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▶ **To cite this version:**

Julie Doron, Quentin Rouault, Marc Jubeau, Marjorie Bernier. Integrated mindfulness-based intervention: Effects on mindfulness skills, cognitive interference and performance satisfaction of young elite badminton players. Psychology of Sport and Exercise, 2020, 47, pp.101638. 10.1016/j.psychsport.2019.101638 . hal-02512456

HAL Id: hal-02512456
https://hal.science/hal-02512456

Submitted on 21 Jul 2022

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Version of Record: https://www.sciencedirect.com/science/article/pii/S1469029218304746
Manuscript_e734ae468f222e7d44e6235f7a87f3ca

Integrated mindfulness-based intervention: Effects on mindfulness skills, cognitive interference and performance satisfaction of young elite badminton players

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Acknowledgments

The authors would like to thank the athletes and coaches who took part in the study, the French Federation of Badminton for organization support, Anthony Mette who conducted placebo intervention based on relaxation sessions, Maël Goisbault for qualitative data transcription and Jean-Philippe Lachaux for his expert advice on the protocol.

Funding

This study was funded by the French Ministry of Sports (grant n°15r16).

Conflict of Interest

Julie Doron and Marc Jubeau have received research grants from French Ministry of Sports. Quentin Rouault and Marjorie Bernier have collaborated to this research project. All the authors declare that they have no conflict of interest.

Integrated mindfulness-based intervention: Effects on mindfulness skills, cognitive interference and performance satisfaction of young elite badminton players

Over nearly two decades, there has been growing interest in applying mindfulness- and acceptance-based interventions (MABI) in sport settings for the purpose of enhanced sport performance and well-being of athletes and coaches (Baltzell, 2016; Birrer, Röthlin, & Morgan, 2012; Gardner & Moore, 2012, 2017; Röthlin & Birrer, 2019). In contrast to traditional psychological skills training (PST), MABI promote "a modified relationship with internal experiences (i.e., cognitions, emotions, and physiological sensations), rather than seeking to change their form or frequency" (Gardner & Moore, 2012, p. 309). MABI appeared as a promising and holistic approach fostering the development of performance-relevant psychological skills within competitive sport settings (Baltzell, 2016; Birrer & Röthlin, 2017; Birrer et al., 2012; Gardner & Moore, 2012, 2017; Röthlin & Birrer, 2019). However, MABI have largely drawn from clinical and health settings and their application in the sport context, especially with elite athletes, needs further development and validation to fulfil the desired outcomes related to sport performance (Birrer et al., 2012; Bühlmayer, Birrer, Röthlin, Faude, & Donath, 2017; Noetel, Ciarrochi, Van Zanden, & Lonsdale, 2017; Sappington & Longshore, 2015). The current study therefore aimed to design and implement a MABI integrated into the badminton training of young elite players, and to investigate its impact on sport performance-related outcomes.

Elite sport offers a very different environment to daily life or clinical contexts and places high demands on athletes' behaviour (Birrer & Morgan, 2010; McDougall, Nesti, & Richardson, 2015; Swann, Moran, & Piggott, 2015). High-intensity sports, such as badminton, require advanced technical, tactical, physical, and psychological skills (Birrer & Morgan, 2010; Lees, 2003; Phomsoupha & Laffaye, 2015). Due to the demands, speed and intermittent nature of the game, badminton players must deal with pressure and a constantly changing environment

(Birrer & Morgan, 2010; Lees, 2003; Phomsoupha & Laffaye, 2015). Performance can be undermined by non-pathological psychological inhibitors such as cognitive interference (Birrer et al., 2012; Gardner & Moore, 2017). Distracting stimuli (e.g., external events, bodily sensations, emotional reactions) can become highly disruptive and disengage athletes from their goals (Birrer et al., 2012; Gardner & Moore, 2017). Interfering thoughts, such as task-irrelevant, self-preoccupied thinking or performance worries, can distract attention from task-relevant cues and consume cognitive resources that could be better used for task-processing (Lane, Harwood, & Nevill, 2005). Accordingly, training athletes in mindfulness and acceptance skills is a potentially meaningful goal in minimising the debilitating effects of cognitive interference and enhancing performance (Goodman, Kashdan, Mallard, & Schumann, 2014). Specifically, MABI's beneficial effects on a wide range of outcomes, comprising effects on cognition and affect, may be explained by two main mechanisms (for a review, see Lindsay & Creswell, 2017): (a) the use of attention to monitor present-moment experience (i.e., attention monitoring skills), and (b) a mental attitude of acceptance toward momentary experience (i.e., acceptance skills). Moreover, according to Monitor and Acceptance Theory (MAT; Lindsay & Creswell, 2017), these two mechanisms should not be taught in isolation but rather together, considering their potential synergistic effects. Given that attention monitoring may heighten affective experience and reactivity, acceptance skills are also necessary to modify the relation to the monitored experience. Research evidence suggests that these MABI's underlying mechanisms may be very relevant in order to help athletes to manage their internal experiences more effectively and maintain optimal functioning in highly demanding performance environments (for reviews, see Bühlmayer et al., 2017; Gardner & Moore, 2012, 2017; Lindsay & Creswell, 2017; Noetel et al., 2017; Sappington & Longshore, 2015).

