

Beyond Training Volume: Psychological Readiness and Sustainable Performance in Badminton

Xi Zhou¹, Mohd Radzani Bin Abdul Razak^{1*}

¹ City Graduate School, City University Malaysia, Menara City U, No. 8, Jalan 51A/223, 46100 Petaling Jaya, Selangor Darul Ehsan, Malaysia

ARTICLE INFO	ABSTRACT
Article history: RECEIVED 15 September 2026 ACCEPTED 3 October 2026 PUBLISHED 12 October 2026 Keywords: badminton; training load; recovery; psychological well-being; sustainable performance	Badminton training is often evaluated as if more exposure should produce better performance. That assumption overlooks the conversion problem between prescribed work and useful adaptation. This narrative review integrates badminton training research with evidence on training load, recovery, self-determination, coaching environments, psychological well-being, and athlete mental health. Its central thesis is that sustainable performance emerges when training demands are converted into psychophysiological readiness; recovery opportunities, autonomous motivation, and need-supportive relationships regulate that conversion, while psychological well-being functions simultaneously as a resource, an outcome, and an early warning signal. This account explains why apparently similar programmes generate different results and why correlations between workload and brief wellness scores are inconsistent. Training dose, internal response, competitive level, outcome timing, common-method bias, and the distinction between perceived and objective performance all alter the observed relationship. Athlete experience is therefore better understood as a bundle of self-regulatory skill, exposure history, role pressure, and accumulated load than as a simple moderator measured in years. An integrated readiness-conversion framework is proposed for badminton clubs, together with a research agenda prioritising longitudinal within-athlete designs, multi-source performance outcomes, dyadic coach–athlete data, and culturally grounded studies in Chinese club settings. The review reframes well-being protection as part of performance engineering rather than a competing objective.

1. Introduction

Badminton rewards explosive movement, repeated acceleration and deceleration, rapid perceptual decisions, fine technical control, and tactical adaptation under fatigue. The sport's high-intensity intermittent structure means that successful preparation cannot be reduced to accumulating practice hours or physical work (Phomsoupha & Laffaye, 2015). A training session is only an input. Its value depends on how an athlete responds, recovers, learns, and performs when the next demand arrives.

* Corresponding author: Mohd Radzani Bin Abdul Razak

Email address: radzani.razak@city.edu.my

<https://doi.org/10.70702/bdb/VCVU6258>

This distinction is easily blurred in clubs. Coaches can observe attendance, repetitions, distance, heart rate, or session rating of perceived exertion, but the desired adaptation remains partly latent. Athletes who complete the same external workload can experience different internal loads because of sleep, non-sport stress, fitness, injury history, motivational state, and the meaning they attach to the session (Bourdon et al., 2017; Halson, 2014). A demanding block may stimulate useful adaptation for one athlete, produce short-lived fatigue in another, and contribute to persistent under-recovery in a third. The practical question is therefore not simply whether a programme is effective. It is how, for whom, and under what conditions training is converted into repeatable performance without consuming the health and motivation on which future performance depends.

The badminton-specific intervention literature gives a promising but incomplete answer. Recent meta-analyses report benefits from physical training programmes and core-strength training for several fitness and performance-related outcomes, yet the evidence base contains small samples, varied interventions, heterogeneous tests, and limited follow-up (Ma et al., 2024, 2025). Such studies establish that athletes can improve under structured training; they do not fully explain why the same programme produces unequal adaptation or whether gains persist across congested competition, work or study demands, and changing motivational climates.

Sports science and sport psychology have often addressed these problems in parallel. Load-management research examines dose, fatigue, illness, injury, and recovery. Motivation research examines autonomy, competence, relatedness, persistence, and well-being. Athlete mental-health research examines distress, help-seeking, and organisational responsibility. Treating these as separate literatures leaves the central mechanism fragmented. Recovery affects whether a workload can be assimilated; motivation affects how consistently and attentively athletes train; coaching relationships affect both motivation and willingness to report strain; and psychological well-being affects concentration, decision quality, persistence, and access to support. These are not peripheral influences on a physical process. They help constitute the process by which work becomes readiness.

This review advances a readiness-conversion thesis: sustainable badminton performance is produced when training demands are converted into adaptive psychophysiological readiness through recovery, autonomous motivation, and need-supportive environmental resources. Psychological well-being is neither merely a pleasant consequence nor a generic mediator. It can be a resource that enables learning and self-regulation, an outcome of a supportive training system, and a warning signal when demands repeatedly exceed resources. Athlete experience conditions this conversion, but years played should not be mistaken for a single protective trait. Experience may improve pacing, recovery routines, and emotional regulation while simultaneously increasing accumulated load, identity investment, selection pressure, and reluctance to disclose difficulty.

