Measurement characteristics of athlete monitoring tools in professional Australian football

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Abstract

Purpose: To examine the measurement reliability and sensitivity of common athlete monitoring tools in professional AF players.

Methods: Test-retest reliability (noise) and weekly variation (signal) data were collected from 42 professional Australian footballers from one club during a competition season. Perceptual wellness was measured via questionnaires completed before main training sessions (48, 72 and 96 h post-match), with players providing a rating (1-5 Likert scale) regarding their muscle soreness, sleep quality, fatigue level, stress and motivation. Eccentric hamstring strength and countermovement jump performance was assessed via proprietary systems once per week. Heart rate recovery (HRR) was assessed via a standard submaximal run test on a grass-covered field with players wearing a heart rate monitor. The HRR was calculated by subtracting average heart rate during final 30 s of exercise from average heart rate during final 10 s of rest. Typical test error was reported as coefficient of variation (CV% and TE). Sensitivity was calculated by dividing weekly CV by test CV to produce a signal-to-noise ratio (SNR).

Results: All measures displayed acceptable sensitivity. SNRs ranged from 1.3-11.1. ICCs ranged from 0.30 to 0.97 for all measures.

Conclusions: The HRR test, CMJ test, eccentric hamstring strength test and perceptual wellness all possess acceptable measurement sensitivity. SNR analysis is a novel method of assessing measurement characteristics of monitoring tools for professional AF players. These data can be used by coaches and scientists to identify meaningful changes in common measures of fitness and fatigue.

Key Words: athlete monitoring, reliability, sensitivity

Introduction

Athlete monitoring systems are commonly used in professional team sports to provide coaches and scientists with an understanding of player performance readiness and injury risk.[1-3] Information from these systems is used to plan training load to maximise adaptations whilst maintaining player availability for competition.[4] Recent research and technological advances has increased the number of tools available to assess constructs of fitness and fatigue. These include submaximal heart rate tests,[5] countermovement jump tests,[6] lower limb muscular strength tests[7] and perceptual wellness questionnaires.[8]

Due to environmental constraints and risk of injury in fatigued athletes, it is impractical for professional team sport athletes to complete maximal physical capacity tests during the season to determine changes in fitness and fatigue.[9] Therefore, practitioners rely on monitoring tools that are submaximal in nature and can identify changes in constructs of fitness and fatigue regularly throughout training and competition to assess the performance readiness of their players. To provide useful information to coaches and scientists, these tools should display measurement characteristics of validity (the ability of a test to measure what it is designed to measure), reliability (the consistency of results from a test) and sensitivity (the extent to which a test can detect changes beyond the typical error in results).[10,11] Reliability can be assessed via test-retest analysis, where measurements are collected from the same individuals under identical test conditions.[12] This produces a typical error measure, often expressed as a coefficient of variation percentage (CV%) that indicates the level of error to be accounted for when interpreting changes in that test.[13] Using the CV%, the sensitivity of a test can be established via signal-to-noise anlysis.[12] Indeed, measurement signal is often assessed via intervention studies where responsiveness (i.e. a change in performance) is measured following the intervention,[14] however this is not possible in professional team sport environments due to time and cost constraints. Therefore, in the case of team sport athlete testing, "signal" refers to individual changes in a monitoring test in response to training stimuli (provided by a valid test), while "noise" is represented by the typical error in the measurement (from test-retest reliability analysis). Measurement signal and noise can be combined to produce a signal-to-noise ratio (SNR), providing practitioners with an index of responsiveness in a measure relative to the typical error in the test. This information is important to coaches and scientists as it allows confident interpretation of athlete monitoring data by identifying meaningful changes (i.e. those that exceed the "noise" in the test).

Studies in professional Australian Football (AF) have shown perceptual wellness questionnaires are sensitive to weekly change in training load[8] and match load,[15] suggesting they are valid measures of training response in this athletic population. However, the measurement characteristics of perceptual wellness questionnaires has received little research attention. A study of collegiate basketballers reported a total wellness test CV% of 6.9,[6] while research in professional AF reported a Chronbach's alpha of 0.87 as a measure of reliability on a composite scale of nine wellness constructs.[8] These findings indicate that perceived wellness questionnaires possess acceptable reliability as measured by CV%,[12] however the capability of these questionnaires to detect changes that exceed the typical error is unknown. Moreover, no research has examined the reliability of perceived wellness using individualised z-scores. Additionally, while the Nordic eccentric hamstring strength test possesses acceptable reliability as a measure of hamstring force production and can discriminate between previously injured and uninjured athletes,[16] the sensitivity of this test in professional AF players has not been established.