The increasing interest in applying MABI in sport settings has resulted in the development of several tailor-made interventions (for reviews, see Bühlmayer et al., 2017;

Gardner & Moore, 2012, 2017; Noetel et al., 2017; Sappington & Longshore, 2015). MABI were originally designed and conducted for health and well-being purposes (e.g., *Mindfulness-Based Stress Reduction*, MBSR, Kabat-Zinn, 1990; *Acceptance Commitment Therapy*, ACT, Hayes, Strosahl, & Wilson, 1999; *Mindfulness-Based Cognitive Therapy*, MBCT, Segal, Williams, & Teasdale, 2002). Most of the MABI used in sport contexts stem from non-sport-specific theoretical frameworks and programmes, which have been applied in sport contexts to enhance the sport performance and well-being of athletes and coaches. As highlighted by Goodman et al. (2014), two types of interventions have been implemented in a sport context: firstly, interventions including only mindfulness practice, such as in the *Mindfulness Sport Performance Enhancement* programme (MSPE; Kaufmann, Glass, & Arnkoff, 2009); and secondly, interventions combining mindfulness, acceptance and commitment exercises, such as in the *Mindfulness-Acceptance-Commitment* programme (MAC; Gardner & Moore, 2007). These two types of interventions received promising empirical support for their beneficial effects on the development of performance-relevant psychological skills in sport domains (for reviews, see Bühlmayer et al., 2017; Josefsson et al., 2017; Josefsson, Ivarsson, et al., 2019; Noetel et al., 2017; Sappington & Longshore, 2015). Nevertheless, both stronger evidence and enhanced knowledge about the MABI's underlying active mechanisms are still needed in order to achieve more effective interventions for the desired outcomes related to sport performance among elite athletes (Gardner & Moore, 2017; Lindsay & Creswell, 2017; Noetel et al., 2017).

Birrer et al. (2012) pointed out that "with the appropriate openness as well as sport-specific expertise, mindfulness techniques can be integrated in a sport setting in many ways" (Birrer et al., 2012, p. 244). The integration of mindfulness and acceptance exercises into sport-specific situations may be a further way to help athletes assimilate them more readily within ecological training and performance contexts (Briegel-Jones, Knowles, Eubank, Giannoulatos, & Elliot, 2013; Scott-Hamilton, Schutte, & Brown, 2016). In line with this, Scott-Hamilton et

al. (2016) have started to integrate mindfulness practice in relation to cycling. They have developed an integrated mindfulness-training protocol, based on the Mindfulness-integrated Cognitive Behaviour Therapy programme (MiCBT; Cayoun, 2011). Mindfulness exercises were incorporated though a mindfulness-spinning exercise during stationary cycling sessions. The integrated mindfulness exercises enabled the participants to observe any of their sensations (e.g., discomfort) and related-thoughts (e.g., distressing cognitions regarding discomfort), as well as to foster the skill of refocusing attention in a situation resembling a competition context (Scott-Hamilton et al., 2016). However, to date, few MABI integrate in-session practice developed for targeted outcomes and in accordance with the specific demands of the task or discipline in a performance context (Bernier, Thienot, Codron, & Fournier, 2009; Bernier, Thienot, Pelosse, & Fournier, 2014; Birrer & Morgan, 2010; Scott-Hamilton et al., 2016).

The goals of the present study were twofold. The first goal was to design an integrated MABI, drawing heavily on the MAC approach (Gardner & Moore, 2007), which suits the characteristics of the young elite athletes and the specific demands of badminton. The programme, entitled Mindfulness Badminton Integrated programme (MBI), was designed to develop mindfulness and acceptance skills, minimise cognitive interference, and enhance performance satisfaction. The second goal was to implement the MBI programme and investigate its impact through a mixed methods approach (Huynh, Hatton-Bowers, & Smith, 2019). Firstly, the effects of the intervention on mindfulness skills (i.e., awareness, acceptance, refocusing), cognitive interference (i.e., disruptive thoughts) and performance satisfaction were assessed via a quantitative approach (i.e., questionnaires). It was hypothesised that badminton players who participated in the MBI programme would exhibit greater increases in awareness, acceptance, and refocusing skills, as well as performance satisfaction, and greater decreases in disruptive thoughts compared to an active control group of badminton players who participated in a placebo programme. Secondly, qualitative social validation was used to collect the

badminton players' overall perceptions of the MBI programme (i.e., how they acquired the key messages and experienced the content of the programme).

Method

Development of the Mindfulness Badminton Integrated Programme

The MBI programme was designed by our research team, which has solid experience in sport psychology counselling and especially in the implementation of MABI for athletes (8 years on average). The MBI programme was developed as an adaptation of the MAC (Gardner & Moore, 2007) and other previous mindfulness interventions conducted with elite athletes (Bernier et al., 2009, 2014). Following the MAC's principles (i.e., psychoeducation, mindfulness, cognitive defusion, goal-driven behaviour, acceptance, and commitment), it includes four modules described in Table 1: (a) creating adhesion to the intervention and helping athletes understand the attentional process, its limitations and the potential debilitative effects on performance; (b) introducing the principles of mindfulness and cognitive defusion; (c) improving athletes' awareness of their avoidance strategies and developing their ability to adopt an observational and non-judgmental attitude towards their internal experience (i.e., acceptance); (d) combining mindfulness, acceptance and commitment to improve self-regulation of attention during games. To this end, performance routines and attentional foci used by the athletes during games were specified and practised.