The review has three aims. First, it traces a coherent pathway from training dose to readiness and sustainable performance. Second, it critically synthesises agreements and contradictions across physical, psychological, and organisational evidence. Third, it identifies a practical research agenda for badminton clubs, including Chinese club settings where athletes may combine training with education or employment and where relational and organisational context deserves direct study. The intended contribution is a model that tells researchers where conversion may fail and tells clubs what evidence, beyond attendance and self-reported performance, is needed to judge whether training is working.

2. Materials and Methods

2.1 Narrative review design

A narrative design was selected because the focal problem crosses literatures with different units of analysis, measures, and causal assumptions. Badminton intervention studies typically

estimate change in physical or technical outcomes; load studies examine repeated exposure and response; motivation studies emphasise psychological needs and behavioural regulation; and mental-health studies distinguish flourishing from symptoms or disorder. Pooling these as if they estimated one common effect would conceal rather than resolve their conceptual differences. Reporting was guided by the Scale for the Assessment of Narrative Review Articles, particularly its requirements for explicit aims, transparent search description, reasoned selection, scientific reasoning, and relevant endpoint data (Baethge et al., 2019).

Searches were conducted and updated through 31 August 2026 using SciSpace, Consensus, and Sider Scholar, supplemented by publisher records, DOI metadata, reference chaining, and targeted searches of sports-medicine and sport-psychology literature. Search combinations included “badminton performance,” “physical training badminton,” “training load,” “athlete monitoring,” “recovery,” “sleep athlete,” “psychological well-being,” “mental health athlete,” “self-determination sport,” “autonomy support coach,” “social support,” “club sport,” “experience level,” and “China.” Foundational theory and international consensus statements were retained when they were necessary to interpret recent findings.

2.2 Evidence selection and weighting

Priority was given to systematic reviews, meta-analyses, consensus statements, longitudinal monitoring studies, and intervention research. Badminton-specific evidence received high contextual relevance but not automatic methodological priority; a small, short-term badminton study was not treated as stronger than a rigorous multisport synthesis when the question concerned a general mechanism. Evidence from team and other court sports was used when the mechanism plausibly transferred to badminton, with transfer limitations stated. Cross-sectional self-report studies were included mainly to map associations and hypotheses, not to establish temporal mediation.

Studies were weighted by design strength, outcome proximity, measurement quality, sample context, and consistency with convergent evidence. Objective or independently assessed performance, injury, illness, and repeated within-athlete measures were distinguished from global self-ratings. Psychological well-being was also separated from transient wellness items such as soreness, fatigue, mood, stress, and sleep quality. Table 1 summarises the evidence logic used in the synthesis.

Table 1

Evidence domains and interpretive weighting

Evidence domain	Priority evidence	Principal question	Main caution
Badminton preparation	Systematic reviews, meta-analyses, controlled interventions	Which physical capacities and sport-specific outcomes improve?	Small samples, heterogeneous tests, and limited follow-up restrict generalisation
Load and recovery	Consensus statements, longitudinal monitoring, systematic reviews	When does training stimulate adaptation rather than maladaptation?	External load does not represent individual internal response
Motivation and support	Meta-analyses, prospective and dyadic studies	How do coaching and motivational quality sustain engagement and well-being?	Most evidence remains correlational and relies on athlete report
Well-being and mental health	Consensus, systematic reviews, intervention evidence	Is well-being a resource, outcome, or warning signal?	Positive well-being and mental illness are related but not opposite endpoints

Evidence domain	Priority evidence	Principal question	Main caution
Performance	Objective tests, competition indicators, coach ratings, self-report	Does readiness become effective play and persist over time?	Outcomes differ in ecological validity, sensitivity, and susceptibility to expectancy bias

Note. Evidence was interpreted by convergence and explanatory value rather than citation count alone. The narrative review does not claim exhaustive systematic coverage.

The synthesis proceeded in three stages. First, findings were organised along a temporal pathway from training demand to acute response, recovery, readiness, adaptation, and performance. Second, contradictory findings were compared for differences in exposure, sample, timing, analytic method, and outcome definition. Third, motivation, environmental support, psychological well-being, and athlete experience were positioned within the pathway according to the mechanism each could plausibly influence.

3. Results and Discussion

3.1 From training dose to adaptation: the missing conversion step

Training load is commonly divided into external work performed and internal response to that work. External load may include movement, acceleration, stroke volume, work duration, or drill characteristics; internal load may include heart rate, perceived exertion, biochemical response, or subjective fatigue (Bourdon et al., 2017). This distinction is foundational because the same drill is not the same biological or psychological event for every athlete. Fitness, heat, sleep, nutrition, emotional stress, and prior load change the response. Monitoring only the programme therefore measures prescription, not assimilation.

