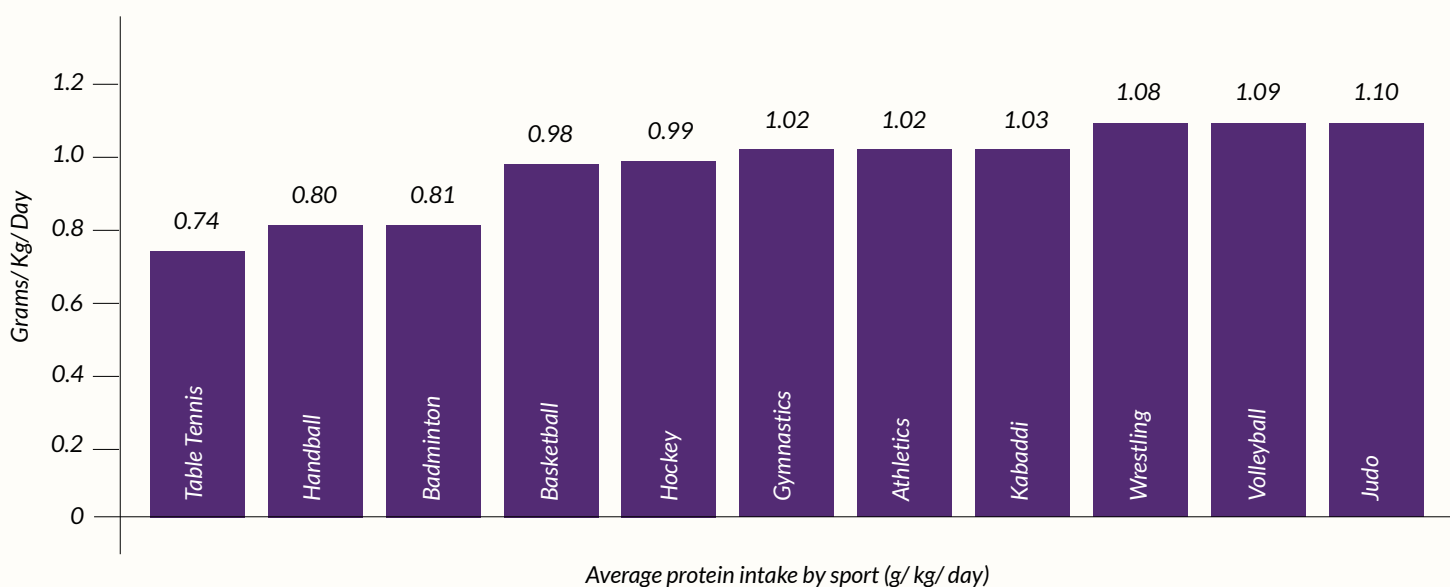
The most striking dietary finding is that not a single athlete in the cohort met the minimum protein threshold of 1.4 g/kg/day. The mean protein intake was 0.8 g/kg/day (SD  $\pm$ 0.3 , equivalent to sedentary adult recommendations, not those for adolescents in active competitive training. Protein is the primary substrate for muscle repair, bone collagen synthesis, and inter-session recovery. A cohort-wide deficit at this level is associated with impaired recovery capacity and elevated injury risk.

The deficit compounds with age. Among athletes under 13, mean protein intake was 1.08 g/kg. By the 13 to 15 age group it had fallen to 0.98 g/kg, and in the 16 to 19 group it dropped further to 0.89 g/kg. This inverse trend coincides with increasing training loads and body mass, creating a widening gap between nutritional supply and physiological demand at precisely the most critical developmental stage.

Across all 12 sports, not a single sport group reached the minimum threshold, with Table Tennis (0.74 g/kg , Handball (0.80 g/kg , and Badminton (0.81 g/kg recording the most severe deficits.

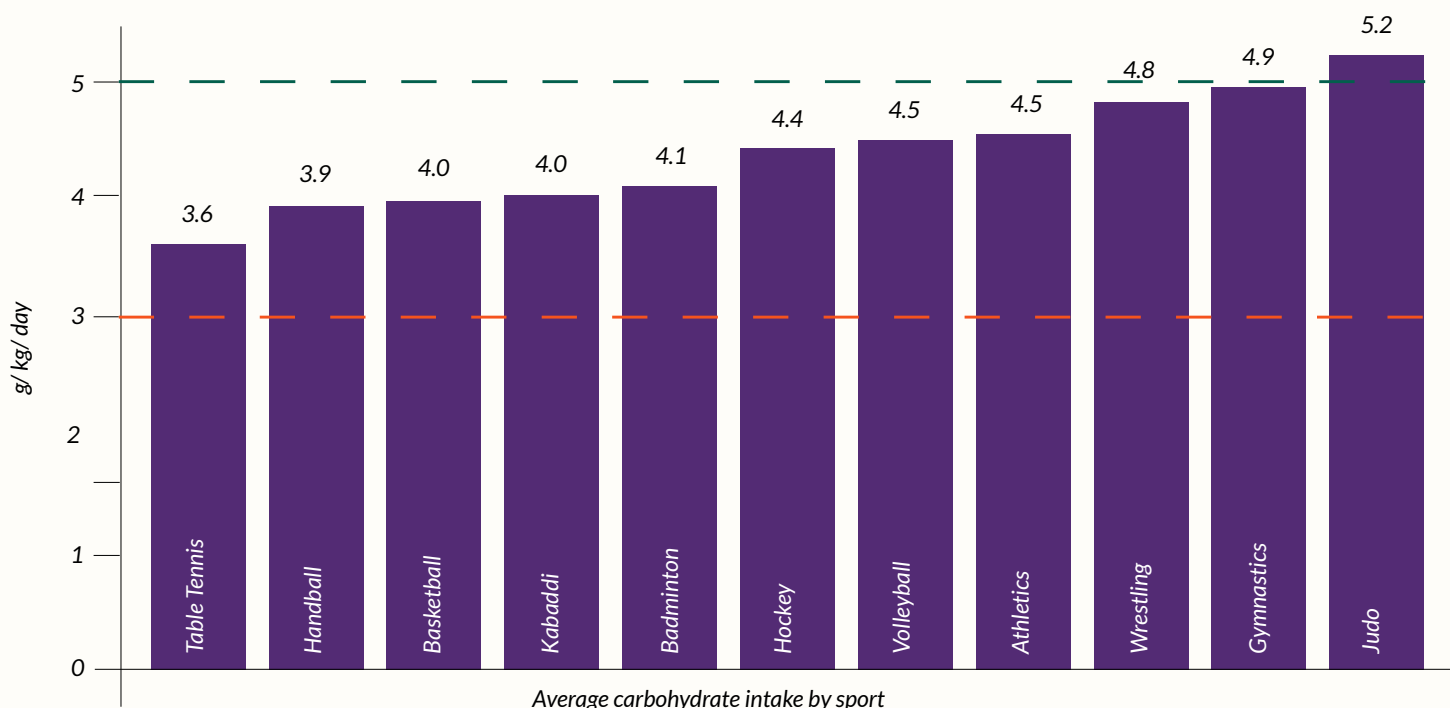
*We don't know how much protein we should eat*

*Athlete, Lucknow FGD*



## Carbohydrate Intake

Mean carbohydrate intake across the cohort was 3.6 g/kg/day (SD ±1.5 , with 86.5% of athletes below the 5 g/kg performance target. Most athletes across all locations were consuming enough carbohydrate to get through their day but not enough to support high-intensity training performance. This maintenance-zone fuelling may explain performance limitations that athletes and coaches attribute to training factors when the underlying cause may be nutritional.



## Fat Intake and the Dietary Pattern

An important counterpoint to the widespread energy and macronutrient deficits is that fat intake was largely adequate, only 1% of athletes fell below the 20% of total energy threshold. This suggests that the dietary pattern in this cohort is not one of overall food deprivation, but rather a structural imbalance in which staple-food-based diets provide sufficient fat while falling significantly short on protein and total carbohydrate volume. The typical diet described by athletes across centres, roti, rice, dal, sabzi, with occasional egg or paneer, is nutritionally coherent for a sedentary person but insufficient in protein density and total energy for an athlete in active competitive training.

*The food that is given is fine for normal people. But these girls are training four to five hours a day. They need more.*

*Coach, Lucknow*

## Structural Barriers to Adequate Intake

Qualitative findings from focus group discussions across all four locations helped explain why nutritional deficits persist despite athletes consuming regular meals.

Kitchen staff consistently reported that menus are pre-set and prepared by estimation, with no adjustment for training intensity or individual athlete requirements. None of the four locations had access to a sports nutritionist. Coaches acknowledged the importance of nutrition but had received no formal training in sports nutrition or energy availability concepts.

Athletes identified several day-to-day barriers: post-training fatigue reducing appetite, school schedules disrupting meal timing, and limited availability of protein-rich foods. In weight-category sports, deliberate food restriction before weigh-ins was reported by athletes in wrestling and kabaddi, a practice that adds acute energy restriction at precisely the moments when physiological demand is highest.

Taken together, these findings point to a system where the conditions needed to support adequate intake are largely absent, and where individual athletes are left to navigate nutritional demands without structural support.

## Food Systems

Kitchen staff across all locations confirmed that menus are pre-planned, prepared by estimation, and not adjusted for training load or individual athlete needs. Supply availability was identified as a key constraint on meal content at some locations, with athletes expressing a desire for greater access to protein-rich foods, fresh fruit, and recovery snacks that the institutional system does not routinely provide. Feedback on food quality was informal where it existed at all, and food waste was reported when meals were oily or unpalatable.

The picture that emerges is of a three-way disconnect: athletes experience nutritional inadequacy and its health consequences without understanding the underlying cause; coaches observe those consequences without the tools to address them; and food systems operate on institutional logic that does not account for the specific demands of competitive athletic training. The result is a gap that no individual within the system is positioned to close alone.

