



Development and validation of the Italian version of the athlete sleep behavior questionnaire (ASBQ-IT): a national survey on recovery strategies and sleep behaviors in Italian athletes

Alex Buoite Stella^{1,2} · Andrea Ferrara¹ · Laura Mazzari¹ · Filippo Ieraci³ · Manuela Deodato¹ · Luigi Murena^{1,2} · Raffaele Sabot^{1,2} · Alessandra Galmonte¹

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Abstract

Purpose This study aims to translate and validate the Italian version of the athlete sleep behavior questionnaire (ASBQ). Moreover, this study also aims to investigate the use of recovery strategies in Italian athletes and their association with sleep behaviors.

Methods After the forward–backward translations and clarity evaluation, the ASBQ-IT was administered to 402 Italian athletes, between 14 and 60 years old. Internal consistency was assessed using Cronbach’s alpha and McDonald’s omega, while for the test–retest temporal stability, a subsample of 69 athletes repeated the questionnaire after 14 days. Finally, comparisons were made according to the ASBQ-IT scores, as well as between independent factors, such as type of sport and use of recovery strategies.

Results In reliability analysis, 388 athletes (25 ± 8 years, 37.3% females) correctly completed all the items. McDonald’s ω and Cronbach’s α estimates of 0.638 and 0.621 suggested acceptable reliability, while the test–retest reliability showed a sufficiently accurate intraclass correlation of 0.819. Athletes with a “bad sleep behavior” according to the ASBQ were more likely to participate in a team sport (64% vs. 53%, $p = 0.017$), have suffered from injury in the last month (30% vs. 18%, $p = 0.006$), and report using recovery strategies (52% vs. 40%, $p = 0.018$), in particular local ice (29% vs. 16%, $p < 0.001$).

Conclusions The proposed version of the ASBQ-IT showed acceptable internal consistency and temporal stability, therefore encouraging its use in Italian athletes to assess sleep behaviors and promote good practices and tailored sleep hygiene interventions.

Keywords Sleep · Sport · Exercise · Performance · Recovery

Introduction

As outlined in the recent expert consensus recommendations [1], alterations of normal sleep can be found in athletes and in particular elite athletes might be characterized by reduced sleep duration and poor sleep quality. Such sleep disturbance can be common after intense training as well as before competition [2], and might depend on some non-sports-specific factor, as societal factors, and some sports-specific factors, including high training loads, short- and long-haul travels, evening competitions (after 18:00) and early morning trainings (before 08:00) [1]. Although more research is needed to clearly define the impact of such sleep disturbances on athletic performance, it is generally recognized that sleep deprivation might impair physical performance, while chronic sleep improvement through the repeated exposure

✉ Alex Buoite Stella
abuoitestella@units.it

¹ Postgraduate Course in Science and Techniques for Exercise and Sport Recovery, Department of Medicine, Surgery and Health Sciences, University of Trieste, Strada di Fiume 447, 34149 Trieste, Italy

² PhD Program in Personalized Medicine and Innovative Therapies, Department of Medicine, Surgery and Health Sciences, University of Trieste, Strada di Fiume 447, 34149 Trieste, Italy

³ Trinity Laban Conservatoire of Music and Dance, London, UK

to strategies aimed to improve sleep quality and duration can improve sport-specific and physical performance [3]. In addition, good sleep is often recognized as one of the pillars for proper recovery in sport, suggesting that it might be fundamental for optimizing performance and preventing negative developments, such as underrecovery, nonfunctional overreaching and overtraining syndrome, and injuries or illnesses [4, 5].

To ensure appropriate sleep in athletes, sleep education should be followed by sleep screening to determine if disturbance is present in order to implement the most suitable intervention [1]. Despite several tools being available, both objective (e.g., polysomnography or actigraphy) and subjective (different questionnaires and scales), only a few of them are focused on athletes [6]. While the athlete sleep screening questionnaire (ASSQ) has been developed to provide clinical screening [7], the athlete sleep behavior questionnaire (ASBQ) has been specifically designed to understand what sleep behaviors are practiced by elite athletes and better tailor behavior modifications based on their responses [6]. Indeed, some evidence suggests that sleep behavior education and subsequent changes in maladaptive habits might improve athletes' sleep [8], possibly reflecting better performance. Despite its recent development, ASBQ has already been translated and validated in other languages, including French [9], Japanese [10], Brazilian [11], Turkish [12], German [13], and Arabic [14], and it has been used in several publications [15–19] as well as recommended in the expert consensus recommendations [1].