Badminton magnifies this problem. Match play combines intermittent metabolic demand with lunging, overhead actions, rapid changes of direction, visual search, anticipation, and decision-making (Phomsoupha & Laffaye, 2015). Physical preparation can improve strength, agility, speed, and related test outcomes. The meta-analysis by Ma et al. (2025) supports the usefulness of structured physical programmes, while Ma et al. (2024) found that core-strength interventions can improve several badminton-relevant outcomes. Yet neither “physical training” nor “core training” is a uniform treatment. Programme duration, intensity, supervision, baseline ability, test choice, and comparator all differ. Improvements in a laboratory or field test may also precede, exceed, or fail to transfer to competitive performance.

The load literature warns against a simple more-is-better interpretation. The International Olympic Committee consensus statements describe load as necessary for adaptation but potentially harmful when increases exceed an athlete’s capacity to tolerate them or when recovery and non-sport stress are ignored (Schwellnus et al., 2016; Soligard et al., 2016). Gabbett’s (2016) training–injury prevention paradox captures the nonlinearity: appropriately developed high chronic capacity can be protective, whereas poorly prepared spikes can be risky. This does not justify one universal workload ratio or threshold. Vanrenterghem et al. (2017) argue that injury pathways depend on how external load becomes internal physiological and biomechanical load, reinforcing the need for individual and task-specific interpretation.

The concept of overtraining adds a temporal dimension. Functional overreaching can temporarily reduce performance before adaptation; non-functional overreaching and overtraining syndrome involve more persistent impairment and a wider constellation of symptoms (Meeusen et al., 2013). A cross-sectional survey cannot reliably distinguish these states, because a fatigued athlete observed during a planned loading block may be adapting, while a similar score after

repeated inadequate recovery may signal maladaptation. Time, trajectory, and the surrounding training plan determine meaning.

The first synthesis claim follows: training effectiveness is not a direct property of programme exposure. It is an athlete-by-demand conversion process. The programme creates an opportunity for adaptation, but the realised effect depends on internal response, recovery, learning quality, and subsequent opportunity to express the adaptation. This claim also changes evaluation. Attendance, workload, and post-programme satisfaction are implementation indicators; they are not evidence that the intended conversion occurred.

3.2 Recovery is part of training, not the interval between sessions

Recovery is sometimes represented as passive time after the “real” work. The consensus account is more demanding: recovery is a multilevel process through which physiological and psychological resources are restored or adapted, and its requirements vary within and between athletes (Kellmann et al., 2018). An effective plan therefore coordinates stress and recovery rather than adding isolated techniques after excessive load.

Sleep provides the clearest example. Sleep loss can impair reaction time, decision-making, mood, learning, and physical performance, although findings vary with task, deprivation protocol, sport, and athlete characteristics (Fullagar et al., 2015). Expert recommendations consequently emphasise individual assessment, education, scheduling, environment, and referral when sleep problems persist rather than one generic sleep prescription (Walsh et al., 2021). For badminton, where perceptual speed and technical precision matter, a recovery deficit may appear first as unstable decision quality or error control rather than a large change in gross fitness.

Monitoring can support this process, but only when measurements are interpreted as signals rather than verdicts. Halson (2014) recommends combining feasible internal and external indicators and examining the individual athlete over time. Saw et al. (2016) found subjective measures often responded more consistently to acute and chronic training stress than many objective measures, supporting their practical use. This does not make a short wellness scale an objective measure of readiness. Duignan et al. (2020) found relationships between single-item well-being indicators and training load ranging from absent to very large, with mostly trivial-to-moderate associations in larger datasets. Differences in scale direction, timing, analysis, and construct definition contributed to the inconsistency.

Afonso et al. (2025) reached a complementary conclusion in their systematic review of football monitoring: physical, technical, tactical, and well-being indicators were commonly collected, but genuinely integrated multivariate models were rare. Although football tracking variables do not transfer directly to badminton, the methodological lesson does. Collecting more streams does not create an integrated explanation unless the analysis specifies how context, response, and performance interact.

The apparent conflict between these reviews is instructive rather than fatal. Subjective measures can be sensitive to an athlete’s integrated state without correlating strongly with any single workload metric. A morning rating reflects sleep, soreness, illness, academic or work stress, relationships, and expectations, not only yesterday’s session. Weak correlation with external load may therefore indicate that the measure is capturing a broader internal state. Conversely, a high correlation can be misleading if both variables share timing, expectation, or reporting practices. The useful question is whether changes predict meaningful outcomes or prompt productive conversation, not whether every self-report mirrors the coach’s load file.