Each module lasted two weeks and comprised one to three sessions consisting in different situations, exercises and discussions that were incorporated as far as possible either into the badminton training sessions or into the physical training sessions (see Table 1, column 3, for details of the tools). Between sessions, homework was also assigned both to reinforce the skills being taught in each module and to provide material for discussion in subsequent sessions. Key messages (Table 1, column 5) consistent with the session goal (Table 1, column 2) were specified in advance for each session by the authors of the programme. They aimed to clarify

the principles of mindfulness, acceptance and commitment that were being taught. Sessions need to be perceived by the athletes as applied and useful to their badminton performance. Five of the eight sessions were set up either totally or partially on the badminton court (see Table 1, column 4). In this respect, the integrated exercises were created with the help of the coaches and were led jointly by both the consultant (i.e., the second author) and the coaches. Individual experiences of games during the programme were subsequently debriefed and used to reinforce the understanding of key messages and application of the newly developed skills. In accordance with the MAC approach, goal setting was used to help athletes clarify their goal-driven behaviours and promote their commitment. This may help athletes sustain the focus of attention on goal-related cues, while disengaging from disruptive stimuli in practice and competition (Noetel et al., 2017). In particular, goal setting was based on a daily diary (e.g., McCarthy, Jones, Harwood, & Davenport, 2010). This daily diary served to increase adherence to the intervention, also reinforcing skills by personalizing the goal-setting and by transmitting daily messages related to the concepts of mindfulness, acceptance and commitment (e.g., "Mindfulness is not about trying to change what is going on inside you. It is simply about being aware of what is happening and accepting it, in order to focus on what has to be done."). Individual feedback for each athlete on his or her improvement in terms of defining and specifying his or her goals was provided by the consultant.

Implementation and Evaluation of the MBI Programme

Participants. Thirty-eight young elite badminton players from two French Badminton Federation (FFBad) National Training Centres were recruited for this study. Both of these centres housed the best national young players and so were equivalent in terms of badminton performance level. All players were asked by their coaches to participate in the intervention as part of their training programme. Twenty-six badminton players were assigned by the FFBad to the MBI group, made up of players from both National Training Centre 1 (n = 12) and

National Training Centre 2 (n = 14) (see Figure 1). Twelve athletes from National Training Centre 1 were also assigned by the FFBad to the control group (i.e., following the placebo programme) (see Figure 1). One badminton player from the control group and eight badminton players from the MBI group were excluded from the study due to injury (see Figure 1). Finally, the MBI group was composed of eight females and 10 males (M_{age} = 16.22, SD_{age} = .94, range = 14-18 years), who were competing at national and/or international levels, having played badminton for an average of 8.36 years (SD = 1.41, range = 6-11 years) and training for an average of 15.21 hours per week (SD = 1.56, range = 12-17.30 hours). The control group was composed of six females and five males (M_{age} = 16.64, SD_{age} = 1.29, range = 14-18 years) who were competing at national and/or international levels, having played badminton for an average of 8.91 years (SD = 1.51, range = 6-11 years) and training for an average of 14.50 hours per week (SD = 2.73, range = 10-18 hours). Whilst the participants were aware of mental skills training and sport psychology, none of the participants reported using PST in a systematic manner and/or had experienced MABI.

Prior to participation, all players (or a legal representative when the player was under 18 years old) signed informed consent forms. They were informed that they could withdraw from the study at any time and that the confidentiality and anonymity of the data would be respected. This study obtained ethical approval (no. 15r16) from the scientific committee of the French Ministry of Sports regarding standard research practice and the guidelines outlined for research involving people.

Procedure. The MBI programme was implemented by the second author, who had also been an expert badminton player (10 years of practice, ranking in the national top 50) and badminton coach for five years. Meetings were held with the coaches of the two National Training Centres, which are both similar in terms of training (e.g., resources, number of athletes, training characteristics, federal guidelines). None of the coaches had ever used PST, MABI or

sport psychologists in order to enhance performance, nor had they followed any training in this area. Prior to the start of each intervention, an identical procedure was followed with the coaches at both centres in order to present the respective interventions, explain the main objectives, provide information about the key messages in the same way and make sure the interventions would fit the athletes' schedules appropriately. At the end of these meetings, it was agreed that the coaches would be involved in the interventions as much as possible in order to reinforce their impact on the athletes. In addition, parents and the athletes' club coaches were informed by letter about both the intervention and its associated key messages. The coaches asked all participants to complete the online questionnaires one week before the intervention and two weeks after it, as well as to take part in the interview two months afterwards.

In order to evaluate the efficacy of the MBI programme, the MBI group was compared to an active control group that was following a placebo programme. This placebo intervention was designed to control the intervener effect and included relaxation techniques based on progressive muscle relaxation (PMR) (Jacobson, 1938) that are not thought to develop mindfulness and acceptance skills, or have any effect on performance (Carletto et al., 2017; Pelka et al., 2016). This relaxation technique involves mainly muscular activity and is not deemed to involve significant cognitive and metacognitive activity. The placebo programme consisted in a 30-minute relaxation session carried out by a sport psychologist once a week for eight weeks. Continued and autonomous practice was encouraged.