Submaximal heart rate tests may be administered at regular intervals to provide practitioners with a non-fatiguing assessment of changes in aerobic fitness in team sport athletes.[17] Previous research in professional AF reported a submaximal heart rate recovery test to be a valid and reliable measure of training status.[17] However, the capacity of this test to detect changes exceeding the typical error has not been examined in this athletic population. Additionally, countermovement jump tests (CMJ) are commonly used to assess neuromuscular fatigue in professional AF players.[18,19] CMJ performance has been shown to be responsive to match load, with substantial reductions in CMJ flight time following competition matches,[19] while another study reported decreases in CMJ performance were related to increases in low-speed movement and reduced accelerations during competition matches.[18] Moreover, CMJ performance has been shown to demonstrate acceptable measurement reliability in team sport athletes, with CV ranging from 1.1% to 7.1% across a range of jump variables.[20] However, no research has investigated if weekly variation in CMJ performance exceeds the typical error in this test among professional AF players.

Collectively, research suggests that perceptual wellness questionnaires, eccentric hamstring strength tests, CMJ tests and submaximal heart rate tests possess varying levels of reliability among a range of athlete cohorts. However, the extent to which changes in these tests exceed their typical error remains unknown, limiting interpretability of test results for coaches and scientists. Therefore, the purpose of this study was to establish the reliability and sensitivity of common monitoring tests in a professional AF population. This information will allow coaches and scientists of professional AF teams to confidently identify and interpret meaningful changes in commonly collected monitoring data.

Methods

Subjects

Data were collected from 45 professional Australian footballers (age: 24.6 ± 4.0 y; height: 1.88 ± 0.07 m; weight: 86.0 ± 9.0 kg) from one club during the 2018 AFL competition season (week prior to round 1 to round 23, i.e. March to August). Informed consent and institutional ethics approval were obtained (UTS HREC: ETH17-1942). Reliability and weekly variation testing protocols were identical for all four tests. The number of subjects varied between measurement tests and is reported in Table 2 and Table 3.

Perceptual wellness

Players completed a short questionnaire on a smartphone device before the main field training session (7:00 to 9:00) prior to each competition match, prompting them to provide a rating from 1 to 5 (1 representing a low or poor rating and 5 representing a high or good rating) in relation to their perception of muscle soreness, sleep quality, fatigue level, stress and motivation. The questionnaire used in this study was customised for the observation group based on a common protocol used in previous research.[21] Test-retest reliability was conducted using an identical protocol on a main training day (96 h post-match in the final week of competition), approximately 30 minutes after their initial completion of the questionnaire, consciously avoiding recall of their previous responses. This method of reliability assessment was based on previous research in elite athletes.[22] All perceptual wellness responses were reported relative to players' individual mean and standard deviation as a z-score.[15]

Eccentric hamstring strength

Eccentric hamstring strength was assessed once per week (72 hours post-match) in the afternoon following the main skills training session of the week using a proprietary hamstring strength testing system (Nordbord, Vald Performance, Albion, Australia). Players placed their feet inside two hooks at the back of the Nordbord (superior to the lateral malleolus of each ankle) and slowly moved their torso forward, with their bodyweight eliciting contraction of the hamstring muscle group. Once in a near-flat prone position, players placed their hands in front of themselves and gently fell toward the floor. Verbal cues were provided to prompt a 50% warm up repetition (i.e. not maximal effort), followed by three maximum effort repetitions. Test results were analysed by limb force in Newtons (left, right and average). This protocol was based on a previous study using a customised apparatus,[16] however no research has established specific protocols for the system used in this study. Test-retest reliability was conducted using an identical protocol in the afternoon of a typical training day, with maximal tests separated by three minutes of static recovery.[16]

CMJ performance

CMJ performance was assessed once per week (96 hours post-match) during a strength training session in the afternoon following the main skills session of the week during the competition season. Players held a wooden rod (12 x 1200 mm) across their shoulders and were instructed to choose a depth where they felt they could jump as high as possible. Verbal cues were provided to prompt a 50% warm up repetition, followed by three maximum effort repetitions from the same starting position. This protocol was based on previous research using similar testing systems.[23,24] Force and jump height were measured by a proprietary force plate system (ForceDecks, Vald Performance, Albion, Australia) with a sampling rate of 1000 Hz. Test-retest reliability was conducted using an identical protocol in the afternoon of a main training day, with tests separated by five minutes of passive recovery.[23] Variables chosen for analysis were based on previous studies in professional AF players[20] and collegiate athletes,[23] including peak jump height, mean concentric force, reactive strength index, relative peak power and relative peak force.