Recovery practices also carry a behavioural and social component. Athletes need time, knowledge, resources, and permission to use them. A club that praises constant availability, schedules late sessions before early work or study, or treats fatigue disclosure as weakness can

undermine recovery even while distributing recovery advice. Recovery strategy utilisation is therefore not solely an individual compliance variable. It is partly an organisational outcome.

3.3 Motivation quality regulates how training is enacted

Motivation is often reduced to quantity: the more motivated athlete is assumed to train harder and perform better. Self-determination theory makes a more useful distinction between autonomous motivation—acting with interest or personally endorsed value—and controlled motivation driven by pressure, guilt, rewards, or avoidance (Deci & Ryan, 2000; Ryan & Deci, 2020). Both can generate effort in the short term, but their implications for persistence, learning, and well-being differ.

This distinction clarifies why greater effort is not always better. An autonomously motivated athlete may engage attentively, seek feedback, and adjust load when necessary. A strongly controlled athlete may also complete high volumes, but may conceal fatigue, interpret rest as failure, or persist through injury to protect status. The observed behaviour—attendance and effort—can look similar while the self-regulatory process and long-term risk differ. Motivation therefore influences the quality of training enactment, not only its amount.

Meta-analytic evidence supports this pathway. Mossman et al. (2024) synthesised 1,320 correlations from 131 independent samples and found coach autonomy support strongly associated with athlete well-being and autonomous motivation, negatively associated with amotivation, and closely related to support for competence and relatedness. In a much broader meta-analysis, Slep et al. (2024) found that interpersonal support for autonomy, competence, and relatedness was strongly related to need satisfaction and well-being but only small-to-moderately related to performance. This difference in effect size is important. Supportive relationships may reliably improve the conditions under which athletes function, while their translation into performance remains dependent on skill, physical capacity, task difficulty, competition, and measurement.

The evidence also cautions against treating autonomy support as permissiveness. Competence support includes clear expectations, appropriately challenging tasks, structure, informative feedback, and acknowledgement of improvement. Relatedness support includes care, respect, and reliable involvement. In demanding performance environments, athletes need all three. Choice without structure can feel like neglect; structure delivered through threat can frustrate autonomy; warmth without competent feedback cannot correct technique. A high-quality badminton environment integrates rationale, standards, feedback, and relational safety.

Grassroots evidence is especially relevant to clubs. Rato Barrio et al. (2021) mapped 52 studies of adult grassroots sport and concluded that empowering environments, autonomy-supportive coaching, relationship quality, and social support were central to well-being, while also noting the heterogeneity and methodological weakness of the field. Club athletes are not simply lower-level versions of elites. They may pay for participation, train around employment or study, receive less integrated medical support, and vary widely in performance goals. These conditions alter both demands and resources.

3.4 Environmental support is a system of usable resources

“Environmental support” becomes analytically weak when it denotes every positive feature surrounding an athlete. The construct is more useful when decomposed into resources that change behaviour or response: coach need support; peer belonging; access to facilities and expertise; predictable scheduling; recovery opportunity; psychological safety; injury and mental-health referral; and meaningful performance feedback.

Sport participation is often associated with physical, psychological, and social benefits, but the distribution of benefits depends on the experience created within sport (Eime et al., 2013). A club can provide belonging and competence while also producing exclusion, surveillance, or status

anxiety. The same social density that supports persistence can intensify comparison and make disclosure costly. Environmental support should therefore be assessed by what athletes can actually use, not by whether a resource formally exists.

Mental-health research illustrates the gap between availability and usability. The International Olympic Committee consensus statement describes mental-health symptoms and disorders as common enough in elite athletes to require systematic prevention, recognition, referral, and treatment within performance systems (Reardon et al., 2019). Rice et al. (2016) had earlier shown that the evidence base was dominated by cross-sectional studies, inconsistent definitions, and limited prospective work. More recent help-seeking evidence indicates that stigma, low mental-health literacy, preference for self-reliance, and concerns about career consequences remain barriers (Cosh et al., 2024). A list of services is not support if athletes do not trust that using them is safe.

Purcell et al. (2019) therefore propose an ecological framework in which mental health is influenced by individual, interpersonal, sport, and broader-system factors. That approach fits badminton clubs better than a purely clinical or individual-deficit model. Coaches need boundaries and referral pathways rather than an expectation that they diagnose athletes; administrators need confidentiality and workload practices; teammates shape norms; and athletes need credible routes to support. Environmental resources matter because they change both exposure and response.