Measures.

Mindfulness Inventory for Sport (MIS). A French adaptation of the MIS (Thienot et al., 2014) was used to measure mindfulness skills specifically applied to sport performance. It contains 15 items, each of which is rated on a Likert scale from 1 (not at all) to 6 (very much). This measure includes three subscales: (a) *awareness* (5 items; being aware of disruptive stimuli and their associated internal reactions; e.g., "I am aware of the thoughts that are passing through

my mind."); (b) *acceptance* (5 items; adopting a non-judgmental attitude towards these stimuli and reactions; e.g., "When I become aware that I am really upset because I am losing, I criticise myself for reacting this way."); and (c) *refocusing* (5 items; quickly refocusing attention on goal-related cues; e.g., "When I become aware that I am tense, I am able to quickly bring my attention back to what I should focus on."). The values of Cronbach's alpha were: α_{T1} = .70, α_{T2} = .76 for awareness, α_{T1} = .76, α_{T2} = .78 for acceptance, and α_{T1} = .61, α_{T2} = .78 for refocusing.

Thought Occurrence Questionnaire for Sport (TOQS). A French adaptation of the TOQS (Hatzigeorgiadis & Biddle, 2000; Lane et al., 2005) was used to assess the cognitive interference or thought disruption that athletes may experience during competition. It contains 17 items, each of which is rated on a Likert scale from 1 (almost never) to 7 (very often). This measure includes three subscales: (a) *performance worries* (6 items; thoughts associated with a perceived failure to attain performance goals; e.g., "During the game, I thought about previous mistakes I have made."); (b) *task-irrelevant thoughts* (5 items; day-dreaming and thoughts not associated with competition; e.g., "During the game, I thought about what I'm going to do when I get home."); and (c) *thoughts of escape* (6 items; thoughts related to removing oneself from the situation; e.g., "During the game, I thought about quitting."). The values of Cronbach's alpha were: α_{T1} = .78, α_{T2} = .73 for performance worries, α_{T1} = .66, α_{T2} = .80 for task-irrelevant thoughts, and α_{T1} = .65, α_{T2} = .80 for thoughts of escape.

Performance satisfaction. Participants subjectively rated their actual performance satisfaction on a Likert scale from 0 (totally dissatisfied) to 10 (totally satisfied), as recommended by Biddle, Hanrahan, and Sellars (2001).

Social validation. Social validation was used to collect the MBI programme participants' overall perceptions of the intervention in two stages. In the first stage (i.e., two weeks after the end of the programme), participants subjectively rated their satisfaction

regarding the intervention on a Likert scale from 0 (totally dissatisfied) to 10 (totally satisfied) and evaluated the efficacy of the intervention on their performance on a Likert scale from 0 (not at all) to 10 (very much). In the second stage (i.e., two months after the end of the programme), a semi-structured interview lasting approximately 30 minutes was conducted by the first or fourth authors with each MBI programme participant in order to qualitatively examine their perceptions of the programme. The interviewers did not participate in the implementation of the MBI programme and the interview was their first contact with the badminton players. The two interviewers designed and used the same interview guide (available upon request from the authors). Participants were asked what they had learnt and understood from the MBI programme and what tools and exercises they considered most useful and had continued to apply since the end of the programme. The interview guide contained open-ended questions (e.g., "In general, what did you think of the programme?", "What have you learnt?", "What was the most useful intervention content (tools, exercises, situations, etc.)?") and probes (e.g., "Can you explain your answer?"), aiming to assess the understanding and appropriation of the key messages and tools of the MBI programme (see Table 1). In each interview, all the intended questions related to the different aspects of the interview guide were asked. All interviews were recorded.

Data analysis.

Statistical analysis. Analyses were carried out using the SPSS 17.0 statistical software package (SPSS, Inc., Chicago, IL, USA). Firstly, preliminary analyses were conducted to screen the data for missing or out-of-range values, as well as the normality of the data. Secondly, the MBI and control groups were compared at pre-intervention by applying analyses of variance (ANOVA) and chi-square test to the continuous and categorical variables respectively. Thirdly, in order to investigate the impact of the intervention (MBI *vs.* placebo), a multivariate analysis of covariance (MANCOVA) was performed with the scores of the main variables (i.e., MIS,

TOQS, performance satisfaction) at post-intervention as dependent variables, and the scores of the main variables (i.e., MIS, TOQS, performance satisfaction) at pre-intervention as covariates to take the effect of pre-intervention scores into account in the overall results (Tabachnick & Fidell, 2013). The MANCOVA was followed by univariate analyses of covariance (ANCOVAs) to determine the specific effect of the MBI programme on each of the outcome variables (i.e., MIS, TOQS, performance satisfaction). Fourthly, follow-up *t-tests* were used to examine the change from pre- to post-intervention among the MBI group and control group separately.