Therefore, the first aim of this study was to translate and validate the Italian version of the ASBQ (ASBQ-IT), testing its internal consistency and test–retest reliability, in a sample of Italian athletes from different sport disciplines. From these data, it will also be possible to provide some descriptive data of the Italian sports population. Finally, considering the interplay between sleep and recovery, a second aim of this study was to evaluate whether any association between the self-reported recovery strategies and the ASBQ is present.

Methods

Translation and validation of the questionnaire

A translation and validation study was conducted to assess the reliability of the newly developed ASBQ-IT. The original version of the ASBQ [6] consisted of 18 items assessing the sleep behaviors and habits of elite athletes, considering three main domains: routine/environmental factors (6 items, maximum score 30: Q1, Q5, Q15, Q16, Q17, Q18), behavior factors (7 items, maximum score 35: Q2, Q4, Q8, Q10, Q11, Q12, Q13), and sports-related factors (5 items,

maximum score 25: Q3, Q6, Q7, Q9, Q14). Each question asked how frequently athletes engaged in specific behaviors, and a 5-point Likert scale was used as follows: 1 = never, 2 = rarely, 3 = sometimes, 4 = frequently, 5 = always; therefore, a total score between 18 and 90 could be found, and a score of ≤ 36 has been suggested to indicate “good sleep behavior”, whereas a total score ≥ 42 “poor sleep behavior” [6]. Recent meta-analytic results have demonstrated a good level of internal consistency (Cronbach's alpha 0.73, 95% CI 0.63–0.80), and in terms of test–retest reliability there was a very good degree of consistency (ICC = 0.88, 95% CI 0.87–0.89) [20]. Before initiating the translation process, based on the revision proposed in the Arabic translation of the ASBQ [14], the item related to the use of stimulants when training or competing was revised as follows “I use stimulants when I train/compete (e.g., caffeine) after mid-day”, based on the rationale that caffeine consumption in the morning is not expected to impair sleep [21]. This amendment did not result in any negative effect on the internal consistency of the questionnaire [14].

According to best practices and in line with the previous translations of the ASBQ [9, 14, 22], the Italian translation process followed five steps: (i) translation from English to Italian (performed by two independent translators who were fluent in both languages), (ii) synthesis (two translators compared their versions of the questionnaire and reached a consensus on the final version), (iii) back-translation (two independent translators fluent in both Italian and English translated the Italian version back into English), (iv) expert comparison (an English native speaker compared the back-translation with the original version of the ASBQ). Once the Italian version was confirmed based on the feedback of the English native speaker, the questionnaire was administered to a convenience sample of 12 experts including sports physiotherapists and sports psychologists, and they were asked to rate each item's clarity on a 6-point Likert-type scale from 1 = not clear at all to 6 = totally clear, as well as propose any corrections [9]. After minor changes (adjustments on the placement of the “comma”), the final version of the ASBQ-IT was defined (Supplementary File 1).

To determine the reliability of the questionnaire, based on sample size recommendations requiring at least 300 participants [9], the ASBQ-IT was administered through a web-based service (SurveyMonkey) and distributed through the research network throughout the whole Italian country. This study was approved by the institutional review board (134/2023), and it was performed in accordance with the Declaration of Helsinki. Informed consent was available on the web platform, and all subjects gave their consent by ticking the box. Data were anonymized as participants provided a nickname, being instructed not to use any possible identification (e.g., place of birth, initials, etc.). To be eligible for participation in the study, individuals had to be Italian native

speakers, between 14 and 60 years, and they had to engage in a competitive sport activity for at least 2 years. A total of 402 individuals completed the questionnaire, and among them 388 correctly completed all the items and were therefore included in reliability analysis. To assess test–retest reliability, a subsample of participants ($n = 69$) completed the questionnaire again after two weeks.