3.5 Psychological well-being: mediator, outcome, or warning signal?

Psychological well-being is frequently positioned as a mediator between positive training conditions and performance. That formulation is plausible but incomplete. Ryff's (1989) account of well-being includes autonomy, environmental mastery, personal growth, positive relations, purpose, and self-acceptance. Sport-specific scholarship similarly argues that athlete well-being is multidimensional and cannot be reduced to positive mood or absence of symptoms (Lundqvist, 2011). A one-time scale score therefore cannot represent all pathways implied by the construct (Zhao et al., 2025).

Three roles should be distinguished. First, well-being can be a resource. Athletes with a sense of competence, purpose, connection, and manageable stress may regulate attention, learn from error, communicate earlier, and persist through difficulty. Second, well-being can be an outcome. Need-supportive coaching, meaningful improvement, belonging, and manageable load can enhance it. Third, a decline can be a warning signal. Persistent fatigue, sleep disturbance, low mood, irritability, and loss of motivation may indicate under-recovery, external stress, injury risk, or emerging mental-health difficulty. The same variable can occupy different positions in a causal system at different time scales.

This temporal reciprocity creates a serious challenge for cross-sectional mediation. If training effectiveness, environmental support, motivation, well-being, and performance are reported by the same athlete at the same time, a statistically significant indirect effect may arise from shared method, general positive appraisal, or reverse causation. Better performance may enhance well-being; athletes who feel well may judge their coach and programme more favourably; selection may retain athletes whose health tolerates the environment. A cross-sectional path coefficient cannot identify which process occurred.

The intervention evidence supports cautious optimism rather than a simple performance claim. Wang et al. (2025) identified potential benefits of psychological skills, third-wave, and positive-psychology interventions for elite-athlete well-being, but the review also reported modest study quality, sensitivity of some effects, and substantial implementation uncertainty. Improving well-being is a defensible end in itself. Claims that an intervention improves competitive performance

through well-being require separate, adequately powered evidence using temporally ordered and ecologically meaningful outcomes.

Poucher et al. (2022) further show why mental health should be conceptualised dynamically across an elite athlete's career. Transitions, injury, performance pressure, organisational instability, and identity can change risk and protection. Kuettel and Larsen (2020) likewise found that risk and protective factors span individual, social, sport, and societal levels. The implication for club research is that psychological well-being should be modelled as a fluctuating state embedded in a career and environment, not a stable personal bridge inserted between two survey scales.

3.6 Why apparently similar studies reach different conclusions

The literature does not contain one contradiction but several kinds of non-equivalence. Table 2 organises the principal sources of disagreement and their implications.

Table 2

Sources of conflicting evidence and their interpretation

Apparent conflict	Likely source of disagreement	Critical interpretation	Better design response
Higher load predicts both improvement and impairment	Dose, rate of change, baseline capacity, recovery, and observation window differ	Acute fatigue, functional overreaching, and maladaptation are not the same state	Model individual trajectories and planned training phases, not one cross-sectional score
Wellness scores track load in some studies but not others	Items, scale direction, timing, aggregation, and analysis differ	Subjective state integrates non-training stress and need not mirror one external metric	Predefine clinically or practically meaningful change and triangulate load, sleep, symptoms, and performance
Coach support strongly predicts well-being but weakly predicts performance	Performance is more distal and multiply determined	A supportive climate enables functioning but cannot substitute for skill, capacity, or strategy	Test serial and moderated pathways with objective outcomes and sufficient lag
Motivation predicts adherence yet pressure can also increase effort	Autonomous and controlled regulation are combined	Equal effort can arise from different regulatory processes and carry different long-term costs	Measure motivational quality, need satisfaction, and need frustration separately
Experienced athletes appear more resilient in some samples	Selection, accumulated exposure, status, and self-regulation are confounded	Years played may represent both resources and concealed risk	Disaggregate competitive level, load history, coping skill, role, age, and career stage
Training improves field tests but competitive results remain uncertain	Outcome proximity and ecological validity differ	Capacity gains do not automatically transfer to tactical execution under pressure	Combine physical tests with technical quality, decision measures, match indicators, and sustained availability

Note. These explanations are mechanism hypotheses grounded in convergent evidence, not proof that one source accounts for every discrepant finding (Duignan et al., 2020; Slemp et al., 2024; Soligard et al., 2016).

Sample composition is the first source of divergence. Elite, academy, university, and recreational athletes differ in baseline ability, training history, support, incentives, and schedule control. A recovery strategy feasible in a centralised programme may be impractical for an adult

club athlete who trains after work. Sex, age, injury status, and event type can further change both exposure and response. Findings averaged across such groups may describe no individual well.