*We don't have a nutritionist. I tell them what I know from experience, but I'm not qualified to give specific advice. We need someone with proper training here.*

*Coach, Ayodhya*

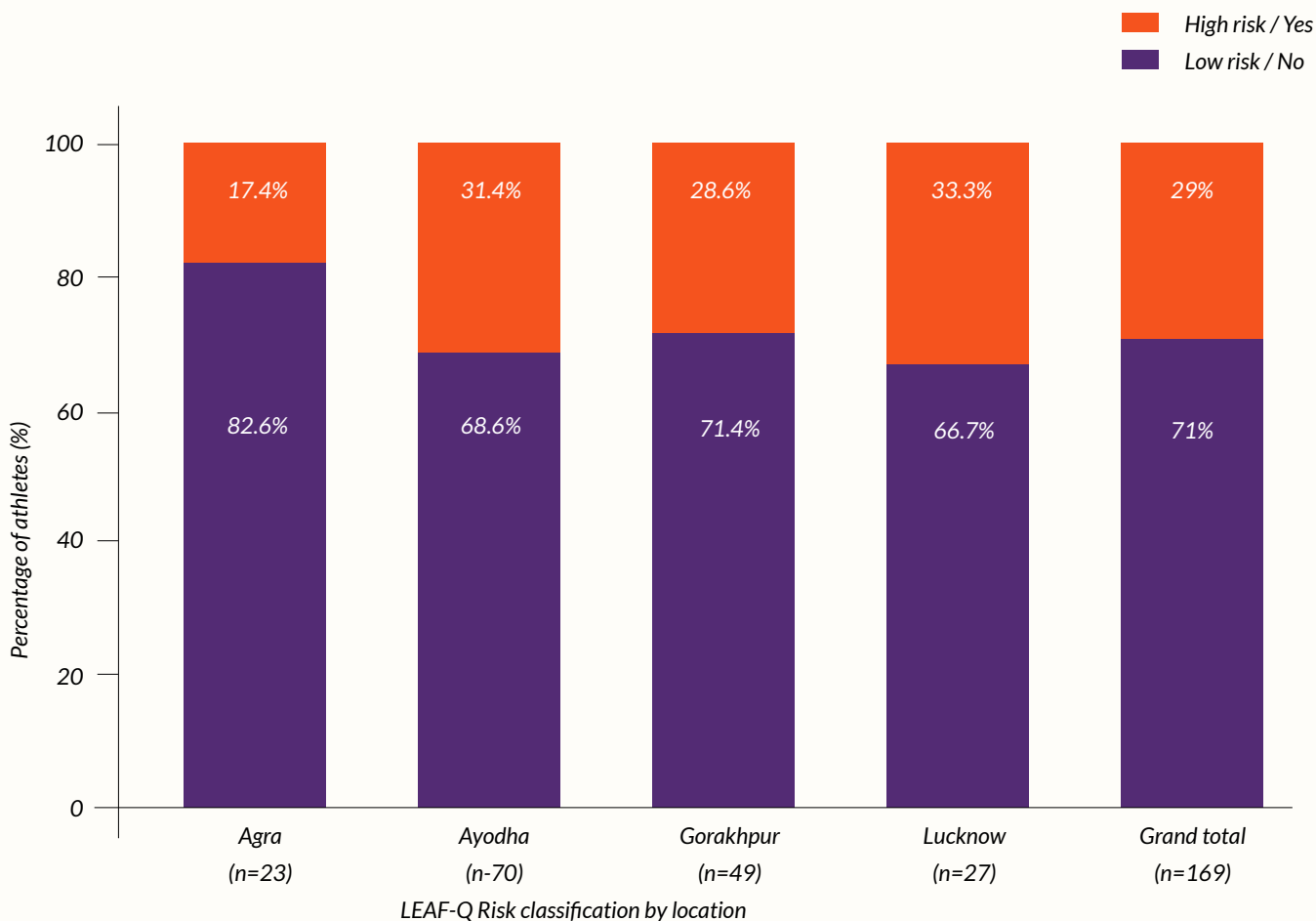
# LEA Risk: LEAF-Q Findings

The LEAF-Q screening tool assesses four physiological domains associated with LEA: Injury History, Gastrointestinal Function, Menstrual Function, and Hormonal and Contraceptive Use. A total score of 8 or above classifies an athlete as high risk. The results across this cohort indicate that LEA-related physiological patterns are widespread, and that their reach extends well beyond the 29% classified as clinically at risk.



## Overall Risk Prevalence

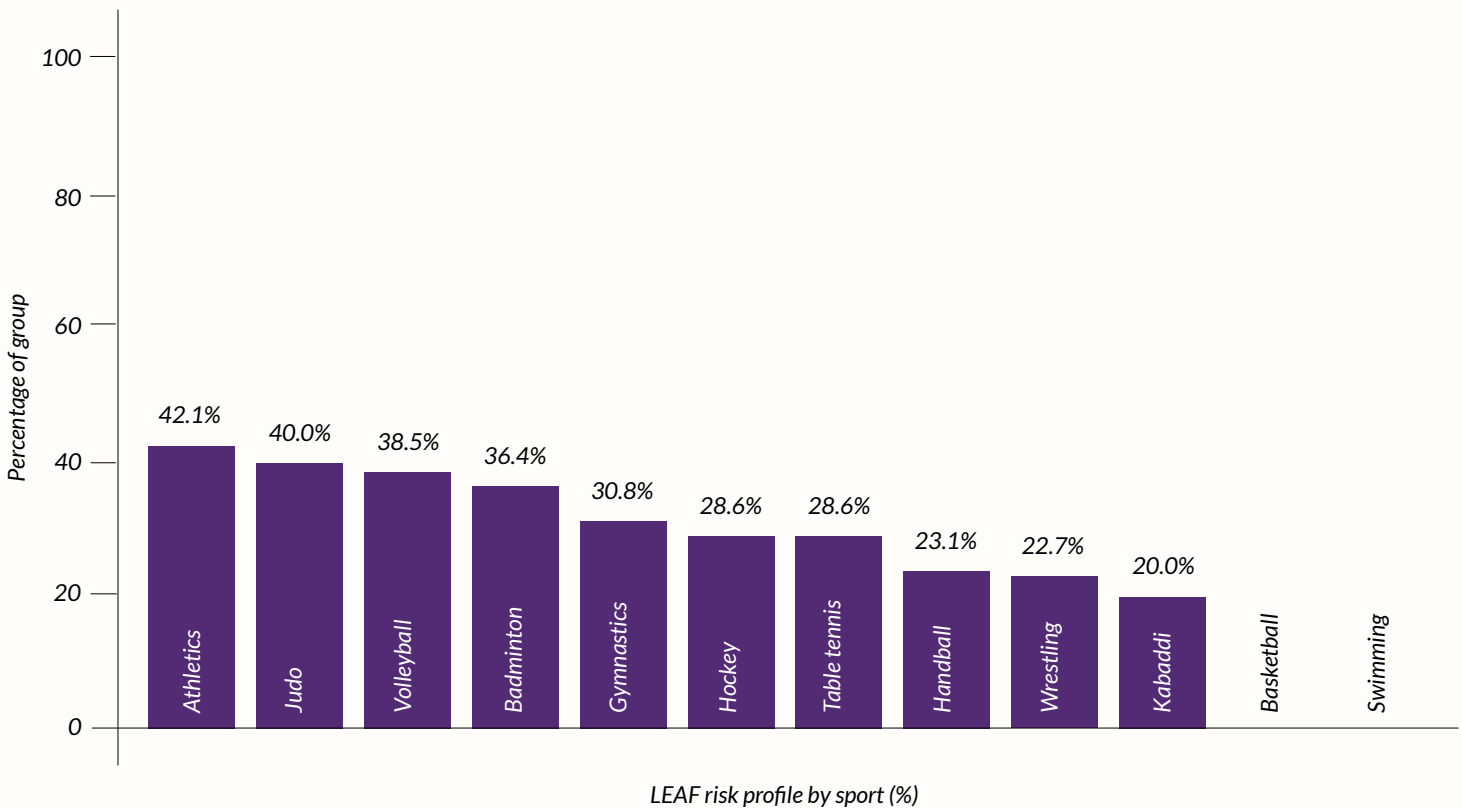
Of the 169 athletes screened, 49 (29%) were classified as high risk for LEA based on a validated LEAF-Q cut-off score of 8 or above. A notable pattern in the score distribution was the concentration of athletes in the 5 to 7 range, sitting just below the high-risk threshold. This borderline group, while not yet classified as high risk, represents athletes in a physiologically vulnerable position. Without proactive nutritional support, this subgroup is at risk of progressing into clinical risk categories.



## Sport-Specific Risk

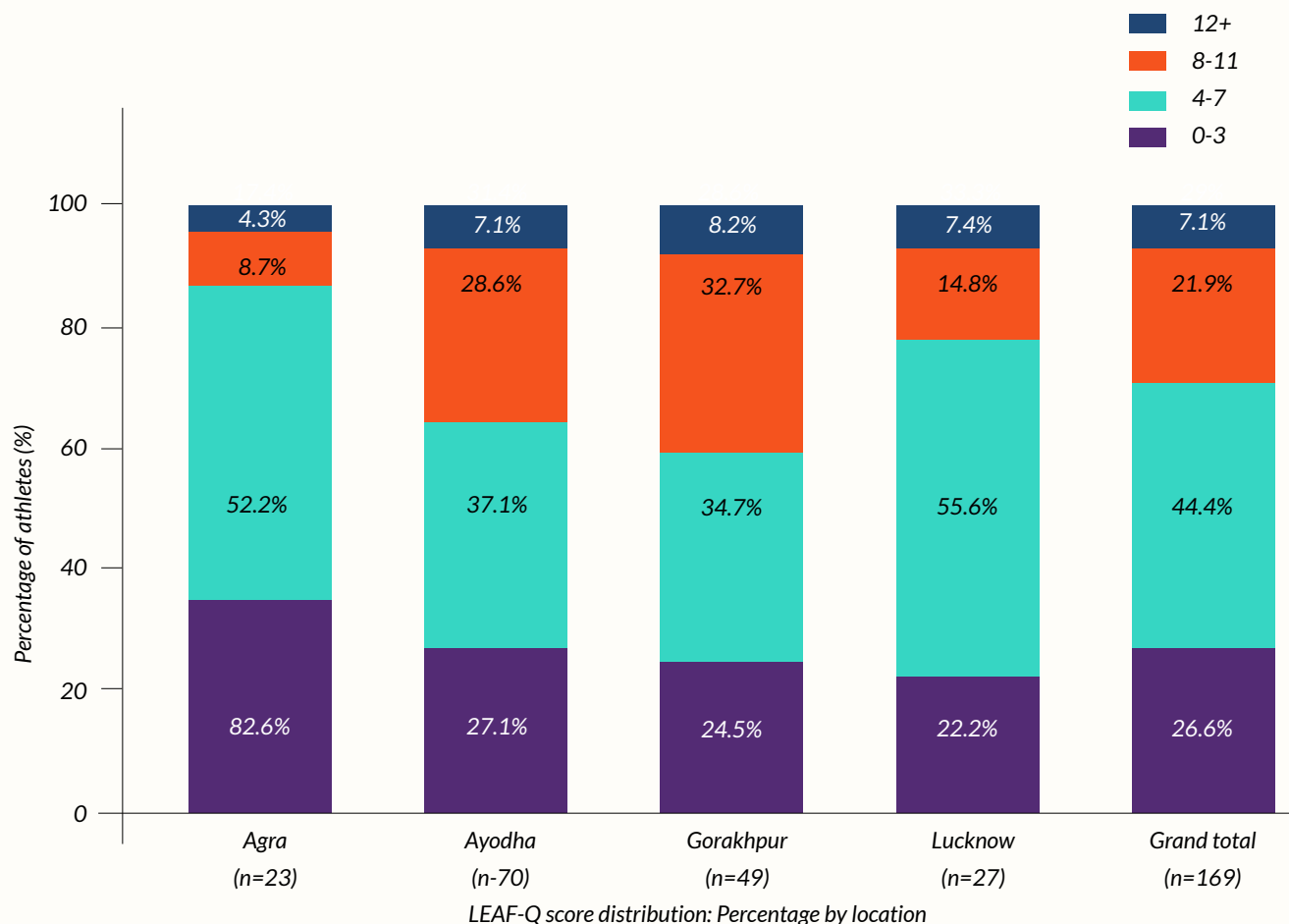
LEA risk varied substantially across sports. Athletics showed the highest LEAF-Q high-risk prevalence at 42.1%, followed by Judo (40.0%), Volleyball (38.5%), Badminton (36.4%), and Gymnastics (30.8%). Weight-category sports such as Judo showed risk patterns likely compounded by the practice of making weight, where acute restriction is layered on top of chronic inadequacy. Volleyball and Badminton, which require high power-to-weight ratios, may involve deliberate restraint driven by performance beliefs rather than clinical awareness of the consequences.