Sleep behavior in Italian athletes and association with recovery strategies

To collect information about sleep behavior in Italian athletes and how different recovery strategies might be associated with sleep quality, participants in the reliability study were also asked to respond to some basic demographic questions, questions related to their training and sport characteristics, and finally, questions regarding their knowledge and use of different sport recovery strategies. With regard to recovery strategies, participants were initially asked a dichotomous filter question: “Do you use recovery strategies after training or competition?”. Those who responded affirmatively were subsequently asked to indicate which recovery strategies they used from a predefined list and to specify whether each strategy was used after training or after competition. The response options included sport massage, foam rolling, massage gun, cryotherapy, heat therapy, compression therapy, electrotherapy, and other. Participants were also presented with the following active recovery strategies: stretching, light exercise, mindfulness, counseling, and social activities.

Statistical analysis

Statistical analysis was performed with SPSS v.23 (IBM Inc.). Shapiro–Wilk test for normality of distribution was performed, and data were normally distributed. Descriptive statistics were used to characterize the sample and summarize the results, considering means and standard deviations (SD) for continuous variables and frequencies (percentages) for the categorical variables.

The internal consistency of the ASBQ-IT was assessed using McDonald’s ω and Cronbach’s α as previously recommended [23]. For the test–retest temporal stability of the questionnaire, intraclass correlation coefficients (ICC) with 95% confidence interval based on mean rating, absolute-agreement, a 2-way mixed effects model was used, considering results > 0.70 as acceptable [24].

Based on the ASBQ cut-off scores, participants were grouped in “good sleep behavior” (total score ≤ 36 a.u.) and “poor sleep behavior” (total score ≥ 42 a.u.), and data regarding anthropometrics, sports history/behavior, and recovery practices were compared with an independent samples t -test or chi-square test accordingly, and also reporting mean

differences and 95% confidence intervals (CI). Similarly, a comparison between team sports athletes and individual sports athletes was performed, including the different ASBQ items. Significance for statistical effects was set at $p < 0.05$.

Results

Participants’ age was 25 ± 8 years and 37.3% were females. The main sport disciplines were: volleyball (16.9%), tennis (10.4%), soccer (10.2%), track & field (8.7%), rowing (6.2%), and swimming (5.9%). Team sports were practiced by 58% of the sample, and 16.6% competed at an international level (7 participants were Olympic athletes). In the last month, 23.4% reported they suffered a sport-related injury, resulting in 6.7% of them in a training/competition loss > 28 days.

We conducted sensitivity analysis comparing participants included in reliability analysis ($n = 388$) with those excluded due to incomplete questionnaire responses ($n = 14$). No significant differences emerged in demographic or sport-related characteristics (all $p > 0.05$). These findings suggest that the excluded participants were comparable to the analyzed sample and that the final sample remained representative of the original cohort. Moreover, examination of the missing responses did not reveal any systematic pattern as omissions were distributed across different items rather than concentrate on a specific domain.

ASBQ-IT reliability

The newly developed ASBQ-IT showed an acceptable internal consistency reliability, with McDonald’s ω and Cronbach’s α estimates of 0.638 (95% CI 0.587–0.683) and 0.621 (95% CI 0.564–0.674), respectively. The test–retest reliability assessment showed an acceptable agreement for each item of $r = 0.703$ (95% CI 0.611–0.804) ($p < 0.001$), and total ASBQ-IT showed an intraclass correlation of 0.819 (95% CI 0.723–0.883). All items of the ASBQ-IT showed positive factor loadings, both for the complete scale and the scale divided into the three domains (“routine/environmental factors” 0.203–0.634, “behavioral factors” 0.153–0.414, and “sport-related factors” 0.032–0.608), revealing that they are measuring the same underlying construct of sleep-related behaviors.

Sleep behavior and recovery strategies in Italian athletes

Total ASBQ-IT score of the included sample was 41 ± 6 , ranging from a minimum of 18 to a maximum of 66. Therefore, 46% were categorized as having a “poor sleep behavior” based on the ASBQ cut-off of 42 points and 21.6%

“good sleep behavior” based on the ASBQ cut-off of 36 points. In detail, the “routine/environmental factors” score was 13 ± 3 (on 30), the “behavioral factors” score was 16 ± 3 (on 35), and the “sports-related factors” score was 12 ± 3 (on 25).

When participants were compared according the ASBQ score, athletes with a “bad sleep behavior” were characterized by a higher number of competitions in a month (0.43, 95% CI 0.01–0.86, $p=0.049$), and compared to the “good sleep behavior”, were more likely to participate in a team sport (64% vs. 53%, $p=0.017$), to have suffered from injury in the last month (30% vs. 18%, $p=0.006$), and using recovery strategies (52% vs. 40%, $p=0.018$), in particular local ice (29% vs. 16%, $p<0.001$).

