INTERNATIONAL JOURNAL OF MEDICAL SCIENCE AND DENTAL HEALTH
(ISSN: 2454-4191)
www.ijmsdh.org (2026)

Check for updates

Received: 30 Sep 2026
Revised: 10 Oct 2026
Accepted: 22 Oct 2026
Published: 15 Nov 2026

2026: OCTOBER - IJMSDH
Page No – 20-25
DOI - 10.55640/ijmsdh-12-11-03

Article Citation: Turdialiyev Shavqatillo Xoshimjon o'g'li, Malkov Antoniy Vladimirovich, & Teshabayev Muhammadqodir Gulyamovich. (2026). Validation of A Digital Dietary Monitoring Tool for Assessing Nutrition Adherence in Adolescent Footballers. International Journal of Medical Science and Dental Health, 12(11), 20-25. https://doi.org/10.55640/ijmsdh-12-11-03

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Validation of A Digital Dietary Monitoring Tool for Assessing Nutrition Adherence in Adolescent Footballers

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Abstract

Background: Accurate dietary monitoring is difficult in adolescent athletes because self-reporting burden, missed eating occasions and day-to-day variation can weaken the quality of nutrition data. Digital tools may reduce this burden and create a direct feedback channel, but their practical value should be examined before they are used for individual nutrition decisions.

Objective: To evaluate a Telegram-based dietary monitoring tool for assessing dietary adherence in adolescent footballers and to examine whether the observed outcomes support its preliminary validity in practical use.

Methods: The digital-monitoring comparison included 120 adolescent footballers, with 60 players in a group not using the Telegram bot and 60 players in a group using the bot. The platform functioned as a structured digital food diary within an individualised nutrition algorithm: players recorded daily food intake, the information was reviewed against nutrition targets, and detected mismatches could trigger feedback and dietary correction. The available study materials reported five aggregate outcomes: dietary adherence, the proportion of "empty calories", muscle-mass dynamics, fat-mass dynamics and an end-of-match energy-deficit indicator. Because participant-level paired measurements against a reference dietary method were not available for this analysis, the comparison was descriptive and was interpreted as preliminary implementation validation rather than criterion validation.

Results: Dietary adherence was 35–40% in the group without digital monitoring and 87% in the bot group. The reported share of "empty calories" was 15–20% without the bot and <5% with the bot. Muscle-mass dynamics were +15% and +25%, respectively, whereas fat-mass dynamics were +10% and +5%. The end-of-match energy-deficit indicator was 15–20% without digital monitoring and 5% with the bot. The direction of change was internally consistent across behavioural, dietary and physiological domains.

Conclusions: Telegram-based monitoring was associated with higher reported adherence and a more favourable pattern of secondary nutrition-related outcomes in this adolescent football cohort. These findings support the tool as a practical monitoring and feedback layer within an individualised nutrition programme. They do not establish measurement accuracy against a reference method; a formal criterion-validation phase using paired weighed food records or interviewer-administered recalls is still required.

Keywords: Adolescent footballers; digital dietary monitoring; Telegram bot; nutrition adherence; dietary assessment; mHealth; sports nutrition; validation.

1. Introduction

Nutrition monitoring in adolescent football sits at the intersection of two sources of variability: rapid biological development and a training schedule in which energy demand changes from day to day. A dietary plan may therefore be physiologically appropriate on paper yet fail in practice if the athlete does not record intake consistently or does not follow the intended pattern. In this setting, the quality of the monitoring process becomes part of the nutrition intervention itself [1,3].

Traditional dietary assessment has well-recognised limitations in athletes. Food records and recalls can be affected by omissions, portion-size error, retrospective recall and behavioural reactivity. These problems may be amplified in adolescents, whose eating often occurs across home, school and training environments. Validation studies in athletes have consequently shown that self-reported intake can differ materially from reference measures, particularly when energy requirements are high [4,6].