Measurement is the second. “Sports performance” can mean self-perceived improvement, fitness tests, coach ratings, technical accuracy, ranking, match outcome, or availability to train. These outcomes are related but not interchangeable. Self-report predictors and self-report outcomes inflate coherence through shared perspective. Match results are ecologically valid but noisy because they depend on opponent, tactics, draw, and small numbers. The solution is not one perfect measure but a prespecified outcome system.

Timing is the third. Motivation and well-being can change daily; adaptation may require weeks; competitive development may require seasons. Cross-sectional designs collapse these clocks. Even longitudinal studies can miss the mechanism if measures are too infrequent or if they ignore planned load phases. Intensive repeated measurement, combined with periodic objective testing and competition data, is better aligned with the process (Cao et al., 2024).

Analysis is the fourth. Group-level associations do not necessarily describe within-athlete change. An athlete who is generally more positive than teammates may also report higher support and performance, while day-to-day changes in that athlete’s well-being may have little relationship with performance. Multilevel models should separate between-person differences from within-person dynamics. Mediation also requires temporal ordering and assumptions that are rarely satisfied by one-wave surveys.

Finally, publication and survivorship shape the visible evidence. Athletes who leave because of injury, burnout, cost, or conflict may be absent from club samples. Successful programmes and significant outcomes are more likely to be reported. The remaining athletes can make demanding environments appear safer or more effective than they were for the original cohort.

3.7 Athlete experience is a configuration, not a number

Experience is intuitively attractive as a moderator. More experienced athletes may know how to pace, recover, interpret bodily signals, manage competition, and communicate with coaches. Through repeated appraisal and coping, they may build more efficient responses to familiar demands, consistent with transactional accounts of stress and coping (Lazarus & Folkman, 1984). Experience can also sharpen the distinction between normal training discomfort and warning signs.

However, years of participation bundle together age, competitive standard, accumulated load, injury history, status, role, and selection. Experienced athletes may face higher expectations, denser competition, greater identity foreclosure, or more pressure to conceal problems. Less experienced athletes may be physically unprepared but more willing to accept rest. A single interaction between “years played” and well-being therefore has no stable theoretical meaning.

Future studies should treat experience as a profile. Relevant indicators include training age, competition level, weekly and seasonal exposure, injury and interruption history, self-regulatory skill, recovery knowledge, dual-career demands, role in the club, and perceived security. Moderation can then test a mechanism—for example, whether recovery literacy buffers the association between load change and next-day readiness—rather than asking whether an undifferentiated number of years changes every pathway.

3.8 The readiness-conversion framework

The evidence can now be assembled into an integrated model. Figure 1 depicts training demands as inputs whose effects depend on available recovery, motivational regulation, and environmental resources. These conditions shape appraisal and psychophysiological readiness, which in turn influences training quality, adaptation, competitive execution, and sustainable availability. Athlete experience and context calibrate each link rather than operating only at the

final performance pathway. Feedback from readiness and performance should revise the next prescription.