Compared to those participating in individual sport disciplines, the athletes who participated in team sports were older (2 y, 95% CI 0.4–4.0, $p=0.013$), heavier (6.9 kg, 95% CI 4.6–9.2, $p<0.001$) and taller (0.06 m, 95% CI 0.04–0.07, $p<0.001$), performed less training in a week (-1.2 , 95% CI -2.3 to -0.1 , $p=0.032$) but more competitions in a month (1.0, 95% CI 0.6–1.4, $p<0.001$) (Table 1). In terms of sleep behaviors, team sports athletes reported a higher score (more frequent behaviors) in some items, such as “training or competing after 19:00” (0.8 a.u., 95% CI 0.5–1.1, $p<0.001$), “consuming alcohol before going to sleep” (0.4 a.u., 95% CI: 0.3–0.6, $p<0.001$), “sleeping at home in a less than ideal environment” (0.2 a.u., 95% CI 0.0–0.3, $p=0.044$), and a lower score for “going to sleep with sore muscles” (-0.3 a.u., 95% CI 0.4 to -0.1 , $p=0.003$), “taking sleeping aids” (-0.2 a.u., 95% CI -0.3 to -0.0 , $p=0.010$), and “traveling impairs a balanced wake–sleep rhythm” (-0.2 a.u., 95% CI -0.4 to 0.0, $p=0.046$) (Fig. 1).

Considering the use of recovery strategies, 45.5% reported regular use of at least one recovery strategy, primarily foam rolling (32.8%), sports massage (therapist 25.6%, percussive massage 21.6%), cryotherapy (local ice 20.6%, whole body 4.7%). Active recovery and other strategies, such as stretching, light exercise, mindfulness, etc., were commonly used by 53.7% of the participants. Finally, wearables were used by 30.8% of the participants, but only 3.0% used them to assist their recovery. Those who reported to regularly use recovery strategies were characterized by a higher number of monthly competitions (0.7, 95% CI 0.3–1.1, $p=0.001$), a higher volume of training/competitions in a week (5 h, 95% CI 3–6, $p<0.001$), and compared to those not using recovery strategies, were most likely females (44% vs. 31%, $p=0.008$), competed at a higher level (all Olympic athletes used recovery strategies, $p<0.001$), and suffered from recent injuries (32% vs. 16%, $p<0.001$) (Table 2). In terms of association between the use of recovery strategies and the sleep behaviors, accordingly to the higher ASBQ score, athletes using recovery strategies reported higher items score related to “going to sleep with sore muscles” (0.4 a.u., 95% CI: 0.3–0.6, $p<0.001$), “overthinking, worrying and planning while in bed” (0.4 a.u., 95% CI 0.2–0.6, $p<0.001$), “taking sleeping aids” (0.3 a.u., 95% CI -0.1 to 0.4, $p<0.001$), “not sleeping at home” (0.4 a.u., 95% CI: 0.2–0.6, $p<0.001$), “traveling impairs a balanced wake–sleep rhythm” (0.3 a.u., 95% CI 0.1–0.5, $p=0.002$), but less “using electronic devices before going to sleep” (-0.2 a.u., 95% CI: -0.1 to -0.4 , $p=0.010$) (Fig. 2).

Table 1 Demographics and sport characteristics of the sample according to the sport type

	Individual Sport ($n=169$)	Team Sport ($n=233$)	Significance
Age (years)	23 ± 8	25 ± 8	0.013
Females [n (%)]	72 (43)	78 (33)	0.062
BM (kg)	67.5 ± 11.2	74.4 ± 12.3	<0.001
Height (m)	1.74 ± 0.09	1.80 ± 0.09	<0.001
Trainings/wk (count)	6 ± 3	5 ± 7	0.032
Training duration (h)	2.1 ± 0.7	2.9 ± 10.0	0.310
Competitions/month (count)	2 ± 2	3 ± 2	<0.001
Competition level [n (%)]			<0.001
Regional	60 (36)	142 (61)	
National	65 (38)	68 (29)	
International	39 (23)	21 (9)	
Olympic	5 (3)	2 (1)	
Total exercise volume (h/wk)	15.5 ± 8.3	12.0 ± 7.5	<0.001
Recent injury [n (%)]	38 (22)	56 (24)	0.717