Digital dietary assessment was developed partly to reduce these practical barriers. Online 24-hour recall systems and mobile food records have shown that adolescents can use technology to document food intake, and relative validation work has demonstrated that digital systems can achieve useful agreement with interviewer-administered methods when the recording process is well structured [7,10]. More rigorous work has also compared mobile records with doubly labelled water or weighed food diaries, illustrating both the promise of digital monitoring and the need to distinguish group-level usefulness from individual-level accuracy [11,13,14].

In sport, digital tools offer an additional function beyond measurement: they can connect recording, feedback and behaviour change. Image-assisted applications used in athletes have supported repeated meal logging and nutrition education, but adherence commonly changes over time and the validity of the resulting dietary estimates remains method-dependent [12,13]. For adolescent footballers, a low-friction messaging platform may be particularly useful because it can be embedded into the communication environment already used by players and staff.

The present study evaluated a Telegram-based monitoring component incorporated into a broader individualised nutrition algorithm. The bot was not treated as an isolated application. It operated after assessment of the player, estimation of energy needs, evaluation of diet adequacy and formulation of an individual diet. The scientific question was therefore whether continuous digital monitoring was accompanied by a coherent improvement in adherence and nutrition-related indicators under field conditions.

2. Objective

To evaluate a Telegram-based dietary monitoring tool for assessing dietary adherence in adolescent footballers and to examine whether the observed outcomes support its preliminary validity in practical use.

3. Methods

3.1. Study design and participants

The digital-monitoring analysis was embedded in a study of 120 adolescent footballers. For the monitoring comparison, the study presentation defined two groups of equal size: 60 players who did not use the Telegram bot and 60 players who used the bot. The broader research programme included adolescent players across different biological maturation stages and playing positions, with nutrition assessment linked to individual energy requirements.

3.2. Role of the digital monitoring tool

The Telegram bot was used as a structured dietary diary and feedback interface. Players entered information on foods consumed during the day. These entries were incorporated into the study's nutrition-management sequence, in which dietary intake was judged against the player's individual nutritional plan and identified mismatches could lead to correction of the diet.

The tool therefore served two linked functions: repeated data capture and reinforcement of dietary behaviour.

3.3. Integration with the individualised nutrition algorithm

The digital tool represented the final monitoring stage of a five-step workflow. First, the player's individual status was assessed using biological development, playing role, body mass and relevant metabolic/body-composition information. Second, daily energy expenditure was estimated. Third, actual intake was compared with energy and nutrient requirements. Fourth, an individual diet was constructed. Fifth, Telegram-based monitoring was used for follow-up and dietary correction. This sequence is important because the bot did not generate nutritional requirements independently; it monitored adherence to targets established earlier in the clinical-nutrition pathway.

3.4. Outcomes

Five aggregate outcomes were available for the comparison. Dietary adherence was reported as a percentage-based study indicator. Diet quality was represented by the reported proportion of "empty calories". Two body-composition-related outcomes were presented as percentage changes in muscle-mass and fat-mass dynamics. A fifth study-defined indicator described the energy deficit at the end of match play. The available aggregate source did not preserve the operational denominator or calculation formula for each indicator; therefore, the values are reported exactly as supplied and are not redefined in this manuscript.

3.5. Validation framework

The evaluation was structured around three levels of validity. Face and implementation validity concerned whether the tool could be incorporated into the daily nutrition workflow and achieve sustained recording. Convergent field validity concerned whether higher digital adherence occurred together with directionally compatible changes in diet quality, body-composition indicators and end-of-match energy deficit. Criterion validity would require paired comparison of the bot's dietary estimates with an independent reference method such as a weighed food record, an interviewer-administered multiple-pass recall, or a recovery biomarker for energy intake [5,8,11,13,14]. Such paired reference data were not available for the present analysis.