Hockey warrants particular attention. Despite a moderate overall LEAF-Q high-risk rate of 28.6%, hockey players showed the most alarming injury profile in the cohort, a stress fracture rate of 22.9% and an overuse injury rate of 45.7%. Both figures substantially exceed clinical benchmarks. The combination of high training volume, impact loading, and a mean protein intake of 0.99 g/kg creates conditions in which bone fails to repair at the rate it is being stressed. This is not a training problem in isolation; it is also a nutritional insufficiency with physical consequences.



## Location Profiles

Each centre presents a distinct risk profile that requires tailored rather than uniform intervention.



Lucknow has the highest overall LEA risk prevalence (33.3% ), the highest GI burden (40.7% ), and is the only centre with cases flagged across all four LEAF-Q domains. Athletes here are experiencing the most complex multi-system presentations in the cohort. Communication around menstrual health appears relatively more open here, supported by the female coach.

Ayodhya is the most systematically underfed centre. With 73 athletes, the largest group, and a mean energy intake of 26.8 kcal/kg, both high-risk and low-risk athletes here average below the clinical danger threshold. The dietary issue at Ayodhya appears environmental: kitchen supply constraints, fixed menus, and limited access to protein-rich foods affect all athletes regardless of individual habits. Ayodhya also has the highest absolute count of injured athletes (n=24).

Gorakhpur presents the paradox of the cohort. The best-fed centre by energy intake (39.2 kcal/kg) simultaneously records the highest menstrual dysfunction rate (38.8% ) and the highest injury risk rate (49% ), with nearly 80% of athletes carrying at least one health risk flag. This pattern is consistent with training demands that exceed even a relatively higher energy supply, suggesting that the nutritional needs of athletes here are not being met by current intake despite that intake being the highest across sites.

Agra shows the most protective risk profile overall, with the lowest LEA prevalence (17.4% ) and the most balanced body composition distribution. However, qualitative data from Agra raises concerns that extend beyond nutritional metrics, athletes described barriers to raising menstrual and health concerns, inadequate medical facilities, and dynamics within the training environment that require attention independent of the nutritional findings.

## Menstrual Health

Menstrual health is widely recognised in sports science as a sensitive indicator of physiological well-being and energy adequacy in female athletes. Findings from this cohort suggest that menstrual dysfunction is common, underreported, and inadequately supported across all locations.

Overall, 30.8% of athletes (n=52) met the clinical criteria for menstrual dysfunction, including irregular cycles and amenorrhoea, with prevalence varying across locations. Notably, the location with the highest mean energy intake also recorded the highest rate of menstrual dysfunction. This apparent paradox points to the complexity of LEA in athletic populations: where training load is high, even a relatively adequate energy intake may be insufficient to maintain normal reproductive function. It also underscores the risk of relying on dietary intake data alone as a proxy for energy availability.

## What Athletes Reported

Qualitative data indicates that the extent of menstrual disruption in this cohort is more severe than prevalence figures alone convey. Athletes described periods stopping for two to three months during intensive training, episodes of heavy bleeding with clotting and significant pain, and cycle delays ranging from 20 days to several months. In one case, a gap of eight months was reported.

Athletes also reported changes in flow volume and cycle timing during periods of higher training load. Many treated these changes as expected consequences of hard training rather than as health signals requiring attention.

*One athlete captured a widely held perception across the cohort:*

*When training gets very intense, my periods become irregular or stop altogether. I thought this was normal for athletes.*

## Communication and Support

Comfort levels in raising menstrual health concerns varied across locations and were largely shaped by the gender and approachability of the individual coach rather than any formal support structure. Where female coaches were present, athletes reported greater ease in disclosing health concerns.

No location currently has a formal protocol for monitoring menstrual health, documenting irregularities, or facilitating medical referral. Support remains reactive and informal, reflecting an absence of institutional guidance rather than indifference from coaches or staff.

*I handle it on my own. I haven't told my coach. I don't know how he would react.*

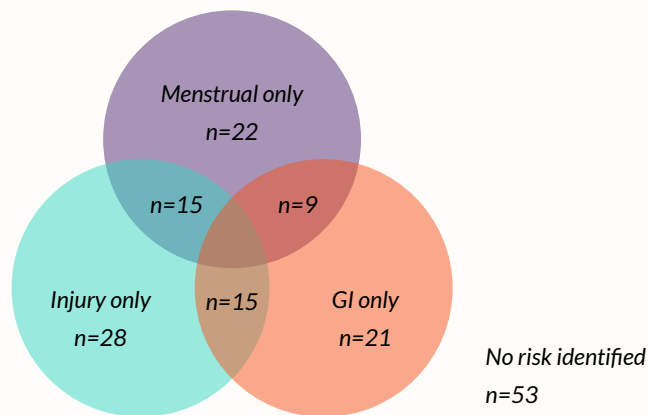
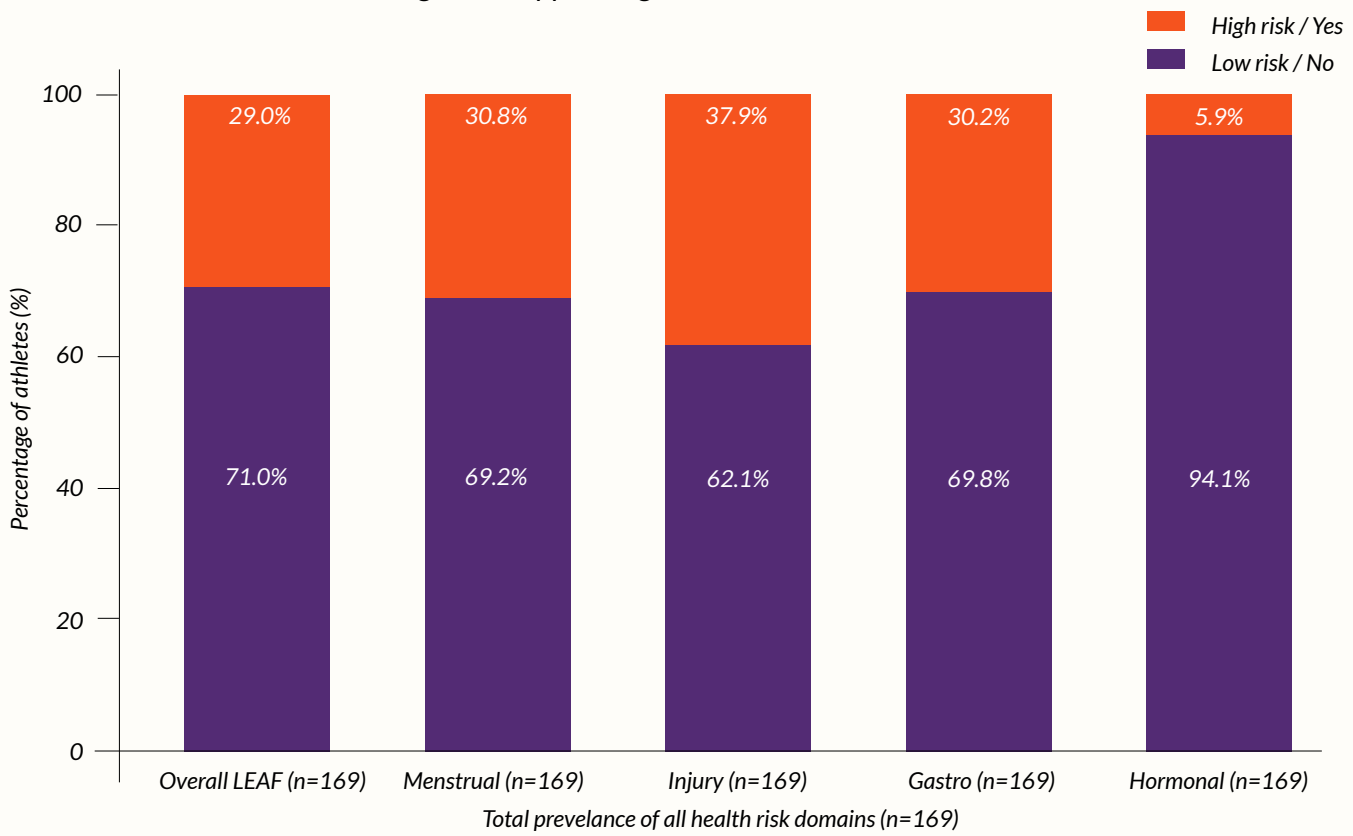
*Athlete, Agra FGD*

## Risk Co-occurrence and Physiological Overlap

Looking beyond individual domains, the systemic burden on athletes becomes clearer when risk co-occurrence is examined. While 31.4% of athletes showed no risk flags, 41.4% carried risk in a single domain, 21.9% across two domains simultaneously, and 4.7% were flagged across three or four domains.

The physiological overlap analysis reveals how symptoms cluster within individuals. Of the 116 athletes carrying at least one risk flag, 45 were in overlap zones carrying two or more simultaneous domain risks. Injury-only was the most common single-domain presentation (n=28), suggesting that musculoskeletal breakdown may often be the first visible signal of energy deficiency before hormonal or digestive changes become apparent. Six athletes presented with the full clinical triad across all three primary domains, representing the highest level of concern within this cohort.

These patterns indicate that for a meaningful proportion of athletes, health compromise is not isolated to a single system. Where risks co-occur, the physiological burden is cumulative and the need for integrated support is greatest.



The 'Health Triad' overlap: Risk co-occurrence (n=169 total athletes)

For more domain specific insights go through the appendix A

# Discussion

This programme provides one of the first integrated, multi-site assessments of energy availability, dietary intake, body composition, and menstrual health among adolescent female athletes in residential training settings in Uttar Pradesh, drawing on data from 169 athletes across four locations and 12 sports disciplines.

The findings of this programme sit within a well-established physiological framework. Low Energy Availability, the condition that arises when dietary intake does not cover both exercise energy expenditure and the body's baseline physiological needs, is the underlying mechanism connecting the dietary, hormonal, musculoskeletal, and performance deficits documented across this cohort. It does not require extreme restriction to manifest. At the levels of intake observed here, the menstrual disruption, flat lean mass trajectories, and elevated injury risk are not incidental findings. They are the expected physiological consequence of a cohort training at high loads on intake that does not meet their needs. The Female Athlete Triad and its broader evolution, RED-S, provide the clinical framework within which these findings should be interpreted, and within which any meaningful response must be designed.

## **A Structural Problem, Not an Individual One**

The universality of the nutritional deficit is its most important feature. When inadequacy appears across every sport, every location, and every age group, and when kitchen staff, coaches, and athletes all describe the same constraints, the primary driver is environmental rather than individual. Athletes are eating what is available. What is available is not sufficient for competitive athletic training.