Submaximal heart rate test

Submaximal heart rate tests were conducted on eight occasions throughout the competition season (48 hours post-match) as part of a warm up for the main skills session of the week. Players were instructed to run back and forth on a grass-covered field over 80-m intervals for five minutes at a submaximal speed (12 $km \cdot h^{-1}$) while wearing a heart rate monitor (Polar T31 Wireless Heart Rate Monitor, Polar Australia). Players were prompted by a beep at the end of each running interval to ensure they maintained the correct running speed. Following the exercise protocol, players were instructed to sit on the ground and remain still for 60 s. Heart rate data was captured using 10 Hz Global Positioning System (GPS) units worn by each individual player between their scapulae within a small pouch in their training jersey, and downloaded using proprietary software (Openfield 1.20.0, Catapult Sports, Melbourne, Australia) following each test. The average heart rate (beats per minute) of each player in the final 30 seconds of the test period (HRex) and in the final 10 s of the 60 s recovery period (HRR) were collected.[17] Heart rate recovery was calculated by subtracting the average heart rate (beats per minute) during the final 30 s of the heart rate test from the average heart rate during the final 10 s of the 60 s rest period. Individual maximum heart rate values were derived from maximal testing (2-km time trial) conducted during the preseason training period.[25] Test-retest reliability was conducted using an identical protocol, with tests separated by a non-training day (48 hours) during the preseason training period.

Statistical analyses

Data were exported from proprietary software and collated in a customised Microsoft Excel spreadsheet (Microsoft, Redmond, USA). Test-retest reliability was assessed using customised spreadsheets[26] to calculate the typical error, expressed as a coefficient of variation percentage (CV%), and intraclass coefficient (ICC) for CMJ test, eccentric hamstring test and HRR test. Perceived wellness reliability was calculated using the same spreadsheets to generate a TE (typical error) value, as z-scores did not require log-transformation. Normality of wellness data was confirmed via inspection of histograms. Typical weekly variation was assessed using the same custom spreadsheets (CV%).[26] Weekly perceptual wellness was categorised by number of hours post-match (48, 72 and 96 hours) as it was the only measure collected at multiple time points within a training week. The SNRs for the four tests at each time point were calculated by dividing weekly variation by the CV or TE established via test-retest reliability. Mean, standard deviation and 90% confidence intervals were also calculated.[12] SNRs were assessed as "poor" if <1.0, "acceptable" if 1.0-1.5, and "good" if >1.5, adapted from research in other professional sports.[22,27]

Results

Test-retest reliability results for perceptual wellness, eccentric hamstring strength, CMJ and heart rate recovery are shown in Table 1. Weekly variation and SNRs are shown in Tables 2 and 3. All monitoring measures at all time points displayed acceptable to good SNRs. ICCs ranged from 0.30 to 0.97 across all other measures.

Table 1 near here

Table 2 near here

Table 3 near here

Discussion

The aim of this study was to establish the measurement reliability and sensitivity of common monitoring tests in professional AF players. Our findings show that the heart rate recovery test, CMJ test, eccentric hamstring strength test and perceptual wellness test all possess acceptable sensitivity and therefore can confidently be used by coaches and scientists of professional AF teams to identify meaningful changes in constructs of fitness and fatigue in their players.