3.6. Statistical analysis

Table 1. Position of the digital tool within the nutrition-management pathway

Stage	Main task	Output
1. Individual assessment	Biological development, playing role, body mass and relevant metabolic/body-composition information	Individual status characterised
2. Energy requirement	Resting and activity-related energy needs are integrated	Daily energy target established
3. Diet adequacy	Actual intake is compared with energy and nutrient requirements	Deficit, adequacy or excess identified
4. Individual diet	Diet is tailored to maturation, playing demands and daily energy/nutrient needs	Individual nutrition plan constructed
5. Digital monitoring	Daily intake is recorded through Telegram; mismatches are reviewed and corrected	Follow-up, feedback and dietary correction

4. Results

4.1. Monitoring implementation

All five reported outcomes showed a consistent separation between the group using Telegram-based monitoring and the group without the digital tool. The clearest difference was observed in dietary adherence, while the other outcomes moved in a direction that was compatible with improved nutritional control.

4.2. Dietary adherence and diet-quality indicators

Dietary adherence was reported at 35–40% in the group that did not use the bot and at 87% in the group using digital monitoring. The "empty calories" indicator showed the opposite

pattern: 15–20% without digital monitoring and <5% with the bot. Thus, the group with higher recording/adherence also had a lower reported contribution from foods classified by the study as providing "empty calories".

4.3. Body-composition and energy-deficit indicators

Muscle-mass dynamics were reported as +15% in the group without the bot and +25% in the group using the bot. Fat-mass dynamics were +10% and +5%, respectively. The study-defined end-of-match energy-deficit indicator was 15–20% without digital monitoring and 5% with the bot. These outcomes do not independently prove that the bot measured food intake accurately, but their direction is compatible with the hypothesis that more continuous monitoring was accompanied by better adherence to the intended nutrition strategy.

4.4. Interpretation of validity

The monitoring group did not show improvement in only one isolated metric. Instead, higher reported adherence occurred alongside a lower "empty calorie" share, a more favourable reported muscle/fat pattern and a lower end-of-match energy-deficit indicator. This cross-domain consistency provides preliminary convergent support for the practical value of the monitoring system. However, because the analysis did not compare bot-derived nutrient values with a simultaneous reference dietary method, the present results should not be described as proof of criterion accuracy.

Table 2. Comparative outcomes of Telegram-based dietary monitoring

Outcome	No Telegram bot (n=60)	Telegram bot (n=60)	Field interpretation
Dietary adherence	35–40%	87%	Higher adherence with digital monitoring
"Empty calories" share	15–20%	<5%	Lower reported low-nutrient energy contribution
Muscle-mass dynamics	+15%	+25%	More favourable reported muscle-mass direction
Fat-mass dynamics	+10%	+5%	Lower reported fat-mass increase
End-of-match energy-deficit indicator	15–20%	5%	Lower reported deficit

Table 3. What the present data can and cannot validate

Validation domain	Status	Reason
Implementation validity	Supported	The tool was integrated into daily monitoring and achieved higher reported adherence.
Convergent field validity	Preliminarily supported	Adherence, diet-quality, body-composition and energy-deficit indicators changed in a coherent direction.
Criterion validity / measurement accuracy	Not established	No paired comparison with a weighed food record, multiple-pass recall or recovery biomarker was available.
Individual-level agreement	Not established	No participant-level paired bot/reference dataset was available for Bland–Altman or ICC analysis.

5. Discussion

The principal finding was that Telegram-based dietary monitoring was associated with a markedly higher reported level of adherence in adolescent footballers. The same group also showed more favourable values for the four secondary outcomes available in the study presentation. The importance of this pattern is not that any single indicator validates the technology, but that the behavioural signal and the nutrition-related signals moved together.

This result is plausible in the context of digital dietary research. Adolescents generally engage readily with mobile technology, but the quality of dietary data depends on whether recording becomes part of the daily routine rather than an occasional task [9,10]. Digital tools can reduce the distance between eating, recording and feedback. That shorter feedback loop is especially relevant in academy sport, where training schedules change rapidly and a paper food diary may be completed retrospectively.