This pattern is consistent with evidence from low-and-middle-income sport contexts globally, where institutional food systems are designed around general population adequacy rather than the specific physiological demands of competitive training. The cereal-dominant, fat-adequate, protein-deficient dietary pattern observed here is not unusual in the Indian residential sport context. What is significant is the gap it creates: athletes consuming diets that meet general nutritional standards while remaining chronically under-fuelled for the demands placed on them daily.

## **The Protein and Energy Gap**

Mean energy intake of 26.5 kcal/kg/day, with 87% of athletes falling below the 35 kcal/kg threshold, places this cohort well within the range associated with chronic LEA in the literature. More striking is the protein finding: a mean intake of 0.8 g/kg/day, comparable to sedentary adult recommendations, in a population training twice daily across contact, endurance, and skill-based sports. All athletes fell below the minimum 1.4 g/kg standard for athletic populations.

The age-related decline in protein intake, from 1.08 g/kg in athletes under 13 to 0.89 g/kg in the 16 to 19 age group, is particularly concerning. This is the inverse of what the evidence recommends. Protein requirements increase with training maturity and physical development, yet the data shows intake moving in the opposite direction as athletes age and training demands intensify. This is not a pattern of individual dietary choices. It reflects a food environment that does not scale with athletic development.

At a mechanistic level, chronic protein insufficiency in adolescent athletes impairs muscle protein synthesis, delays recovery from training-induced muscle damage, and compromises the anabolic adaptation that high-load training is intended to produce. Combined with inadequate total energy, the conditions for lean mass development are simply not present for most athletes in this cohort.

## Menstrual Dysfunction as an Indicator and the Role of Environment

The 30.8% prevalence of menstrual dysfunction is consistent with rates reported in international studies of female athlete populations, though direct comparison is complicated by differences in screening tools and disclosure environments. The finding that the location with the highest mean energy intake also recorded the highest menstrual dysfunction rate is consistent with evidence that training load relative to energy intake, rather than absolute intake, determines reproductive function. This underscores the limitation of using dietary intake data alone as a proxy for energy availability.

Equally significant is what the qualitative data reveals about disclosure. Athletes across locations described normalising menstrual disruption as an expected feature of hard training, consistent with international literature documenting widespread underreporting among athletes who lack sport-specific health education. Locations where female coaches created open communication environments showed more disclosure, not necessarily more dysfunction. Prevalence figures in this assessment likely underestimate actual rates, and the coaching environment is itself a health variable that warrants attention alongside nutrition and screening.

The qualitative accounts go beyond what screening tools capture. Athletes described amenorrhoea lasting two to eight months, episodes of heavy bleeding with clotting and significant pain, and cycle delays extending across training camps. Many had not sought help because they did not know what was abnormal, or had come to see disruption as the price of serious training. These are clinical presentations that went unrecognised in the absence of any monitoring system.



## The Developmental Stakes

Adolescence is the most critical window for musculoskeletal development, hormonal maturation, and the establishment of bone density that will underpin an athlete's physical capacity across their career. The combination of chronic energy deficit, inadequate protein, and declining intake with age suggests that the expected anabolic and developmental adaptations to training are not occurring in this cohort. The consequences are not confined to current performance. They extend to injury vulnerability, reproductive health, and the long-term athletic potential of every athlete assessed.

## What Education Changes and What It Cannot

The workshop intervention produced meaningful and measurable knowledge gains. Recognition of abnormal menstrual symptoms nearly tripled. Help-seeking behaviour when symptoms affect training increased substantially. These outcomes demonstrate that structured, contextually relevant education can shift awareness and attitudes within a short timeframe, and that athletes and coaches in this setting are responsive when given the opportunity to engage.

However, knowledge and behaviour change are not the same thing. An athlete who understands she needs more protein cannot increase her intake if the food environment does not provide it. A coach who recognises a warning sign cannot act on it without a referral pathway. The persistence of risk indicators despite knowledge gains is not a failure of the intervention. It is evidence that awareness is a necessary but insufficient condition for change. The educational gains from this programme are best understood as creating readiness, a foundation on which structural investment can build. Without that investment, the knowledge will outlast the behaviour change it was intended to produce.



# Learnings & Limitations

Several methodological considerations should be kept in mind when interpreting the findings of this study.

The cross-sectional design means that associations between dietary intake, body composition, and LEAF-Q risk indicators cannot be interpreted causally. Dietary intake was assessed using a two-day 24-hour recall, which may not fully represent habitual intake, and some degree of under- or over-reporting is inherent to self-reported dietary methods. Body composition data was collected for the first time for most athletes, making longitudinal comparison impossible at this stage.

As a self-reported screening tool, the LEAF-Q is subject to recall bias and social desirability effects. Given the disclosure barriers documented in the qualitative data, prevalence figures for menstrual dysfunction and related risk indicators may underestimate actual rates within the cohort.

Access to athletes was not uniform across all locations. At some centres, major tournaments coincided with the data collection period, meaning a proportion of athletes were unavailable for assessment at certain points. This introduced some inconsistency in sample completeness and is reflected in missing data for select individuals.

Qualitative data was not collected at one location due to logistical constraints, limiting the contextual interpretation of its quantitative findings. Finally, the findings reflect a specific population in residential training settings across four districts of Uttar Pradesh. Generalisation to other states or non-residential settings should be approached with caution, though the consistency of patterns across locations, sports, and age groups suggests they are unlikely to be site-specific artefacts.

A key learning from this study is that integrated data collection at scale, spanning dietary assessment, body composition, screening tools, and qualitative inquiry, requires longer timelines and more flexible access arrangements than a single fixed data collection window allows. Future iterations would benefit from phased access planning that accounts for competition calendars and athlete availability in advance.



# Recommendations

This section presents recommendations arising from the programme findings across two areas: strengthening athlete health systems within residential training centres, and leveraging India's existing national nutrition and adolescent health programmes to support athlete populations at scale.

## 1. Reframing the Problem: From Individual Behaviour to System Design

The findings of this assessment establish that the challenges observed are not primarily attributable to individual athlete behaviour. They are a product of the environments in which athletes train and live. A significant proportion of athletes were found to be operating below recommended energy and protein intake levels, alongside indicators of menstrual disruption, fatigue, and injury risk. Structured workshops demonstrated that knowledge improves when information is made accessible. However, improvements in awareness did not consistently translate into sustained behavioural change.

This is a predictable outcome. Athletes in residential training systems have limited control over food availability, meal composition, timing, and access to health services. The recommendations that follow therefore focus on strengthening system design rather than increasing education alone.

- **Recommendations for UP State Sport Department**

### Programme Overview and Integration Pathways

The table below provides a reference overview of the national programmes most relevant to athlete nutrition and health, including their current operational status, core function, the gap as it pertains to athletes, and the recommended integration pathway.

Programme	Core Function	Gap for Athletes	Integration Pathway
Mission POSHAN 2.0(Prime Minister's Overarching Scheme for Holistic Nourishment)	Addresses malnutrition through behaviour change communication, digital monitoring via POSHAN Tracker, and multi-ministry coordination across ASHA, AWW, and ANM networks.	Athletes in residential centres are outside Anganwadi and school-based delivery channels and do not benefit from district convergence platforms.	Align hostel procurement with PM POSHAN supply chains; incorporate fortified rice, oil, and flour as standard hostel procurement items.
Anaemia Mukta Bharat (AMB) (Anaemia-Free India Strategy)	6x6x6 strategy for anemia reduction. Adolescents 10-19 receive weekly IFA Blue tablets through schools. Haemoglobin screening tracked on national dashboard.	Athletes in residential centres may not be enrolled in school-based IFA delivery and might not receive routine haemoglobin screening.	Designate sports centres as AMB delivery points; schedule quarterly haemoglobin screening aligned with AMB protocols.

Programme	Core Function	Gap for Athletes	Integration Pathway
ICDS(Integrated Child Development Services Scheme)	Supplementary nutrition and growth monitoring for children under six and adolescent girls through Anganwadi centres. One of India's longest-running nutrition delivery systems, operational since 1975.	ICDS does not target older adolescents in sports systems. No equivalent growth or nutrition monitoring structure exists within training centres.	Adapt ICDS monitoring indicators for athlete tracking; leverage Anganwadi workers for outreach to younger athlete cohorts.
RKSK(Rashtriya Kishor Swasthya Karyakram / National Adolescent Health Programme)	Launched 2014; covers 253 million adolescents across six domains: nutrition, sexual and reproductive health, mental health, NCDs, injuries, and substance misuse. Services delivered through AFHCs at PHC, CHC, and district hospital levels.	Athletes do not routinely access AFHCs. No formal referral linkages exist between sports centres and the RKSK network.	Map each training centre to its nearest RKSK AFHC; establish formal referral protocols; schedule periodic RKSK counsellor visits to sports centres.
MHS(Menstrual Hygiene Scheme)	Provides subsidised sanitary napkins, menstrual hygiene education, and safe disposal messaging through ASHAs and Anganwadi centres for adolescent girls aged 10 to 19 in rural areas.	Residential sports centre athletes are not consistently within MHS supply catchment despite meeting eligibility criteria.	Formally include residential sports centres in MHS supply chain; align menstrual hygiene education with RKSK behaviour change activities.
National Food Fortification Programme(under FSSAI)	Mandatory fortification of staple foods: rice, wheat flour, edible oil, and milk with iron, folic acid, Vitamin B12, and Vitamins A and D. Distribution through TPDS and institutional channels.	Athlete diets may not consistently include fortified foods if hostel procurement does not align with FSSAI-compliant supply chains.	Ensure hostel kitchen procurement specifies FSSAI-fortified rice, oil, and flour. Verify compliance with procurement officers.

## National Sports Policy and Sports Science Integration

India's sports policy framework increasingly emphasises the role of scientific support systems in athlete development. National-level initiatives, including the National Sports Policy direction, Khelo India, and Sports Authority of India systems, recognise that athlete performance is supported not only by training, but also by nutrition, recovery, health monitoring, and multidisciplinary support.

Within this framework, nutrition is positioned as a core component of athlete preparation. Policy direction supports the inclusion of sports science personnel such as nutritionists, physiotherapists, and medical staff as part of structured athlete development systems.

While these provisions exist at the national level, state residential training centres operate with varying levels of access to such services. This creates an opportunity to align state-level systems more closely with national policy direction, particularly in areas of nutrition, monitoring, and integrated athlete support.

State-run residential centres form a critical part of the athlete development pipeline and therefore represent a key site for operationalising national priorities related to athlete health, nutrition, and performance.

### Alignment with National Sports Policy and Implementation Systems

Component	What Policy/Framework States	Current Reality in Training Centres	Relevance to This Report	Recommended Alignment
Sports Science Integration	National policy direction emphasises integration of sports science into athlete development systems	Implementation varies across centres; structured support is not uniformly available	Athletes train without consistent physiological monitoring or support	Embed basic sports science functions within all residential centres
Multidisciplinary Support Systems	Policy promotes coordinated functioning of coaching, medical, and sports science teams	Functions often operate independently with limited coordination	Health, nutrition, and training decisions are not always aligned	Strengthen coordination between coaching, medical, and nutrition systems
Athlete Health Monitoring	Athlete welfare and health monitoring are recognised as priorities within policy direction	Monitoring systems are not consistently implemented at centre level	Early warning signs are not systematically captured	Introduce structured monitoring systems aligned with sports science principles

- For Sports Centers

### 1. Strengthening Fuelling and Nutrition Systems

The most immediate area for intervention lies in improving the adequacy and structure of food provision within residential training centres. Existing food systems ensure consistency and access, forming a strong operational foundation. They are not, however, currently calibrated to the energy demands of adolescent athletes in regular high-intensity training. The gap between what is served and what is required does not demand new infrastructure. It requires a performance-oriented approach applied to an existing system.