The present results showed that all wellness measures displayed acceptable SNRs at 48, 72 and 96 hours post-match, with perceived stress displaying the greatest sensitivity (SNR: 1.3 to 11.1). Notably, perceived stress and perceived soreness were the only two elements to display SNRs of >2.0 at any time point, suggesting that these are the most responsive to training stressors of the five wellness elements examined in this study. Interestingly, perceived stress displayed the equal-lowest SNR at 96 hours post-match, suggesting that factors affecting player stress levels were most influential at 48 and 72 hours post-match, possibly related to the previous week's match. Overall, SNRs for all wellness elements were lower (i.e. a weaker signal) at 96 hours post-match than at earlier time-points, with perceived soreness the only element to display a SNR of >1.5, indicating that players had stable perceptions of stress, motivation, sleep quality and fatigue within 96 hours post-match. This is in agreement with previous research in professional rugby league that reported perceived fatigue, general wellbeing and soreness to return to pre-game values within four days post-match.[21] Other research in professional AF also reported perceived fatigue, stiffness, sleep quality, stress and general wellbeing to improve as gameday approached (i.e. as hours following the previous match increased).[8] Another notable finding of the current study was that perceived sleep quality, motivation and fatigue displayed relatively low SNRs at all time points (SNR: 1.3 to 1.4). This suggests that players perceive changes in these elements as small throughout a typical training week, therefore coaches and scientists should interpret changes in sleep quality, motivation and fatigue with relative caution. Perceived sleep quality, fatigue and motivation also displayed the highest typical error of the five elements examined in this study, indicating poor reliability. Collectively, our findings suggest that perceived stress and soreness provide the most useful information regarding a player's perceived readiness to train on the basis of acceptable reliability and relatively good responsiveness to training stressors.

Submaximal heart rate tests are considered valid measurements of aerobic fitness in individual and team sport athletes.[28,29] We found the typical test error in HRex and HRR to be considerably higher than those reported in previous research using similar protocols,[17] with disparities possibly due to subtle differences in test protocols, the smaller sample of players and the different manufacturer of the heart rate monitors used in the present study. Moreover, the previous study performed testing on an artificial turf surface indoors in contrast to our testing being conducted outdoors, the latter being less of a controlled testing environment. Additionally, different temperatures on testing days in the present study (20.0 degrees Celsius and 25.5 degrees Celsius, respectively) may further explain the difference in findings. Nonetheless, despite the relatively high typical error reported in our study, HRex and HRR displayed acceptable SNRs, indicating that the test can identify changes that exceed the typical error. Notably, HRex displayed greater sensitivity than HRR (5.3 compared to 1.4), therefore we suggest using heart rate during submaximal exercise in preference to heart rate during recovery as a training monitoring test in professional AF. Indeed, our study demonstrates that this is a non-invasive test[30] and hence we recommend the inclusion of a submaximal heart rate recovery test in monitoring systems of professional AF players.

The eccentric hamstring strength test in the present study demonstrated lower typical error (CV%: 2.9 – 4.2%) compared to previous research in recreational athletes (CV%: 5.8 – 8.5)[16] and professional footballers (CV%: 4.3 – 6.3).[9] In contrast with the previous study, we assessed reliability using highly-trained athletes who were very familiar with testing protocols. Notably, left limb force production displayed a poorer reliability (CV%: 4.2) and subsequently a lower SNR than right limb (CV%: 3.3) and average force (CV%: 2.9) respectively, which may be due to the specific bilateral strength imbalances of the observation group. Our finding agrees with a previous study in professional footballers that reported a lower test error for force values collected from players' dominant leg (CV%: 4.3) compared to non-dominant leg (CV%: 5.4). This supports monitoring of individual changes in dominant and non-dominant leg hamstring strength in professional football. Collectively, our findings suggest that the test used in the present study is a reliable and sensitive method to assess eccentric hamstring strength in professional AF players throughout a competition season.

Previous research has assessed the reliability of the CMJ test[20] and relationships between CMJ performance and external load[18] in team sport athletes, no studies have determined the sensitivity of this test in professional AF players. The present study examined reliability and sensitivity of five CMJ variables, with concentric mean force (SNR: 2.3) and relative peak force (SNR: 2.5) displaying the greatest capability to detect changes that exceed the typical test error. Interestingly, these two variables also displayed similarly low typical test error (CV%: 2.1 and 2.6, respectively) to those reported previously,[20] suggesting they may be the most responsive CMJ measures for coaches and scientists of professional AF teams to monitor. However, previous research in collegiate athletes reported lower inter day CVs than those reported in our study, with test CV% ranging from 2.7 – 4.3% in relative peak power, relative peak force and relative mean force.[23] The differences in findings may be explained by the design of the present study in measuring CMJ performance within a professional AF training environment in contrast to reliability research conducted in a laboratory setting on three occasions during a seven-day period used in previous research.[23] We also examined the reliability and sensitivity of reactive strength index (RSI), which has been suggested as a superior measure to jump height and other force and power variables in assessing the stretch-shortening cycle of athletes and therefore their explosiveness when jumping.[31,32] Research in professional rugby league reported players with a greater RSI demonstrated superior force, power and impulse during both the concentric and eccentric phases of a CMJ in comparison to their lower RSI counterparts.[32] We found RSI to have relatively low typical error (CV%: 7.0%) and high sensitivity (SNR: 1.9), indicating it to be a useful global measure of CMJ performance in professional AF players.