Notes: body mass (BM); bold values for $p<0.05$ at the independent samples t -test or chi-square test

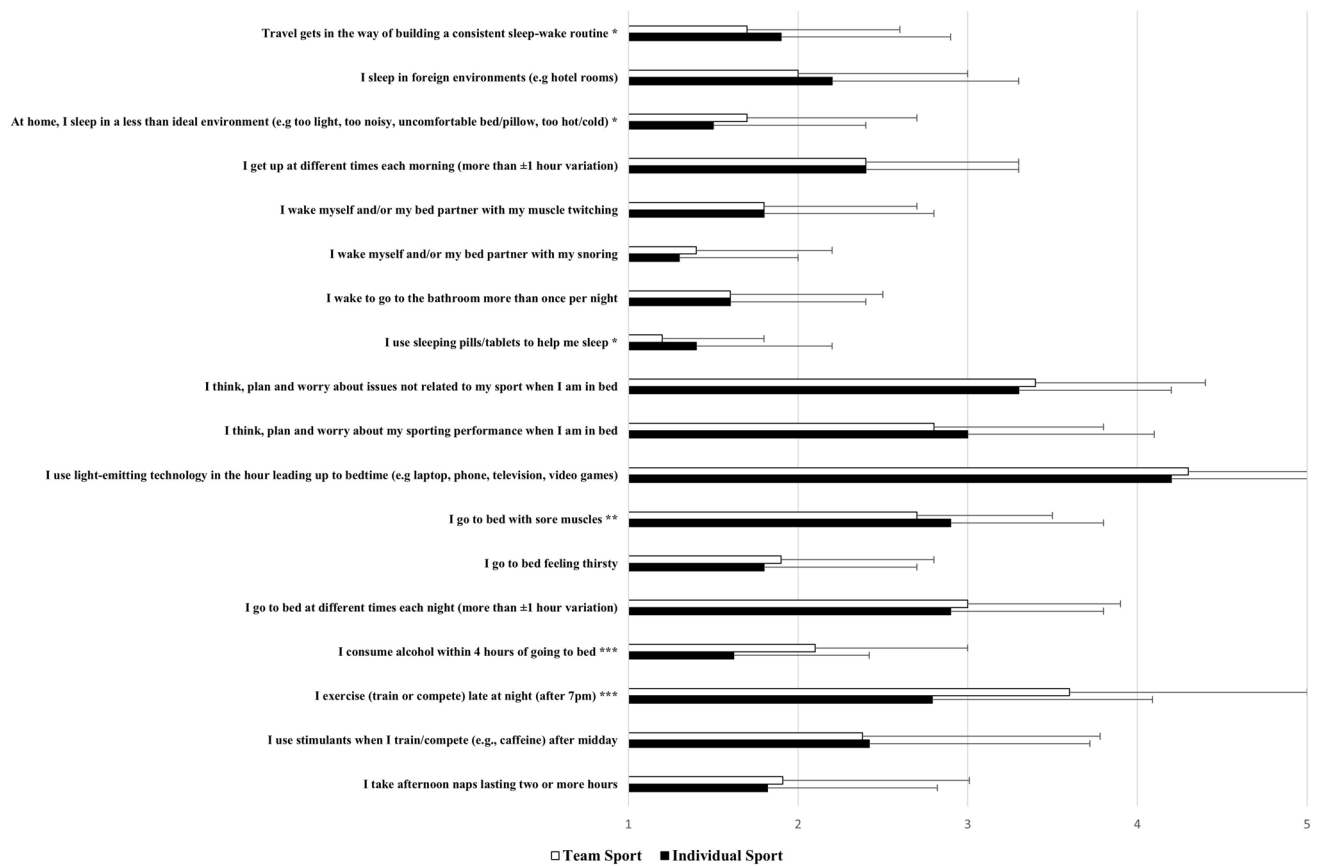


Fig. 1 Details of the ASBQ-IT results, comparing individual ($n = 169$, black bar) and team ($n = 233$, blank bar) sport athletes. Comparison at the independent samples t -test: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2 Demographics and sport characteristics of the sample according to the use of recovery strategies