Area	Key Recommendations	Implementation Mechanism
Menu Planning	Align meal composition with training intensity and sport type Increase total energy availability through targeted portion adjustments Ensure protein adequacy through consistent inclusion of pulses, dairy, and eggs	Nutritionist-led menu review; sport science input on energy targets
Meal Timing	Introduce structured pre-training and post-training eating windows Strengthen breakfast as the primary energy and protein source Ensure recovery nutrition is available within 30 to 60 minutes post-training	Kitchen scheduling aligned to training timetables
Budget Optimisation	Reallocate portions across meals rather than increasing total food cost Improve dietary diversity using locally available and seasonal foods Strengthen nutrient density within existing procurement structures	PM POSHAN supply chain linkages; state procurement guidelines

## 2. Integrating Menstrual Health as a Core Performance Indicator

The presence of menstrual irregularities among athletes reflects underlying physiological stress and energy imbalance. In the context of sport, menstrual health is not a welfare concern separate from performance. It is a direct indicator of energy availability and training load tolerance. Irregular or absent cycles in a training athlete should be treated as a clinical signal requiring investigation.

The programme findings indicate that athletes frequently normalise or conceal menstrual disruption. This is the expected outcome in environments where the clinical relevance of menstrual health has not been communicated to athletes, coaches, or support staff.

Action Area	Recommended Measure
Athlete Monitoring	Integrate a monthly menstrual regularity record into athlete health tracking tools. Record cycle length, regularity, and significant changes over time.
Coach Capacity	Provide structured orientation to coaches on the clinical relevance of menstrual irregularity. Disrupted cycles should prompt consultation with the centre medical officer.
Response Protocol	Define a clear trigger-response protocol: irregularity persisting beyond two cycles triggers review of training load and dietary intake; beyond three cycles triggers referral to a health professional.
System Integration	Align athlete menstrual health tracking with RKSK (Rashtriya Kishor Swasthya Karyakram) counselling frameworks and Adolescent-Friendly Health Clinic referral pathways.

## 3. Establishing Continuous Monitoring and Feedback Systems

A significant limitation of the current system is the absence of structured ongoing monitoring. Baseline assessments and workshops generate data and improve knowledge, but their impact on long-term outcomes is limited without a continuous feedback loop. Athlete health data must be collected systematically, reviewed regularly, and linked to decisions about training and nutrition.

Monitoring Component	Specification
Haemoglobin Screening	Bi-annual screening for all athletes. Referral protocol for values below 11 g/dL. Aligned with Anaemia Mukt Bharat haemoglobin testing protocols.
Menstrual Tracking	Monthly record integrated into athlete health diary. Reviewed at quarterly health assessments.

Monitoring Component	Specification
Dietary Diversity Assessment	Simplified food frequency assessment at quarterly intervals. Used to identify persistent dietary gaps.
Energy and Fatigue Rating	Weekly self-rated score reviewed at fortnightly check-in. Flags athletes requiring early intervention.
Body Composition	Monthly weight and BMI recorded by centre medical staff.
Injury and Recovery Log	Systematic recording of injury episodes, recovery timelines, and recurrence patterns.

These indicators are consistent with monitoring frameworks used in ICDS, Anaemia Mukh Bharat, and RKSK, and can be structured to interface with existing state health reporting systems.

#### 4. Strengthening Institutional Accountability

Sustainable improvement in athlete health outcomes requires clearly defined roles and responsibilities within the training environment. In the absence of assigned accountability, health monitoring becomes discretionary and data collection yields no action.

Area	Key Recommendations	Implementation Mechanism
Defined Responsibility	Assign a named individual at each centre with responsibility for athlete health monitoring Designate the centre medical officer as the primary health authority, distinct from the coaching function Include health indicator review as a standing item at monthly management meetings	Centre administration; sports federation protocols
Integration into Performance Systems	Include health indicators alongside performance metrics in athlete progress reviews Ensure coaches receive regular structured briefings on aggregate athlete health data	Revised athlete management frameworks; coach orientation
Monitoring-to-Action Linkage	Ensure identified risks consistently lead to timely, documented intervention Establish an escalation pathway for concerns not addressed within a defined period Record all interventions in the athlete health file	Standard operating procedures; centre oversight structures

## 5. Moving from One-Time Interventions to Embedded Systems

The programme findings confirm that workshops and assessments generate measurable short-term improvements in knowledge and self-reported behaviour. They do not, in isolation, produce sustained change. This is consistent with evidence from behaviour change research in health and nutrition: single-point interventions produce immediate effects that attenuate rapidly without reinforcing structures.

The transition required is from programme delivery to system design. This means embedding nutrition and health practices within the daily routines, physical environments, and management structures of training centres so that they operate independently of any external intervention cycle. This requires sustained partnership commitments, centre-level capacity, and integration into existing government systems.

### Policy-Driven Supplementation

Micronutrient deficiency, particularly iron deficiency anaemia, is a documented and addressable risk for adolescent female athletes in India. National supplementation programmes provide an existing delivery mechanism that can be extended to this population without requiring new infrastructure.

The supplementation approaches recommended in this programme are limited to those that are directly supported by existing national policy frameworks. This approach ensures that interventions are sustainable, equitable, free of cost to athletes, and consistent with government health priorities.

All supplementation must be administered under medical supervision and documented in the athlete health record. Any supplement introduced outside government supply channels must be verified against the current WADA (World Anti-Doping Agency) Prohibited List prior to use, as athletes are strictly liable for all substances in their system under the WADA Code.

Supplement / Source	Recommended Approach
IFA Tablets (Iron + Folic Acid) via AMB government supply	Source through the government AMB supply chain. Extend IFA Blue tablet delivery to residential sports centres. Conduct bi-annual haemoglobin screening to monitor response. Maintain supplementation records in athlete health files.
Vitamin D3 (pharmaceutical grade)	Screen Vitamin D levels periodically where feasible. Provide supplementation through medical supervision when clinically indicated. Use pharmaceutical-grade preparations only.
Fortified Staples (Rice, oil, flour via PM POSHAN / FSSAI supply)	Ensure procurement of FSSAI-fortified staples through existing government supply systems. Incorporate fortified rice, oil, and flour into daily meal preparation at residential training centres.
Calcium (pharmaceutical grade)	Prioritise dietary sources including dairy, ragi, sesame, and amaranth. Supplement only where clinically required, under medical supervision, using standard pharmaceutical preparations.

## Policy Convergence for Athlete Nutrition and Health Systems

India's approach to nutrition and adolescent health has evolved through multiple large-scale programmes addressing undernutrition, micronutrient deficiencies, and health access across the life cycle. These programmes are operationally active, nationally mandated, and delivered through established channels including schools, Anganwadi centres, public health facilities, and community health workers.

Adolescent athletes fall within the target population of several of these programmes. However, their placement within residential training environments frequently removes them from routine delivery channels, creating a structural exclusion not of policy intent but of operational design. The opportunity lies in formally integrating athlete populations into existing delivery mechanisms rather than constructing parallel systems.

Adolescent athletes do not require new policy frameworks. They require existing frameworks to formally recognise and accommodate the physiological demands of regular high-intensity training.

The path forward lies in connecting and strengthening existing systems so that athletes are consistently supported across nutrition, health, and training environments.



# Conclusion

This programme set out to understand whether adolescent female athletes in Uttar Pradesh are receiving the nutritional support their bodies need to train, grow, and remain healthy. The answer, drawn from 169 athletes across four locations and 12 sports disciplines, is clear: they are not.

The deficit is not marginal. Every athlete in this cohort falls below the minimum protein standard. 87% fall below recommended energy intake. 29% meet the clinical threshold for LEA risk, and more than two-thirds carry at least one physiological warning sign. Menstrual function is disrupted in nearly one in three athletes. These findings, taken together, describe a cohort that is training hard and developing inadequately.

What makes this assessment distinctive is the integration of quantitative and qualitative evidence across multiple locations and disciplines. The numbers describe the pattern. The stories explain why it persists. Together they point to the same conclusion: this is a structural problem embedded in how residential training environments are resourced, planned, and managed, and it requires structural solutions.

The educational intervention delivered through this programme demonstrates that awareness can change rapidly with the right input. Athletes who previously could not identify a single abnormal menstrual symptom could name several after one workshop. Coaches who had not formally considered the link between nutrition and menstrual function began asking different questions of their athletes. These are meaningful shifts. But they are upstream of the real change needed.

The athletes in this cohort do not need to be told to try harder or eat better. They are already trying harder than most people their age, under conditions that make eating well genuinely difficult. What they need is an environment that meets them where they are: menus designed for athletes, not institutions; coaches trained to recognise health risk, not just performance risk; monitoring systems that catch problems before they become injuries; and enough psychological safety to say, without fear, that something is wrong.

This is one of the first integrated assessments of its kind in India. It provides a baseline that did not previously exist. It names a problem that has been present but unquantified. And it offers findings specific enough to act on, not someday, but now, with the athletes whose data fills these pages.

Girls are entering competitive sports in India in growing numbers. That is worth celebrating. What is less visible, and what this programme makes visible, is that many of them are doing so without the nutritional foundation their bodies require. Expanding access to sport without expanding the health infrastructure around it is not progress. It is participation at a cost that falls entirely on the athlete.