While the results of this study provide information on the reliability and sensitivity of common measures for monitoring professional AF players, caution should be taken when generalising these findings. The current study did not relate these monitoring data against outcome measures (i.e. injury or performance), therefore further work is required to establish their efficacy as monitoring tools. Additionally, while the wellness measures examined in this study are commonly used and based on previous research, they have not been developed using accepted psychometric validation approaches, therefore it is recommended that changes exceeding the typical error in the measures reported in this study be interpreted alongside other monitoring data. Further, a possible confounding factor on our results was the collection of test-retest data obtained for eccentric hamstring strength and countermovement jump performance following a field training session. While conducting these tests on a non-training day is preferable, our methods reflect a typical training environment in professional AF football where eccentric testing is not conducted prior to main skills training sessions, providing strong ecological validity for our results.

Conclusion

The present study examined the reliability and sensitivity of commonly used monitoring tools in professional AF. Our findings provide a framework for assessing sensitivity of monitoring tests and can inform practitioners on meaningful changes in results of these tests. While we classified tests with a SNR of 1.0 – 1.5 as acceptable, those that display a SNR of >1.5 will provide practitioners with more useful information when assessing changes in constructs of fitness and fatigue.

Practical applications

- Perceived wellness questionnaires, eccentric hamstring strength tests, countermovement jump tests and submaximal heart rate recovery tests demonstrate acceptable to good sensitivity.
- Monitoring perceived sleep quality, motivation and fatigue via wellness questionnaires provides little insight into the fitness and fatigue status of professional AF players.
- SNR analysis is a novel method of assessing the capacity of a measure to detect changes that exceed typical test error when monitoring professional AF players.

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Table 1: Test-retest reliability of heart rate recovery, perceptual wellness, countermovement jump and eccentric hamstring strength tests.

Monitoring measure	Mean	SD	Subjects	CV/TE (90% CI)	ICC
Heart Rate					
HRex (bpm)	88.8	5.3	16	1.2% (0.9, 1.7)	0.95
HRR (bpm)	28.7	7.0	16	5.0% (3.9, 7.3)	0.60
Perceptual Wellness					
Perceived stress (z-score)	0.0	0.1	14	0.07 (0.06, 0.11)	0.45
Perceived soreness (z-score)	0.2	0.5	14	0.29 (0.22, 0.43)	0.77
Perceived motivation (z-score)	-0.1	1.0	14	0.60 (0.46, 0.89)	0.72
Perceived sleep quality (z-score)	-0.1	1.1	14	0.71 (0.54, 1.05)	0.64
Perceived fatigue (z-score)	0.2	0.8	14	0.65 (0.50, 0.97)	0.30
Countermovement Jump					
Peak jump height (cm)	38.2	5.2	18	3.9% (3.1, 5.5)	0.93
Mean concentric force (N)	1792.9	195.4	18	2.1% (1.7, 3.0)	0.97
Reactive strength index (m/s)	0.56	0.11	18	7.0% (5.4, 9.9)	0.90
Relative peak power (W/kg)	54.1	5.4	18	3.5% (2.8, 5.0)	0.89
Relative peak force (N/kg)	25.3	2.1	18	2.6% (2.0, 3.6)	0.92
Eccentric Hamstring Strength					
Left limb hamstring strength (N)	391.4	63.4	18	4.2% (3.3, 5.9)	0.89
Right limb hamstring strength (N)	401.1	67.5	18	3.3% (2.6, 4.7)	0.87
Average limb hamstring strength (N)	396.4	63.9	18	2.9% (2.2, 4.0)	0.92

HRex: exercise heart rate; HRR: heart rate recovery; bpm: heart beats per minute; cm: centimeters; N: Newtons; W/kg: watts per kilogram of body weight; N/kg: Newtons per kilogram of body weight; m/s: metres per second; SD: standard deviation; CV: coefficient variation percentage; CI: confidence interval; ICC: intraclass coefficient.