	No Recovery ($n = 219$)	Recovery ($n = 183$)	Significance
Age (years)	25 ± 9	25 ± 7	0.264
Females [n (%)]	69 (31)	81 (44)	0.008
BM (kg)	71.5 ± 12.9	71.5 ± 11.6	0.957
Height (m)	1.77 ± 0.09	1.77 ± 0.10	0.782
Trainings/wk (count)	5 ± 7	6 ± 3	0.077
Training duration (h)	2.0 ± 0.5	3.3 ± 11.0	0.073
Competitions/month (count)	2 ± 2	3 ± 3	0.001
Competition level [n (%)]			< 0.001
Regional	136 (62)	66 (36)	
National	62 (28)	71 (39)	
International	21 (10)	39 (21)	
Olympic	0 (0)	7 (4)	
Total exercise volume (h/wk)	11.3 ± 6.5	16.2 ± 8.8	< 0.001
Recent injury [n (%)]	36 (16)	58 (32)	< 0.001

body mass (BM); bold values for $p < 0.05$ at the independent samples t -test or chi-square test

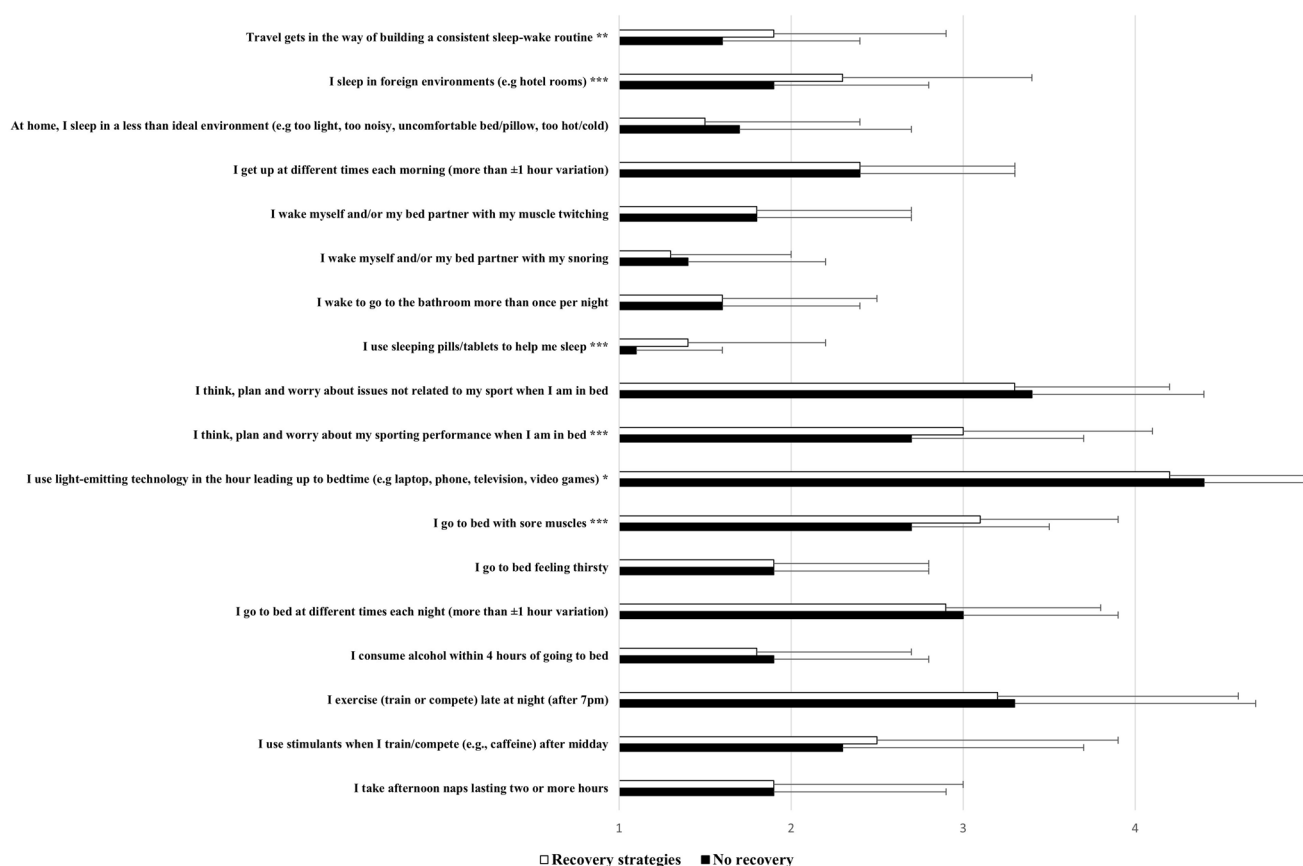


Fig. 2 Details of the ASBQ-IT results, comparing athletes with no typical use of recovery strategies ($n=219$, black bar) and athletes with a typical use of recovery strategies ($n=183$, blank bar). Comparison at the independent samples t -test: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Discussion