**The evidence is here. The athletes are here.  
The next step belongs to everyone else.**

# Appendix

## Appendix A : Data Figures and Key Summaries

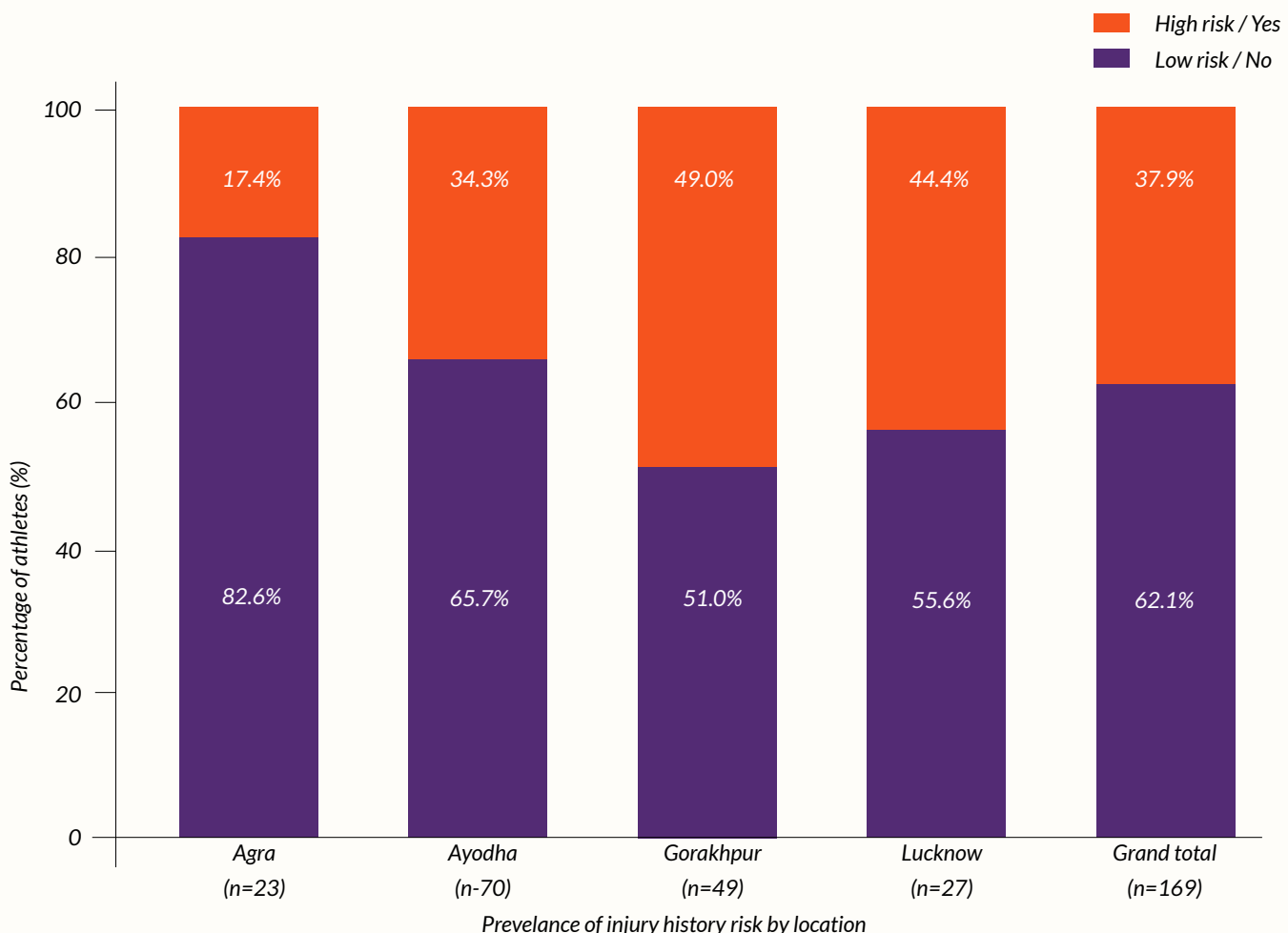
### Domain 1: Injury History (37.9%)

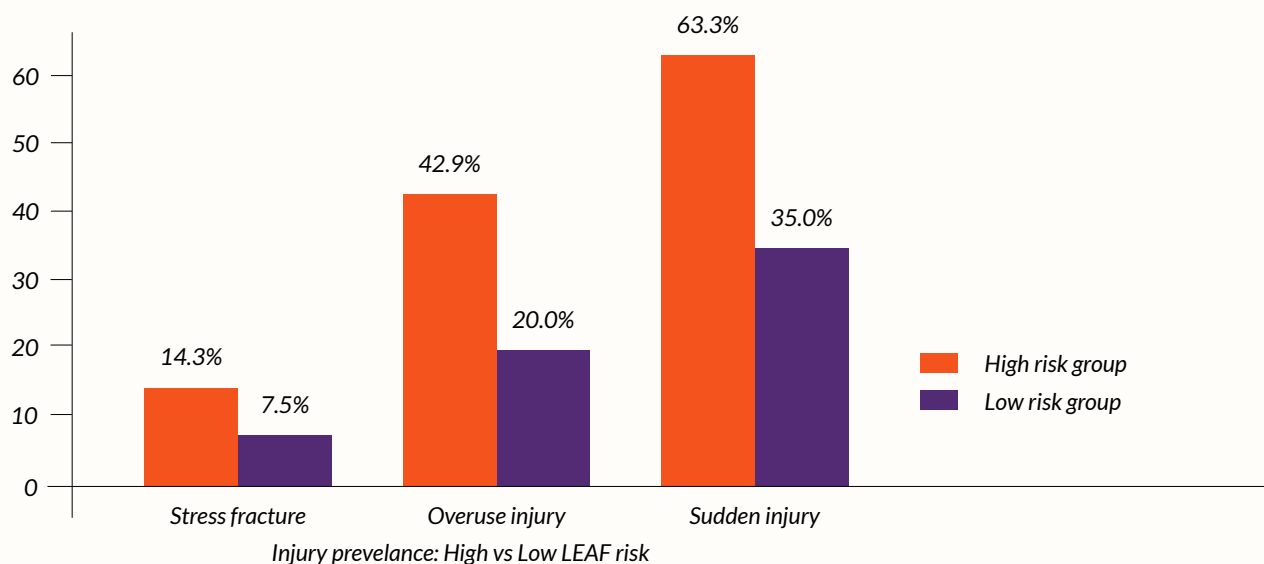
Injury history was the most prevalent risk domain, with 37.9% of the cohort (n=64) flagged. High-risk athletes showed a stress fracture rate of 14.3% compared with 7.5% in the low-risk group, an overuse injury rate of 42.9% versus 20%, and a sudden injury rate of 63.3% versus 35%. High-risk athletes also missed five or more training sessions due to injury in the past year at a rate of 44.9%, compared with 47.5% of low-risk athletes who reported zero missed sessions.

At the sport level, Hockey (45.7% overuse injury rate, 22.9% stress fracture rate) and Judo (40% overuse, 100% sudden injury) showed the most severe injury profiles. The hockey stress fracture rate is more than double the clinical benchmark of 10%, and is consistent with the combination of high-impact training volume and the significant protein and energy deficits observed in this sport group.

*These girls are getting injured and coming back before they are fully recovered. We don't have physiotherapy here. They go outside and pay themselves.*

*Coach, Agra*





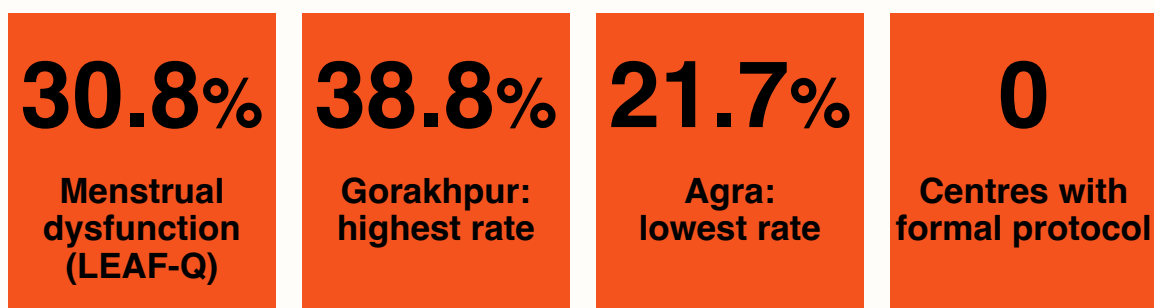
## Domain 2: Gastrointestinal Symptoms (30.2%)

Overall, 30.2% of athletes (n=51) reported gastrointestinal symptoms consistent with LEA-related gut dysfunction, including bloating, constipation, atypical stool consistency, and abdominal discomfort unrelated to menstruation. Prevalence varied across locations, with one location recording notably higher GI burden, which may help explain its elevated overall LEAF-Q risk profile.

A pattern emerged between GI distress and dietary intake: athletes with GI risk reported slightly lower mean energy intake (31.4 vs 32.4 kcal/kg) and carbohydrate intake (4.36 vs 4.52 g/kg). This is consistent with a cycle in which gastrointestinal discomfort reduces appetite and food intake, which in turn worsens energy availability and may further impair gut function.

## Domain 3: Hormonal and Contraceptive Use (5.9%)

Only 5.9% of athletes (n=10) reported hormonal contraceptive use, the lowest prevalence across all four domains. This is clinically significant in that it confirms the vast majority of athletes are reporting on unassisted physiological cycles, meaning the menstrual irregularities observed reflect genuine hormonal disruption rather than contraceptive influence. Gorakhpur showed the highest relative prevalence at 8.2%, while Agra reported zero cases.

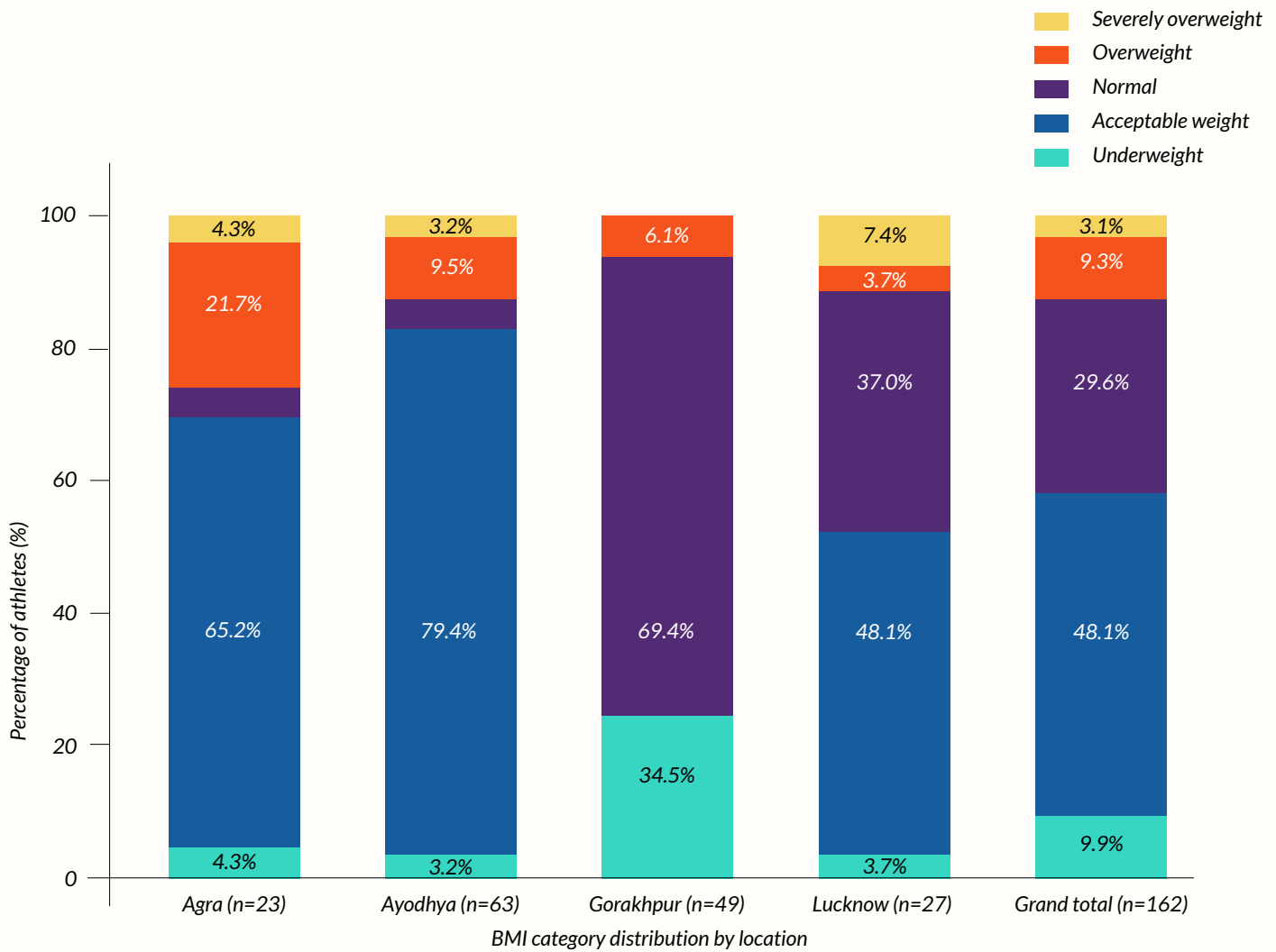


## Body Composition and Anthropometry

Body composition findings reveal patterns that both complement and complicate the dietary and LEA risk data. The most important contribution of the body composition analysis is the demonstration that risk is not distributed according to body size, a finding with significant implications for how athlete health is monitored in practice.