Social validation data analysis. The scores given by the MBI participants to the two rating scales (i.e., intervention satisfaction and efficacy of the intervention) were analysed descriptively. Qualitative data from the semi-structured interviews were transcribed by an independent researcher. This first step provided a set of data organized by the questions in the interview guide. The fourth author conducted the subsequent analysis. The second step consisted in reading the set of data several times. Two themes emerged from this second step: (a) the key messages retained, and (b) the use of the training content proposed in the programme. These two themes were retained because they provided information in-depth understanding of the appropriation process of the MBI programme by the athletes and thus added new and complementary results to the quantitative results (i.e., relative to the effects of the programme on the key variables). In the third step, data were classified by these two themes. For the first theme, all the data were classified by categories corresponding to the key messages of the programme (see Table 1, column 5). For the second theme, all the data were classified by categories corresponding to the tools proposed in the programme (see Table 1, column 3). In each theme, a final step consisted in exploring the number of occurrences in each category and the comments of the athletes on it (e.g., specifications on the application of

a key message in competition, negative or positive views about a tool, explanations of whether or not they use it).

Results

Questionnaire Results

Table 2 shows the means and standard deviations of the main variables for the badminton players in the MBI group and control group at pre- and post-intervention.

Pre-intervention comparisons. Firstly, the groups' characteristic comparisons showed that there was no significant difference between the groups of badminton players in age ($F_{(1, 27)} = 0.99$, $p = 0.33$), badminton playing experience ($F_{(1, 27)} = 0.97$, $p = 0.33$), or number of hours' training per week ($F_{(1, 27)} = 0.80$, $p = 0.38$). In addition, the results of the group (2) × gender (2) chi-square test of association indicated that the number of males and females was not significantly different across the two groups ($\chi^2_{(1)} = 0.28$, $p > 0.05$). Secondly, comparisons of pre-intervention main variables (i.e., MIS, TOQS, performance satisfaction) revealed two significant differences between the groups for performance worries ($F_{(1, 27)} = 7.37$, $p < 0.05$), with MBI group participants scoring lower, and task-irrelevant thoughts ($F_{(1, 27)} = 4.45$, $p < 0.05$), with MBI group participants scoring higher. No significant pre-intervention differences between groups were reported on any other key study variables.

Assessing the impact of the MBI programme. Table 2 displays the results of the MANCOVA analysis. This analysis yielded a significant multivariate large effect of the intervention on the main outcome variables (i.e., MIS, TOQS, performance satisfaction) compared to the control group; Wilks' Lambda $F_{(7, 21)} = 4.23$, $p = 0.005$, partial $\eta^2 = 0.58$. The results of univariate ANCOVAs indicated that post-intervention awareness, performance worries and task-irrelevant thoughts differed significantly across the groups. In addition, follow-up *t-tests* indicated significant changes from pre- to post-intervention in awareness,

refocusing, performance worries and task-irrelevant thoughts among the MBI group, and in acceptance among the control group. All the results are presented in Table 2.

Social Validation Results

Intervention satisfaction and efficacy. At the end of the MBI programme, intervention satisfaction was rated on average at 7.18/10 (*SD* = 1.70) and intervention efficacy at 6.29/10 (*SD* = 1.72).

Retention and understanding of the key messages. To the question "What have you learnt from this programme?", the most frequent answers (i.e., nine athletes) referred to attention to the task at hand (see Table 3) such as refocusing on the present moment when attention had drifted away and maintaining attentional focus on relevant cues. Athletes felt that they were aware sooner that their attention had been interrupted and they were able to refocus more rapidly on the game.

For seven athletes, the second most frequently retained message related to acceptance and non-judgmental attitudes (see Table 3). Across the MBI group, 16 athletes seemed to have understood acceptance and non-judgmental attitude, as well as the benefits for their badminton performance. However, nine athletes said that it was still difficult to apply acceptance and non-judgment in some performance situations (i.e., very frustrating situations) and that they still needed to work on skill acquisition in this area: "It's still difficult to accept that I make mistakes and that it distracts me" (player 2); "I still have trouble accepting it, but when I do manage that, it will be really beneficial and I'll get a lot out of it" (player 10).

Perceived efficacy and use of training content. A wide variety of responses were given to the question "What has been the most useful part of the intervention (tools, exercises, situations, etc.)?". Seven different elements were cited (listed according to the number of occurrences): mindfulness practice with audiotapes (*n* = 8), self-confrontation interview (*n* = 8), performance routine (*n* = 7), daily diary (*n* = 7), "body scan" before badminton session (*n* =

4), situations during badminton sessions and feedback by the consultant ($n = 4$), video interview of Olympic athlete ($n = 1$).

Concerning mindfulness practice with audiotapes, five athletes gave very positive comments: "The audiotapes really helped me to feel my body, to feel the emotions, to let go of my thoughts and so on […] I was able to transfer this to the court. I could feel my emotions better afterwards. I could see the links. I can now manage to do this in a match" (player 5). Conversely, five athletes gave very negative comments on mindfulness practice with audiotapes. For different reasons, they were not motivated to practice or did not have time to: "I didn't understand why we were doing this" (player 10); "The audios are difficult, they're not tangible. Sometimes, they say "What are you thinking about?" But you aren't thinking about anything in particular, so it's complicated" (player 1); "They're quite long, they make us really sleepy" (player 10); "I didn't find the time to do it" (player 6). For four athletes, practicing "body scan" before each badminton session "was helpful to get focused on the training" (player 1).