To the best of the authors' knowledge, to date, this is the first study aimed to validate the Italian version of the ASBQ. In addition, as recovery strategies are becoming popular in sports, this survey aimed to explore the most commonly self-reported recovery modalities and their potential association with sleep behaviors.

The ASBQ-IT showed satisfactory psychometric properties, with acceptable reliability and validity in this population ($\omega = 0.638$, $\alpha = 0.621$, temporal stability ICC = 0.819) only slightly inferior to previous translations and adaptations [20]. Indeed, the recent meta-analysis of Cronbach's alpha reported an estimated average correlation coefficient of 0.72, with a 95% CI between 0.63 and 0.80. Nevertheless, the original version of the ASBQ reported a coefficient of 0.63 [6]. Despite some translations showing higher reliability coefficients [9, 11], some others showed coefficients in line with the present translation [10, 12]. Among the possible reasons for these coefficients, the small number of items in the ASBQ, the multifaceted nature of sleep behavior in athletes, the assumption that all scale items are equally reliable, and the unidimensional factor structure can

be hypothesized [20]. Considering such possible limitations, McDonald's omega has been recommended, but it has been rarely reported in the ASBQ translations [20]. The temporal stability of the questionnaire, assessed through test-retest reliability, was higher than 0.8, suggesting that the ASBQ-IT provides consistent results over time. This psychometric property is critical as the ASBQ has been designed and recommended as a tool to evaluate possible poor sleep behaviors rather than a diagnostic tool as such serving also as a measure to detect the effects of some specific sleep hygiene interventions [1, 6]. Indeed, the usefulness of the ASBQ to identify poor behaviors and address them with targeted sleep hygiene protocols has been investigated, suggesting it might enhance sleep indices in elite male cricket athletes [25].

Based on the results of this survey, a large proportion of Italian athletes (46%) were characterized by ASBQ scores above the recommended cut-off indicating "poor sleep behaviors", and only 21.6% had "good sleep behaviors". In particular, the majority of team sports athletes (64%) were characterized by poor sleep behaviors: among the possible reasons, being the item with the largest difference, team sports athletes typically train or compete later in the evening, potentially influencing their sleep quality. Some studies have

recently been performed to investigate sleep and chronobiology in Italian athletes [26–28]. In particular, a recent study in Italian athletes of different disciplines used the Pittsburgh Sleep Quality Index (PSQI), the Sleep Hygiene Index (SHI), and the Morningness Eveningness Questionnaire (MEQ), finding poor sleep hygiene in 16.1% of the sample and good sleep in 55.4% of the sample, with individual sports athletes showing lower PSQI and SHI scores compared to team sports, in line with our findings suggesting worse sleep behaviors in team sports athletes.

Contrary to our initial hypothesis, athletes reporting a regular use of recovery strategies did not demonstrate better ASBQ scores. However, given the cross-sectional nature of the present study, these findings should not be interpreted as evidence that recovery strategy use influences sleep behaviors. Rather, the observed association is likely explained by differences in training and competition demands. Indeed, athletes reporting a regular use of recovery strategies were also characterized by a higher number of competitions per month, greater weekly training and competition volume, higher competitive level, and a greater prevalence of recent injuries. Furthermore, among the ASBQ items, these athletes reported higher scores for factors, such as muscle soreness, overthinking in bed, use of sleeping aids, and sleeping in non-home or travel environments.

In this context, training load and competition-related demands may represent important confounding factors underlying the association between recovery strategy use and ASBQ scores. Athletes exposed to greater physical and logistical demands are likely both to adopt recovery strategies more frequently and report behaviors associated with poorer sleep. This interpretation is further supported by the finding that, among the individual recovery strategies examined, only local ice application was significantly associated with higher ASBQ scores. The use of local ice may reflect increased muscle soreness and recovery needs rather than a detrimental effect of the recovery strategy itself on sleep behaviors. Indeed, current evidence does not support the notion that these recovery practices negatively affect sleep [29, 30].