### BMI Distribution and the Weight-Risk Paradox

Across the cohort, 48.1% of athletes fell within the normal or acceptable weight BMI range, 29.6% in a higher weight category, and 9.1% in the underweight category. When LEAF-Q risk was examined within each BMI group, the expected relationship, that underweight athletes face the highest risk, did not hold. The overweight group showed the highest high-risk prevalence at 45%, exceeding both underweight athletes (37.5%) and normal-weight athletes (25.4%).



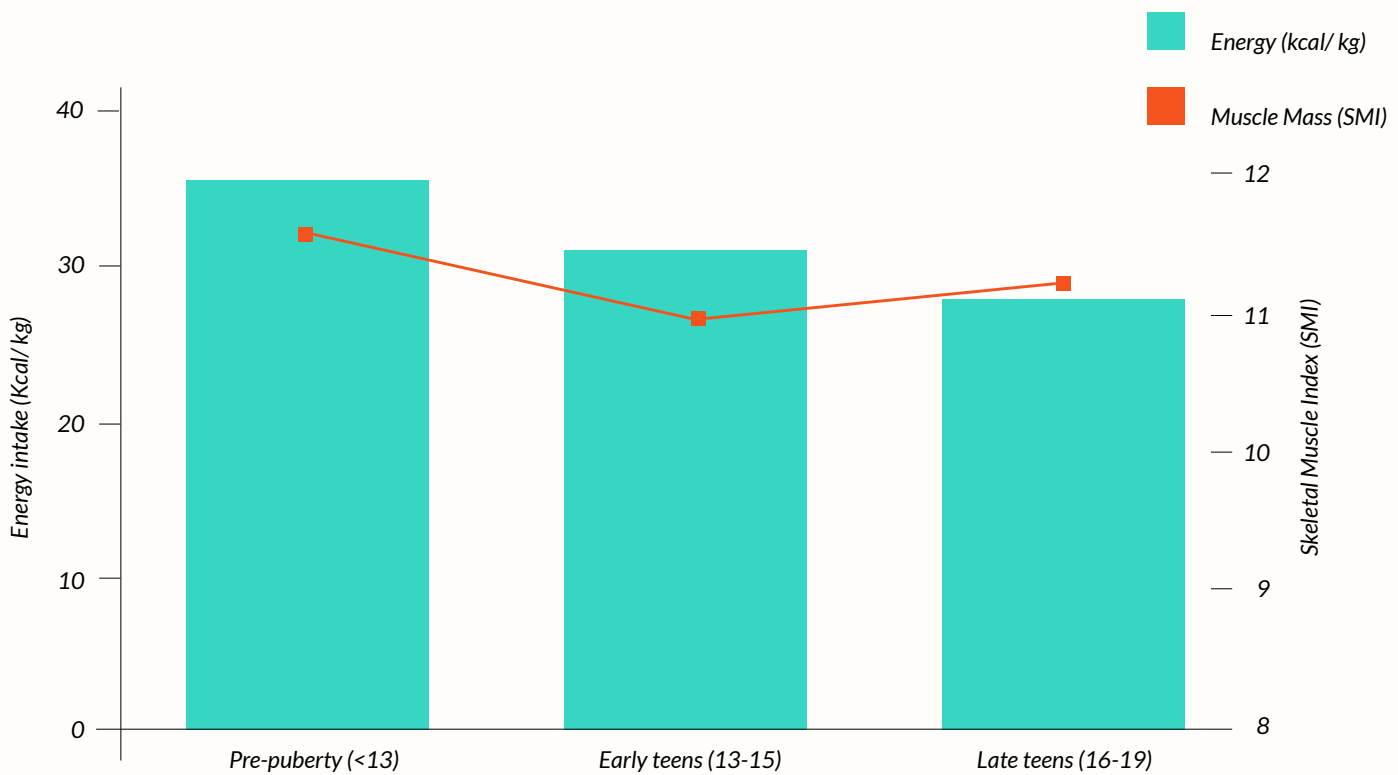
## Skeletal Muscle Index Across Age Groups

In a well-nourished athletic population, skeletal muscle index should increase progressively through adolescence as training stimulus and anabolic hormonal activity combine to drive muscle development. In this cohort, that expected trajectory was not observed. Pre-puberty athletes showed a mean SMI of 11.5, early teens 10.9, and late teens 11.1. Rather than a steady upward progression, muscle mass effectively plateaued, and dipped slightly in the early teen years, before recovering marginally in the late teen group.

This pattern coincides with a declining energy intake across the same age trajectory: from 35 kcal/kg in the pre-puberty group down to 28 kcal/kg in the late teens. The convergence of declining nutritional intake with the most demanding period of physical development raises concern about whether these athletes are building the physiological foundation needed for sustained competitive performance.

*They are training every day and working very hard, but their bodies are not getting stronger the way they should be at this age. Something is missing.*

*Coach, Gorakhpur*



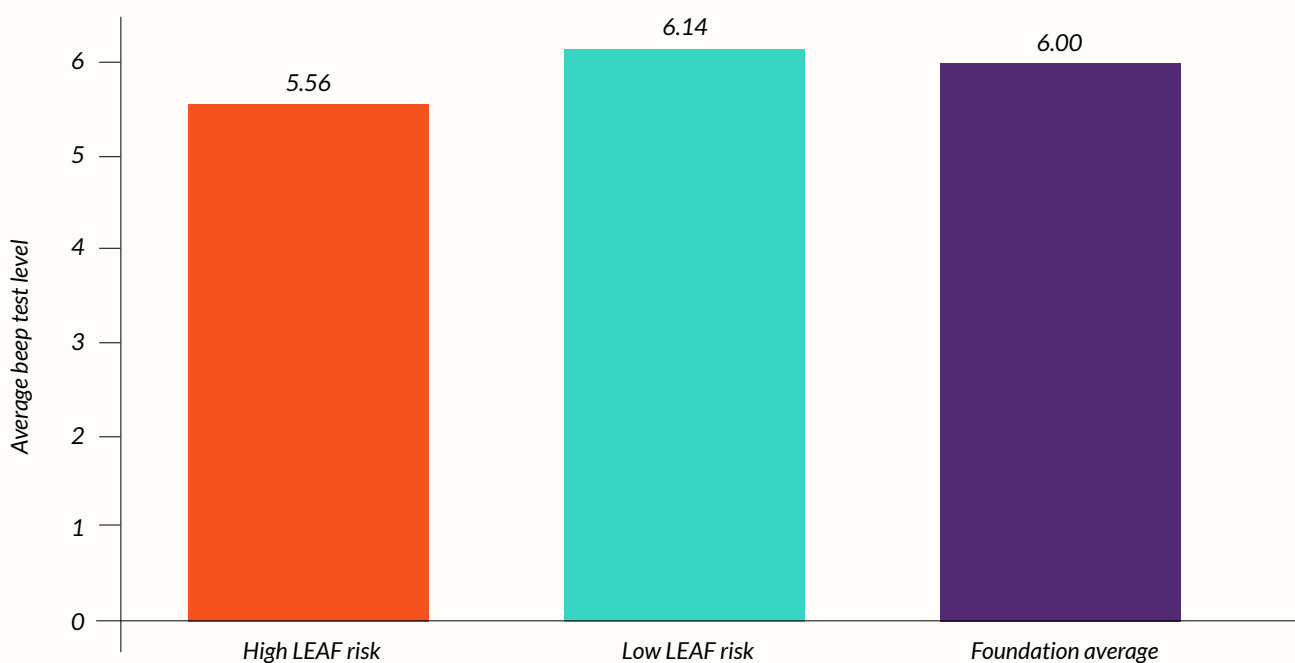
Energy deficiency hindering muscle growth

## Aerobic Performance and Nutritional Risk

Field-based aerobic capacity was assessed using the 20-metre multi-stage shuttle run (beep test) across the cohort. The results were analysed in relation to LEAF-Q risk classification to examine whether nutritional risk status was associated with measurable differences in physical performance capacity.

High-risk athletes averaged a beep test level of 5.56 compared with 6.14 for low-risk peers, a gap that, while modest in absolute terms, is consistent with the performance decrements associated with chronic LEA in the literature.

This distinction has practical relevance. Improving beep test performance in these athletes is less likely to come from event-day fuelling strategies than from sustained improvement in daily energy and macronutrient intake over time.



Aerobic capacity (beep test score): High risk vs. Low risk

## Appendix B: Assessment Tools and Data Collection Instruments

The following tools were used across Phase 1 and Phase 2 of the programme for data collection, screening, and knowledge assessment. All forms were administered in bilingual format (English and Hindi) unless otherwise noted.

### B1: Body Composition Assessment

Body composition was assessed using the Karada Scan bioelectrical impedance analyser. Measurements were taken under standardised conditions: fasted state, post-void, and prior to training.

Parameters recorded for each athlete:

- Name and age
- Height and weight
- Body fat percentage
- Visceral fat
- BMI
- Subcutaneous fat
- Skeletal muscle mass

### B2: Two-Day Dietary Recall

A two-day dietary recall was administered to all athletes to capture habitual intake across training days. Portion sizes were collected using household measures familiar to the athletes to improve accuracy of estimation. Data from both days was averaged for analysis.

Each day's recall captured:

- Breakfast
- Lunch
- Dinner
- Snacks
- Pre-workout intake
- During workout intake
- Post-workout intake

For each eating occasion, athletes recorded the time of consumption, foods and fluids consumed, and estimated quantity.

### B3: LEAF-Q Screening Tool

The Low Energy Availability in Females Questionnaire (LEAF-Q) was adapted for use with Indian grassroots female athletes and administered in bilingual format. The tool screened for LEA risk across four domains: injury history, gastrointestinal health, contraceptive and

hormonal use, and menstrual health. The adapted version retained the validated scoring structure of the original LEAF-Q while incorporating contextually relevant language and response options appropriate for adolescent athletes in residential training settings.