The self-confrontation interview was effective for eight participants. This individual interview, based on a video of a recent game and conducted by the consultant, seemed to enhance the awareness by the athlete of his or her behaviours and mental experiences in real performance situations: "[…] Seeing how I really behave in a game, because I'm not very aware of that" (player 15). It allowed them to realise how they could be more focused and apply mindfulness in games: "[Now] between points I think about refocusing on the issues we identified with Q [the consultant who conducted the MBI] when watching the game" (player 17); "[It] was really useful to me in the next games… taking time between points, clarifying my thoughts before serving or receiving, concentrating, focusing on the point" (player 3).

Another positively perceived tool was the performance routine ($n = 7$). It enabled a link to be made between the non-specific mindfulness training and the specific strategies that

athletes use to regulate their attention in a game. “When you have a routine between points, it helps you get ready for the next point. It was quite good, it helped me a lot […]. Refocusing on something tangible before the point – personally, I refocused on my breathing each time – I really focused on that and it helped me be ready for the next point, instead of thinking about the previous point” (player 1). After the end of the intervention, 11 athletes said that they have continued to use their routine in games.

We also observed that the daily diary was considered to be a useful tool (n = 7). Some of the athletes used this tool to set goals before each training session and competition. They mentioned the benefits that setting goals had on attention regulation: “It helps me to focus on specific points” (player 7); “We’re more focused, less distracted, we get less angry” (player 6). After the end of the intervention, 13 athletes said that they have continued to set some goals for training sessions and competitions.

Discussion

The current study aimed to design and implement an integrated MABI (i.e., the MBI programme) for badminton training and performance settings, and to investigate its impact through a mixed methods approach (Huynh et al., 2019). Firstly, its effects on the mindfulness skills (i.e., awareness, acceptance, refocusing), cognitive interference (i.e., disruptive thoughts), and performance satisfaction of young elite badminton players were assessed from a quantitative approach and compared to an active group control. Secondly, athletes’ overall perceptions of the MBI programme were examined from a qualitative approach. Overall, the results showed that the MBI programme did not lead to a clear improvement in targeted sport performance-related outcomes when compared to an active control group. Nevertheless, social validation data provided additional insights into the elements athletes had retained and applied from the MBI programme.

Consistent with expectations, the MBI group obtained a statistically significant improvement in awareness skills compared to the active control group. By increasing their awareness skills over the course of the MBI programme, badminton players were more aware of ongoing stimuli and their own associated internal reactions, positive as well as negative. These findings support previous interventional studies showing the positive effects of MABI on the development of awareness skills (e.g., Bernier et al., 2014; Goodman et al., 2014; Haase et al., 2015; Josefsson, Ivarsson, et al., 2019; Scott-Hamilton et al., 2016; Vidic, St. Martin, & Oxhandler, 2017).

In contrast, results did not show a statistically significant improvement in acceptance skills for badminton players participating in the MBI programme compared to the active control group. Nevertheless, the badminton players' perceived impact of the MBI programme revealed a more complex picture. They reported understanding the key messages relating to acceptance and how a non-judgmental attitude towards their internal experiences could benefit attention and performance. However, they pointed out their difficulty in applying this in challenging situations, particularly when faced with frustration, performance problems or errors. Lindsay and Creswell (2017) emphasized "that attention monitoring skills begin to improve more immediately after practice, while acceptance may take longer to cultivate" (p. 50). In addition, being more aware of one's current experience without employing acceptance skills may be counterproductive and intensify affective reactivity (Farias & Wikholm, 2016; Gardner & Moore, 2012; Lindsay & Creswell, 2017). Therefore, strengthening the assimilation and application of acceptance skills in a high-performance environment appears necessary to help athletes regulate the intensity of their internal experiences and improve performance (Gardner & Moore, 2012; Lindsay & Creswell, 2017).

Regarding the control group, the findings unexpectedly showed a pre-/post-intervention change in acceptance skills although the placebo programme based on PMR did not target this.

Given that the control group athletes were not exposed, familiarized and/or accustomed to the acceptance's principles and training during PMR, one possible explanation may be a potential response bias to the MIS's acceptance items (Thienot et al., 2014; Zhang, Chung, & Si, 2015). As highlighted by Thienot et al. (2014), the interpretation and understanding of some items may depend on an athlete's experience and practice of mindfulness and acceptance. Given that awareness and refocusing are typical well-known phenomena in a sport context, control group athletes may have properly interpreted and understood the items related to these two subscales because they may relate closely to their experience. As such, it may be easier to self-assess these two skills than acceptance (Zhang et al., 2015). Prior to the beginning of the interventions, neither MBI participants nor those in the control group had heard about acceptance. Until recently, acceptance has been little mentioned in a sport context and may be a rather abstract and ambiguous concept for athletes (Josefsson, Tornberg, Gustafsson, & Ivarsson, 2019). MBI participants were informed of and trained in acceptance and may have succeeded in assessing their skills better than control group participants who had no clear picture of the acceptance processes.