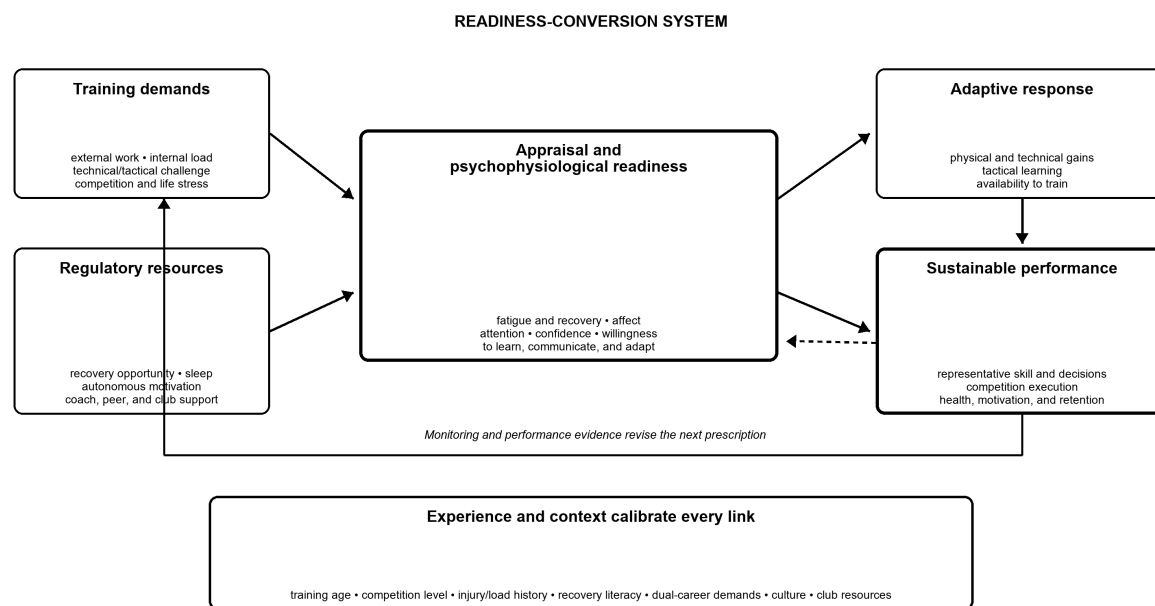


Figure 1. Readiness-conversion framework for sustainable badminton performance

The framework contains two gaps that conventional programme evaluation often misses. The load-to-adaptation gap concerns whether prescribed work is absorbed and produces the intended physical, technical, or psychological change. The readiness-to-performance gap concerns whether available capacity is expressed under tactical, perceptual, emotional, and competitive constraints. Recovery, motivation, support, and well-being can influence both gaps, but not necessarily with equal strength.

Psychological well-being occupies the centre because it integrates and regulates without monopolising explanation. A supportive club can enhance well-being, but well-being cannot replace physical preparation. An athlete can perform well while distressed, particularly over short periods; that does not make the system sustainable. Conversely, a flourishing recreational athlete may improve adherence and enjoyment without seeking elite performance. The appropriate endpoint is goal-relative and time-sensitive.

The framework also makes performance and health reciprocal. Strong, meaningful performance can reinforce competence and motivation. Repeated failure, unexplained selection, pain, or recovery debt can erode them. Monitoring should therefore create an evidence loop rather than a surveillance system: collect a small set of interpretable indicators, discuss them with the athlete, adjust training where warranted, and evaluate whether the adjustment changed readiness or performance.

For badminton clubs, a practical monitoring set might combine session exposure and perceived exertion; brief sleep, fatigue, soreness, stress, and mood indicators; periodic jump, change-of-direction, or sport-specific tests; technical or tactical indicators from representative drills or matches; availability and injury data; and short conversations about motivation and life demands. No single score should determine selection or training. Thresholds should be individualised, and athletes should know who sees their data and how it will be used.

4. Research Gaps and Future Directions

The central empirical gap is not another cross-sectional test of a large linear model. It is evidence about temporal conversion. Table 3 presents a research agenda designed to resolve the field's most consequential uncertainties.

Table 3

Research agenda for badminton clubs

Gap	Recommended design	Minimum measurement set	Decision value
Load-to-readiness dynamics	12–20 week intensive longitudinal cohort with repeated within-athlete measures	External and internal load, sleep, fatigue, soreness, stress, motivation quality, illness and injury	Identifies individual lagged responses and useful adjustment windows
Readiness-to-performance transfer	Prospective study across training and competition blocks	Readiness indicators, representative technical and decision tasks, match context and results	Tests when state readiness becomes effective competitive execution
Well-being as cause and consequence	Random-intercept cross-lagged or dynamic multilevel design	Multidimensional well-being, need satisfaction and frustration, load, life stress, performance	Separates stable athlete differences from within-athlete change and reciprocal effects
Coach–athlete relational process	Dyadic, multilevel study with coach and athlete reports plus observation	Need-supportive and thwarting behaviour, relationship quality, disclosure climate, coach workload	Reduces single-source bias and reveals reciprocal coaching dynamics
Experience heterogeneity	Person-centred or moderated longitudinal design	Training age, level, exposure history, injury, recovery literacy, dual-career demand, role status	Replaces years played with interpretable experience profiles
Chinese club context	Multi-club comparative mixed-method study, including Hainan and other regions	Common core measures, organisational practices, interviews, objective performance, retention	Tests cultural and organisational transfer without treating China as homogeneous
Intervention implementation	Cluster trial or stepped-wedge introduction of a readiness-informed coaching package	Fidelity, acceptability, cost, well-being, availability, performance, unintended effects	Establishes whether an integrated approach works under routine club constraints

Note. Sample-size planning should be based on the multilevel structure, expected within-athlete effect, number of repeated observations, clustering by coach and club, and attrition rather than a generic population formula.

First, researchers should separate measurement occasions and levels. Daily or near-daily state measures can test short lags; monthly assessments can capture broader well-being; physical and technical testing can occur at planned phase boundaries; and competition outcomes can be modelled with opponent and event context. This structure would allow researchers to ask whether changes in load precede readiness, whether readiness precedes performance, and whether performance feeds back into motivation and well-being.