An intriguing finding of this study is the higher proportion of female athletes reporting to use recovery strategies compared with male athletes. Previous findings suggest that female athletes are more likely to report psychological symptoms and nutritional causes of underperformance compared with male athletes. Nevertheless, more literature is needed to confirm and better describe sex differences in the use and effectiveness of recovery strategies [31, 32].

An additional consideration is that recovery strategy use was assessed only as a binary variable (user vs. non-user), without collecting information regarding frequency, duration, or cumulative exposure to each strategy. Therefore,

the present analyses do not allow exploration of potential dose–response relationships between recovery strategy use and sleep-related behaviors. While recovery strategy use was included as an ancillary variable within the broader scope of questionnaire validation, future studies should examine whether the frequency, type, and combination of recovery strategies differentially influence sleep-related behaviors and sleep quality outcomes.

Although the internal consistency indices (Cronbach's $\alpha=0.621$; McDonald's $\omega=0.638$) are comparable to those reported in the original validation study, they should be interpreted with caution as they fall within the “questionable” to “low” range according to current psychometric standards. This represents an important limitation of the present study. The relatively low internal consistency observed in the Italian sample may reflect the multifaceted nature of sleep behaviors. However, it may also indicate that the original three-domain structure (routine, behavior, and sport-related factors) is not fully supported in this population. Therefore, the present findings should not be interpreted as definitive evidence supporting the original factor structure. While the exploratory analysis provided preliminary support for the questionnaire structure, it cannot substitute for confirmatory factor analysis (CFA). While conducting a CFA was beyond the scope of the present translation and cross-cultural validation study, it would represent the most appropriate approach to testing the fit of the original three-factor model. Future research should therefore include CFA in larger and more heterogeneous samples to further evaluate the structural validity of the ASBQ-IT and strengthen the psychometric evidence supporting its use.

Taken together, to the best of the authors' knowledge, the ASBQ-IT is the only Italian tool that has been currently translated and validated to evaluate sleeping habits and behaviors in athletes. In detail, this tool aims to investigate different aspects of sleep behaviors that might impact sleep quality, including behaviors directly affecting sleep, behaviors related to anxiety, and sleep disturbances [9]. Although this tool is not intended to first identify poor sleep quality, it is recommended to detect poor sleep habits that could be targeted to improve sleep with tailored sleep hygiene protocols [1]. Among the strengths of this study, large sample size, wide participation of athletes from different sport disciplines, competition levels, and national involvement encourage the generalizability of these findings. However, internal consistency was a little lower than the average, but in line with the original and some translated versions, while temporal stability was sufficiently accurate. Future studies are recommended to build a stronger evidence base for the use and application of the ASBQ-IT in Italian athletes.

Conclusion

As poor sleep behaviors could be associated with poor sleep quality and affect physical and cognitive performance, this study proposes a translated version of the ASBQ, which has been validated in a large sample of Italian athletes. Query The ASBQ-IT has been shown to have sufficient reliability and can be administered in this population. Moreover, this study has highlighted some differences between individual and team sport athletes, and for the first time, has suggested some possible association between sleep behaviors and the use of other recovery strategies. Therefore, the ASBQ-IT is a simple, fast, and reliable tool that might help to identify Italian athletes with poor sleep behaviors and support their coaches and healthcare staff to promote well-tailored sleep hygiene interventions.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s11332-026-01853-z>.

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Author contribution A.B.S., A.F. and L.M. conceptualized the study, collected the data and performed the primary analysis. A.B.S., R.S. and A.G. analyzed and interpreted the data. A.B.S., F.I. and M.D. drafted the main manuscript text and L.M. and A.G. critically reviewed it. All authors reviewed and approved the final version of the manuscript.

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Data availability Anonymized data can be requested upon reasonable request to the corresponding author.

Declarations

Conflict of interest The authors declare no competing interests. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Informed consent All the participants and their legal guardians were requested to sign an informed consent.

Ethical approval All procedures were approved by the ethical committee of the [removed for review] (protocol code 134/2023, 09.2023).

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