Previous validation work also shows why digital convenience should not be confused with analytical accuracy. In British adolescents, myfood24 showed useful agreement with an interviewer-administered 24-hour recall, but the validation depended on same-day paired measurements and formal agreement statistics [8]. In academy-level footballers, combining a weighed food diary with a 24-hour recall improved the assessment framework because reported intake could be checked against researcher-observed intake [5]. In adults, mobile food records have been tested against doubly labelled water, providing a recovery-biomarker comparison that directly addresses energy-reporting accuracy [11].

The athlete-specific literature reaches a similar conclusion. Image-assisted applications can support nutrition education and meal logging [12], while remote food photography can provide acceptable group-level energy estimates in athletic individuals; nevertheless, individual error may remain large and macronutrient agreement can be weaker [13]. These observations are directly relevant to the present study. A tool may be useful for behaviour management even when its nutrient-estimation accuracy has not yet been fully established.

For this reason, the strongest interpretation of the present data is preliminary field or implementation validity. The bot appears to have functioned as an effective behavioural monitoring layer within an individualised nutrition system. Its value likely came from repeated self-monitoring, visibility of dietary behaviour to the responsible specialist and the possibility of timely correction. The study does not allow these mechanisms to be separated quantitatively, and the observed group differences may also reflect unmeasured differences in motivation, supervision or baseline dietary structure.

The reported reduction in “empty calories” is particularly relevant because it links digital adherence with food-choice quality rather than with recording frequency alone. Similarly, the lower end-of-match energy-deficit indicator suggests that the monitoring process may have helped players align intake more closely with football-related energy demands. These findings are consistent with the broader principle that adequate sports nutrition depends not only on calculating requirements but also on maintaining daily implementation [1,3,15,18].

A formal validation phase should now test the bot at the level of measurement agreement. The most practical design would require the same players to record intake simultaneously with the Telegram tool and with a reference method over several representative days, including at least one high-load day and one lower-load day. Energy and macronutrient estimates could then be examined using mean bias, Bland–Altman limits of agreement, intraclass correlation coefficients, rank classification and, where appropriate, sensitivity/specificity for predefined adherence thresholds. A weighed food record supplemented by an interviewer-administered recall would be a realistic reference in adolescent academy players [5,8,13].

Such a second-phase design would answer a different question from the present study. The current field evaluation asks whether digital monitoring is associated with better adherence and coherent nutrition-related outcomes. Criterion validation would ask whether the numerical intake estimates produced from bot records are sufficiently close to an independent standard for individual clinical or sports-nutrition decisions. Both questions are important, but they should not be conflated.

6. Strengths and Limitations

A strength of this study is that the digital tool was evaluated within the real nutrition-management pathway of adolescent footballers rather than as a laboratory-only interface. The comparison also included outcomes from several domains, allowing the adherence signal to be interpreted alongside diet-quality, body-composition and match-related energy indicators.

The principal limitation is the absence of participant-level paired data against an independent reference dietary method. Consequently, standard measures of criterion validity and agreement could not be calculated. The available digital-monitoring results were aggregate percentages/ranges, preventing adjustment for baseline group differences or biological maturation. In addition, the supplied materials did not specify the monitoring duration, the detailed adherence scoring algorithm, the exact definition of “empty calories”, or the calculation procedure for the end-of-match energy-deficit indicator.

Because the study used adolescent athletes, the findings should also be generalised cautiously outside academy football. Digital engagement may depend on coaching structure, parental involvement, access to smartphones and the intensity of professional nutrition support.

7. Conclusions

Within this cohort of adolescent footballers, Telegram-based dietary monitoring was associated with higher reported nutrition adherence (87% vs 35–40%), a lower reported share of "empty calories" (<5% vs 15–20%), more favourable muscle- and fat-mass dynamics (+25% vs +15% and +5% vs +10%, respectively), and a lower study-defined end-of-match energy-deficit indicator (5% vs 15–20%). The consistency of these findings supports the digital tool as a practical monitoring and feedback component of an individualised nutrition programme. The results represent preliminary field validation; formal claims of measurement accuracy require paired comparison with an independent reference dietary method.

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