In addition, results did not indicate any statistically significant differences in refocusing skills between the MBI and control groups. However, the badminton players among the MBI group showed a pre-/post-intervention improvement. This is supported by athletes' perceptions of the MBI programme, since they reported that the most frequently retained message was to quickly refocus on helpful goal-relevant cues when faced with disruptive stimuli. This is consistent with previous interventional studies highlighting the beneficial effects of MABI on refocusing skills (e.g., Bernier et al., 2014; Goodman et al., 2014; Scott-Hamilton et al., 2016). Nevertheless, the limited impact of the MBI programme on the improvement of refocusing skills compared to the control group might be due to the learning processes of the other mindfulness mechanisms targeted by the MBI programme (i.e., awareness, acceptance,

refocusing). Specifically, learned awareness and acceptance skills may be a pre-condition for being able to switch the focus of attention from disruptive stimuli to relevant goal-related cues (Birrer et al., 2012; Lindsay & Creswell, 2017). The improvement in MBI participants' refocusing skills could thus have been limited by the reported difficulty in employing acceptance in challenging situations.

Given that interfering thoughts can have debilitating effects on sport performance (Lane et al., 2005), the MBI programme was designed to help badminton players deal effectively with cognitive interference. Statistical results showed significant differences in performance worries and task-irrelevant thoughts between the MBI and control groups. The badminton players who followed the MBI programme reported fewer task-irrelevant thoughts after the intervention. The decrease in the occurrence of task-irrelevant thoughts could be associated with the pre-/post-intervention improvement in awareness and refocusing attention. This may have led athletes to focus better on task-relevant thoughts and less on irrelevant ones. In line with this, athletes reported that MBI programme content (in particular, the self-confrontation interview, the performance routine and the daily diary) may have facilitated the identification and clarification of task-relevant cues on which players could focus their attention (or refocus after disruptive irrelevant thoughts) during training and performance (e.g., Bernier et al., 2014). Moreover, results unexpectedly indicated that MBI athletes also reported higher occurrences of performance worries after the intervention. As highlighted above, this may be due to the MBI players' improvement in awareness skills without concurrent improvement in acceptance skills (Farias & Wikholm, 2016; Gardner & Moore, 2012; Lindsay & Creswell, 2017). Given that badminton tournaments were more frequent and had higher stakes towards the end of the programme than at the beginning, the MBI players had become more aware of these contextual changes in performance requirements over the course of the intervention than the control group players, which may have resulted in intensification of affective reactivity and performance

worries. Accordingly, performance worries consisted of disruptive thoughts related to emotional content and may be more problematic to manage than task-irrelevant ones (e.g., other activities, friends). Increasing mindful acceptance of performance worries and other affective performance related-thoughts may help athletes to cope more effectively with unwanted thoughts often triggered by performance situations (Josefsson, Ivarsson, et al., 2019).

While it was expected that the MBI programme would decrease thoughts of escape, the results did not show that the programme had any impact on their occurrence. Overall, the badminton players in both groups reported a lower occurrence of thoughts related to removing themselves from the situation than of other interfering thoughts. As Lane et al. (2005) pointed out, young elite athletes are characterised by experiencing fewer thoughts of escape. Given the low reported scores in this area, this could explain why no change was observed in a sample of young elite athletes over the course of the intervention. The content of MABI could accordingly be oriented principally toward improving acceptance and task-focused attention to help maintain optimal functioning in the presence of irrelevant thoughts or performance worries rather than thoughts of escape.

In terms of performance satisfaction, findings did not show a statistically significant improvement for badminton players participating in the MBI programme compared to the active control group. In their systematic review, Noetel et al. (2017) highlighted conflicting results for the influence of MABI on athletic performance enhancement. To date, few interventional studies have reported clear evidence of performance enhancement (for reviews, see Bühlmayer et al., 2017; Noetel et al., 2017; Sappington & Longshore, 2015). While Josefsson, Ivarsson, et al. (2019) recently showed the positive effects of the MAC approach on enhancing the perceived athletic training performance of elite athletes in comparison to a traditional PST control group, they suggested that these effects may unfold gradually over time. The MBI programme may have more effect on performance if the practice is sustained

and evaluated over a longer period (for reviews, see Bühlmayer et al., 2017; Josefsson, Ivarsson, et al., 2019; Kaufman et al., 2009; Thompson, Kaufman, De Petrillo, Glass, & Arnkoff, 2011). Overall, the present study's findings acknowledged that even an 8-week MABI, integrated into sport-specific situations, did not lead to strong evidence of improvement in athletes' mindfulness components and sport performance-related outcomes when compared to an active group control. As previously highlighted, some of the mechanisms underlying MABI's effects take longer to assimilate and apply (e.g., acceptance), which may have potentially limited MBI's impact (Lindsay & Creswell, 2017). In addition, while recent reviews of the literature yielded preliminary support for the beneficial effects of MABI on sport performance-relevant outcomes (e.g., Bühlmayer et al., 2017; Noetel et al., 2017; Sappington & Longshore, 2015), our results suggested that further high-quality studies (e.g., randomized control group studies, active control group, or multiple baseline designs and standardized intervention manuals) are still needed to provide both stronger evidence and a deeper understanding of the mechanisms underlying MABI's effects on sport performance-relevant outcomes (Gardner & Moore, 2017; Josefsson, Ivarsson, et al., 2019; Noetel et al., 2017).