Second, studies need multi-source outcomes. Self-reported programme effectiveness, psychological well-being, and performance collected from one respondent are insufficient for a strong mediation claim. Athlete reports should be combined with training records, objective or independently assessed tests, coach observations collected separately, injury and availability

records, and competition indicators. When self-report is the most appropriate measure—such as felt fatigue or autonomous motivation—its subjectivity is a feature, but it should not be treated as independent confirmation of another self-report construct.

Third, causal questions require interventions or credible natural experiments. Clubs could introduce an integrated package comprising load planning, individual recovery dialogue, autonomy-supportive coaching, confidential reporting, and feedback-based adjustment. A cluster trial, stepped-wedge design, or interrupted time series could compare changes while respecting operational constraints. Process evaluation should assess fidelity, athlete trust, coach workload, and unintended surveillance effects, not only endpoint scores.

Fourth, the relational system should be measured directly. Slemp et al. (2024) show that support from different people and for different needs has incremental value. Future badminton research should collect dyadic coach–athlete data, distinguish supportive from need-thwarting behaviour, and test whether the club’s disclosure climate changes the accuracy and usefulness of monitoring. Coaches’ own stress and organisational support matter because exhausted coaches may struggle to provide consistent structure and involvement.

Fifth, research in China should avoid assuming cultural uniformity. The broad benefits of need support appear across cultural settings in meta-analysis (Mossman et al., 2024), but the form, interpretation, and feasibility of supportive behaviour can still vary. Multi-club studies should examine how hierarchy, family expectations, education or employment demands, commercial club models, and regional resources influence disclosure, autonomy, and recovery. Hainan can be an informative setting, but claims should be grounded in comparison and local qualitative evidence rather than presented as representative of all Chinese badminton (Pan et al., 2026).

Finally, sustainable performance requires retention of adverse outcomes and departures. Studies should document injury, prolonged absence, dropout, and reasons for leaving. Without these data, survivorship can make a demanding programme appear effective because only those who tolerated it remain available for measurement.

5. Practical Implications

For coaches, the main shift is from prescribing work to managing conversion. Each training block should specify the intended adaptation, the representative evidence that would demonstrate it, the recovery conditions required, and the rule for adjustment. An increase in volume is not a success indicator unless it produces the intended response.

For clubs, well-being should be embedded in performance governance. This means predictable referral pathways, confidentiality, coach education, realistic scheduling, and an explicit norm that reporting strain is information rather than disloyalty. The IOC mental-health framework makes clear that welfare cannot depend on individual resilience alone (Reardon et al., 2019). At the same time, clubs should avoid converting well-being monitoring into continuous evaluation of athletes’ character or selection value.

For athletes, recovery and self-regulation should be taught as skills. The aim is not perfect compliance with universal routines but the capacity to recognise patterns, communicate uncertainty, and test adjustments. More experienced athletes can contribute valuable tacit knowledge, but peer norms should not override medical or psychological expertise.

For researchers and evaluators, the minimum reporting standard should include the actual programme, comparator, baseline capacity, exposure and adherence, training phase, recovery context, outcome source, follow-up duration, and missingness. If performance is self-reported, it should be named as perceived performance. If mediation is tested cross-sectionally, it should be described as an indirect association rather than a demonstrated mechanism.

6. Conclusion

Badminton performance is not the accumulated residue of more training. It is the result of a conversion: prescribed demands must be appraised, recovered from, learned, and expressed under competitive constraints. Recovery, autonomous motivation, and environmental support regulate this process, while psychological well-being can enable adaptation, reflect the quality of the environment, and warn that resources are being depleted.

This readiness-conversion account resolves several apparent contradictions. High load can build capacity or undermine it because dose, rate, baseline preparedness, recovery, and time scale differ. Support relates more strongly to well-being than to performance because performance is distal and multiply determined. Wellness ratings need not mirror external load because they integrate non-training demands. Experience can protect or expose because it contains both skill and accumulated pressure.

The practical consequence is a broader definition of training effectiveness: improvement should be demonstrable in relevant physical, technical, tactical, and competitive outcomes, sustainable across time, and achieved without avoidable erosion of health, motivation, or availability. For Chinese badminton clubs and the wider field, the next step is not a larger one-wave survey. It is longitudinal, multi-source, culturally grounded research that follows the full conversion from work to readiness to performance—and learns from the athletes for whom that conversion fails.

Acknowledgement

The author acknowledges the scholarly work synthesised in this review. No external funding was received for the preparation of this manuscript.

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