### Section 1: Personal Information

- Name
- Address
- Contact details

### Section 2: Athletic Background

- Age sport was taken up seriously
  - Current competitive level
  - Full-time or part-time athletic status
  - Sport
  - Date of birth
- 

### Section 3: Body Measurements and Health

- Current height and weight
  - Highest and lowest weight at current height
  - Preferred competition weight
  - Daily training hours
  - VO2 max score if known
  - Best performance to date
- 

### Section 4: Injury History

- Number of times training was missed due to injury in the past year
  - Total days unable to train
  - History of stress fractures and location
  - Body fat percentage if known
  - Any long-term health conditions
  - Any food allergies
- 

### Section 5: Gastrointestinal Health

- Frequency of bloating unrelated to menstruation
  - Frequency of stomach cramps unrelated to menstruation
  - Bowel movement frequency
  - Typical stool consistency
  - History of overuse injuries
  - History of acute injuries such as fractures, sprains, or dislocations
- 

### Section 6: Contraceptive and Hormonal Use

- Current and past use of oral contraceptives or other hormonal methods
  - Reason for use where applicable
- 

### Section 7: Menstrual Health

- Age at menarche
- Whether periods began naturally
- Whether periods are currently regular
- Date of last period
- Cycle length and regularity
- Number of bleeding days
- Number of periods in the past year
- Presence of heavy bleeding
- History of periods stopping for three or more months
- Changes in menstrual pattern with increased training load

## B4: Qualitative Discussion Guide (Focus Group Discussions)

Separate focus group discussions were conducted with athletes, coaches and support staff, and kitchen and food service staff. The guide explored behavioural, environmental, and systemic factors contributing to LEA risk across all locations.

### Athletes

#### Theme 1: Perception of Nutrition

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- What do you understand by the word nutrition?
- What do you think are nutritious foods?
- What kind of food gives you maximum energy?
- What are alternative sources of nutrition apart from direct food?
- What do you think of dietary supplements?
- Who recommends or prescribes dietary supplements?

#### Theme 2: Nutrition and Eating Behaviour

---

- How many meals or snacks do you eat in a day?
- What do you usually eat before, during, and after training?
- Do you feel your meals give enough energy for training?
- Do your meals change during competition time?
- Are there foods you wish were available more often?
- What are the biggest challenges in following a nutritious diet?
- What habits or situations make it difficult to follow your ideal diet?
- How confident are you in planning meals to support performance?
- Where do you get nutrition information or advice?
- Do you receive nutrition education sessions?

#### Theme 3: Menstrual Health and Training

---

- Do you notice any change in your periods when training becomes intense?
- How do you manage training when you have your period?
- Is it easy to talk about period issues or take rest when needed?
- Have you ever missed or had irregular periods?
- Do you get any support or advice related to menstrual health?

#### Theme 4: Injuries, Recovery, and Physical Fatigue

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- Have you or your teammates had any injuries in the past few months?
- How do you usually recover from injuries or soreness after intense training?
- Do you think what you eat or how much rest you get affects recovery?
- Have you ever trained while still injured or not fully recovered?
- Do you feel you get enough recovery time between training sessions?

#### Theme 5: Body Image and Appearance Pressure

---

- Do you feel any pressure to maintain or change your body shape for your sport?
- Where do you think this pressure comes from?
- Has anyone ever commented on your body shape, size, or weight?
- Do these expectations affect what or how much you eat?
- How do you feel about your body in relation to performance rather than appearance?

## Coaches and Support Staff

### Theme 1:

#### Training Load, Nutrition, and Energy Management

---

- How would you describe the current training load for your athletes?
- Do you make any changes during competition or rest phases?
- Do athletes report fatigue or low motivation during training?
- What nutrition-related challenges do athletes face?
- Do athletes receive any nutrition guidance or structured support?

### Theme 2:

#### Injury, Fatigue, and Menstrual Health

---

- Have you noticed injury or fatigue patterns among athletes recently?
- Are menstrual issues discussed openly between athletes and staff?
- Do you observe any changes in performance or training response during menstruation?
- Do athletes miss training during such times?
- How do you support athletes in managing these issues?

### Theme 3:

#### Recovery Support and Communication Systems

---

- How are health or nutrition issues usually communicated among staff and management?
- How do you identify when an athlete might not be eating enough?
- Are current systems for monitoring recovery and health effective?
- What improvements would help you better support athlete health and nutrition?
- What kind of professional support would be useful?

## Kitchen and Food Service Staff

### Theme 1:

#### Menu Planning and Nutrition Adequacy

---

- Who is responsible for planning daily menus for athletes?
- What factors influence menu decisions?
- Are menus adjusted during competition or high training periods?
- Do you receive any guidance from nutritionists or coaches when planning?

### Theme 2:

#### Meal Quality, Hygiene, and Service Delivery

---

- How do you ensure hygiene and food quality during meal preparation?
- What steps are taken to maintain consistency in meals?
- What are the main challenges in preparing food that meets athletes' needs?
- Are there any resource or ingredient shortages that affect food quality or variety?

### Theme 3:

#### Feedback, Wastage, and Improvements

---

- Have you observed athletes skipping or wasting certain foods?
- What do you think causes wastage?
- How is leftover food handled?
- Do you receive feedback from athletes or coaches about food?
- How are complaints or suggestions handled?
- What support, equipment, or training would help improve food quality or service?

## **B5: Pre-Workshop Knowledge Assessment (Athletes)**

Administered prior to workshop delivery to establish baseline knowledge across menstrual health, nutrition and training habits, body image, and general knowledge.

### **Section 1: Demographic Details**

- Name
  - Age
  - Sport
  - Level of play
  - Whether periods have started
- 

### **Section 2: Menstruation and Training**

- Menstrual product currently used
  - Comfort of product during training or matches
  - How training is managed during periods
  - Reasons for reducing or skipping training during periods
  - Severity of symptoms and their impact on training
  - Whether food intake changes during periods
  - How food intake changes during periods
- 

### **Section 3: Nutrition and Training Habits**

- Number of meals eaten per day
  - Frequency of meal skipping
  - Number of meals skipped per week when skipping occurs
  - Reasons for skipping meals
  - Food intake on hard training days compared to usual
  - Reasons for eating less on hard training days
  - Frequency of tiredness, dizziness, or weakness during or after training
  - Perceived reasons for tiredness or dizziness
- 

### **Section 4: Body Image and Weight**

- Comfort with current body weight or shape
  - Reasons for wanting to change weight if applicable
- 

### **Section 5: Knowledge Quiz**

- Normal menstrual cycle frequency
- Normal bleeding duration
- Identifying abnormal menstrual symptoms requiring attention
- Correct first step when periods affect training
- Understanding of what the body uses energy for
- Consequences of training hard without eating enough
- Purpose of eating before training
- Purpose of eating after training
- Definition of self-talk
- Effects of body shape pressure on athlete health and behaviour

## Appendix C: Reference Standards, Normal Ranges, and Formulas

### C1: LEAF-Q Scoring

Total Score Interpretation

- Not at risk for LEA: score below 8
- At risk for LEA: score of 8 or above

Note: LEAF-Q is a screening tool, not a diagnostic instrument.

### C2: Dietary Intake Reference Standards Total Score

Energy Intake Formula:	Carbohydrate Intake Formula:	Protein Intake Formula:	Fat Intake Formula:
<ul style="list-style-type: none"><li>• Total daily energy intake (kcal) divided by body weight (kg)</li><li>• Below 35 kcal/kg/day: chronically low</li><li>• 35 to 45 kcal/kg/day: potentially inadequate</li><li>• Above 45 kcal/kg/day: adequate for moderate to high training</li></ul>	<ul style="list-style-type: none"><li>• Total carbohydrate intake (g) divided by body weight (kg)</li><li>• Reference range: 6 to 8 g/kg/day</li><li>• Protein Intake Formula: Total protein intake (g) divided by body weight (kg)</li><li>• Reference range: 1.2 to 2.0 g/kg/day</li></ul>	<ul style="list-style-type: none"><li>• Total protein intake (g) divided by body weight (kg)</li><li>• Reference range: 1.2 to 2.0 g/kg/day</li></ul>	<ul style="list-style-type: none"><li>• Total fat intake (g) divided by body weight (kg)</li><li>• Reference range: minimum 0.7 g/kg/day</li></ul>

### Micronutrients (ICMR-NIN 2020, Indian Female-Specific RDAs)

#### Iron

Adolescent girls: 27 mg/day  
Adult females: 21 mg/day

#### Calcium

Adolescent girls: 800 mg/day  
Adult females: 600 mg/day

### C3: Anthropometry

#### BMI Calculation

Formula: Weight (kg) divided by height in metres squared

Note: BMI was not used to classify health status in this cohort. Given that participants were athletes, BMI was analysed descriptively and correlated with LEAF-Q risk categories, recognising that athletes with normal BMI may still be at risk of LEA.

## C4: Body Composition Standards

### Body Fat Percentage by Sport Type and Age (Adolescent Females)

	Aesthetic and lean sports (gymnastics, dance)	Endurance sports (running, cycling, rowing)	Court and field sports (football, hockey, basketball, volleyball, handball)	Power and strength sports (sprints, combat sports, weightlifting)	Aquatic sports (swimming, water polo)
Age 10 to 13:	18 to 25%	19 to 26%	20 to 28%	20 to 28%	20 to 27%
Age 14 to 17:	16 to 22%	17 to 23%	19 to 26%	19 to 27%	19 to 26%
Age 18 to 25:	14 to 20%	14 to 22%	18 to 26%	18 to 28%	18 to 26%

Fat-free mass reference: approximately 78%

### FFMI Reference Ranges (Adolescent Females)

Below 14.0 kg/m <sup>2</sup> :	very low fat-free mass (below 5th percentile)
14.0 to 14.9:	low (5th to 10th percentile)
15.0 to 15.9:	below average (10th to 25th percentile)
16.0 to 16.9:	average (25th to 50th percentile)
17.0 to 17.9:	above average (50th to 75th percentile)
18.0 to 18.9:	high (75th to 90th percentile)
19.0 and above:	very high (above 90th percentile)

### FFMI Reference Ranges (Adult Females)

Below 15.0 kg/m <sup>2</sup> :	severely low
15.0 to 16.0:	low
16.1 to 18.0:	normal
Above 18.0:	high

### SMI Reference Ranges (Adolescent Females)

Below 5.0 kg/m <sup>2</sup> :	very low muscle mass (below 5th percentile)
5.0 to 5.3:	low (5th to 10th percentile)
5.4 to 5.7:	below average (10th to 25th percentile)
5.8 to 6.1:	average (25th to 50th percentile)
6.2 to 6.5:	above average (50th to 75th percentile)
6.6 to 6.9:	high (75th to 90th percentile)
7.0 and above:	very high (above 90th percentile)

### SMI Reference (Adult Females, EWGSOP2)

Low muscle mass: ASM divided by height<sup>2</sup> below 5.5 kg/m<sup>2</sup>

## C5: Aerobic Performance (Beep Test)

VO<sub>2</sub> max Estimation

Final speed (km/h) = 8 + (0.5 × final level)

VO<sub>2</sub> max (ml/kg/min) = 3.46 × final speed (km/h) + 12.2

### Performance Interpretation (Female Athletes)

	Age 10 - 13 yrs	Age 14 - 17 yrs	Age 18 - 25 yrs
Very low:	below 35	below 38	below 37
Low:	35 to 39	38 to 42	37 to 41
Fair:	40 to 44	43 to 47	42 to 46
Good:	45 to 49	48 to 52	47 to 51
Excellent:		53 and above	52 and above

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**"Performance cannot be built on low energy"**