Table 2: Weekly variation and signal-to-noise ratio of heart rate recovery, countermovement jump and eccentric hamstring strength tests.

Monitoring measure	Mean	SD	Subjects	CV (90% CI)	SNR	SNR Rating
Heart Rate (n = 176)						
HRex (bpm)	81.6	6.2	41	7.4 (6.5, 8.9)	5.3	Good
HRR (bpm)	35.4	10.6	41	23.9 (16.2, 28.6)	1.4	Acceptable
Countermovement Jump (n = 206)						
Peak jump height (cm)	38.0	4.4	35	5.9 (5.4, 6.6)	1.5	Acceptable
Mean concentric force (N)	1806.4	225.8	35	4.9 (4.5, 5.5)	2.3	Good
Reactive strength index (m/s)	0.50	0.10	35	13.5 (12.2, 15.2)	1.9	Good
Relative peak power (W/kg)	53.7	5.1	35	5.4 (4.9, 6.1)	1.5	Good
Relative peak force (N/kg)	25.3	2.5	35	6.4 (5.8, 7.2)	2.5	Good
Eccentric Hamstring Strength (n = 543)						
Left limb hamstring strength (N)	378.2	78.1	39	8.4 (7.9, 8.9)	2.0	Good
Right limb hamstring strength (N)	387.1	74.6	39	7.9 (7.4, 8.4)	2.4	Good
Average limb hamstring strength (N)	382.6	74.0	39	7.0 (6.6, 7.4)	2.4	Good

SNR: signal-to-noise ratio; HRex: exercise heart rate; HRR: heart rate recovery; bpm: heart beats per minute; cm: centimeters; N: Newtons; W/kg: watts per kilogram of body weight; N/kg: Newtons per kilogram of body weight; m/s: metres per second; SD: standard deviation; CV: coefficient variation percentage; CI: confidence interval.

Table 3: Weekly variation and signal-to-noise ratio of perceptual wellness measures at 48, 72 and 96 hours post-match.

Monitoring measure	Mean	SD	Subjects	TE (90% CI)	SNR	SNR Rating
48 hours post-match (n = 576)						
Perceived stress (z-score)	0.0	0.7	42	0.78 (0.73, 0.83)	11.1	Good
Perceived soreness (z-score)	0.0	0.9	42	0.94 (0.88, 1.03)	3.2	Good
Perceived motivation (z-score)	0.0	0.8	42	0.78 (0.73, 0.83)	1.3	Acceptable
Perceived sleep quality (z-score)	0.0	0.9	42	0.92 (0.87, 0.97)	1.3	Acceptable
Perceived fatigue (z-score)	0.0	0.9	42	0.91 (0.87, 0.97)	1.4	Acceptable
72 hours post-match (n = 511)						
Perceived stress (z-score)	0.0	0.7	42	0.72 (0.68, 0.78)	10.2	Good
Perceived soreness (z-score)	0.0	0.9	42	0.91 (0.86, 0.98)	3.1	Good
Perceived motivation (z-score)	0.0	0.9	42	0.85 (0.80, 0.91)	1.4	Acceptable
Perceived sleep quality (z-score)	0.0	0.9	42	0.92 (0.87, 0.98)	1.3	Acceptable
Perceived fatigue (z-score)	0.0	0.9	42	0.92 (0.87, 0.98)	1.4	Acceptable
96 hours post-match (n = 431)						
Perceived stress (z-score)	0.0	0.1	42	0.09 (0.09, 0.10)	1.3	Acceptable
Perceived soreness (z-score)	0.0	0.8	42	0.86 (0.81, 0.93)	2.9	Good
Perceived motivation (z-score)	0.0	0.7	42	0.76 (0.71, 0.93)	1.3	Acceptable
Perceived sleep quality (z-score)	0.0	0.9	42	0.89 (0.83, 0.95)	1.3	Acceptable
Perceived fatigue (z-score)	0.0	0.9	42	0.95 (0.89, 1.02)	1.5	Good

SNR: signal-to-noise ratio: SD: standard deviation; TE: typical error; CI: confidence interval.