Regarding practical implications, social validation data provided additional insight on how athletes perceived the MBI programme. The MBI badminton players provided positive feedback regarding the MBI programme content, which was integrated into badminton training sessions and performance situations (Baltzell, 2016; Scott-Hamilton et al., 2016). The key messages and tools were provided in a variety of ways in order to enhance the assimilation and application of mindfulness skills to a sport context (e.g., mindfulness practice with audiotapes, self-confrontation interviews, performance routines, daily diaries, "body scans" before badminton sessions, scenarios during badminton sessions, individual feedback). This could be effective in encouraging athletes' commitment during regular

practice, which is sometimes perceived by athletes as time-consuming and decontextualised from the sport-specific demands, and in helping them assimilate learned skills more readily (e.g., Scott-Hamilton et al., 2016). As some athletes said in social validation interviews, mindfulness practice seems more meaningful if it is related to the sport-specific requirements and their individual performance goals (Bernier et al., 2014; Birrer et al., 2012; Josefsson, Tornberg, et al., 2019). As highlighted by Goodman et al. (2014), athletes may prefer to learn through active and experiential methods. In addition, the originality of the MBI programme stems from the integration of commitment exercises into badminton training in accordance with the MAC approach (Gardner & Moore, 2007). In line with this, goal setting and the daily diary were used to help athletes clarify their goal-driven behaviours and encourage their commitment, as well as to sustain the focus of attention on goal-related cues, while at the same time disengaging from disruptive stimuli in practice and competition (Noetel et al., 2017). Finally, for time-limited elite athletes, who have few opportunities to practice outside training sessions, MABI needs to integrate specific content during training sessions as much as possible (Birrer et al., 2012). Future studies may also wish to investigate the benefit of providing additional "booster sessions" in the months following the intervention, in order to reinforce previously learned skills and promote a commitment to continued practice (Thompson et al., 2011). Furthermore, coaches and athletes' entourages could be made aware of and trained in the programme's key messages in order to help them integrate these during and after the programme (e.g., Longshore & Sachs, 2015). While the athletes' parents, coaches and club coaches were made aware of both the MBI programme and MABI principles, this perspective merits further consideration. In particular, when the talk and behaviour of coaches and entourages are consistent with the acceptance principle, it may reinforce the impact of the intervention.

Limitations

These findings should be considered in the context of several limitations. Firstly, participants were not randomly assigned, but rather allocated by FFBad to the MBI or control groups based on their respective training centre affiliation. In addition, the sample size was small, which could have undermined its statistical power. It is important to note, however, that evaluating the efficacy of an intervention with a target group of elite athletes is difficult. Elite athletes are a scarce population and consequently, samples of elite athletes are small. Moreover, it is very difficult and ethically questionable to persuade athletes and their coaches to be part of a control group. This partly explains why the allocation occurred at a ratio of approximately 2:1 in favour of the MBI. Thus, the difficulty of conducting the MBI programme with an elite athlete sample and assessing its effects in comparison to an active control group should be recognised (Birrer & Morgan, 2010). Nevertheless, it should be noted that the placebo programme was not equivalent to the MBI programme in terms of intervention dose. Future studies need to better control this potential bias. Another limitation and a potential research avenue is the use of self-report questionnaires to measure mindfulness skills and cognitive interference (Bühlmayer et al., 2017; Kabat-Zinn, 2003; Longshore & Sachs, 2015; Shankland, Kotsou, Cuny, Strub, & Brown, 2017; Vidic et al., 2016). This difficulty has often been discussed in the literature on the quantitative measurement of mindfulness (e.g., Kabat-Zinn, 2003; Longshore & Sachs, 2015; Shankland et al., 2017), especially when athletes have not been exposed to MABI (Thienot et al., 2014; Zhang et al., 2015). Future research needs to develop sport-specific tools to measure mindfulness skills and ensure that the results are due to the intervention and not simply to other extraneous factors or self-evaluation bias (e.g., Noetel, Ciarrochi, Sahdra, & Lonsdale, 2019; Shankland et al., 2017; Zhang et al., 2015).

Conclusion

The design, implementation and evaluation of the MBI programme led to contrasting results when compared to an active group control. While the MBI programme appeared to

improve awareness skill and decrease task-irrelevant thoughts, the results also suggested the need to take into account the concurrent development of mindfulness skills to prevent potential counterproductive effects, such as on performance worries (Farias & Wikholm, 2016; Gardner & Moore, 2012; Lindsay & Creswell, 2017). As such, acceptance appeared to be a central underlying mechanism to guarantee MABI's beneficial effects on sport performance-related outcomes (Josefsson, Ivarsson, et al., 2019). Consistent with the MAT approach (Lindsay & Creswell, 2017), more research should be conducted to better explore mindfulness mechanisms and provide a deeper understanding of which specific components and the way they are inter-related influence changes in sport performance-related outcomes (Birrer et al., 2012; Josefsson, Ivarsson, et al., 2019; Lindsay & Creswell, 2017). Accordingly, enhanced knowledge about MABI's underlying mechanisms may enable and result in the design of even more efficient and effective intervention for elite athletes, and more generally, performing populations in high-performance environments (e.g., schools, the military and work).

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Table 1

The Mindfulness Badminton Integrated Programme Session Content

Session themes		Session goals	Tools	Classroom / Integrated session***	Key messages
Module 1: Psychoeducation	Week 1	Session 1 (45 minutes) Create adhesion to the intervention Help athletes understand the processes and limitations of attentional processing Introduce attention functioning principles (e.g., cognitive overload, limited attentional resources and attentional flexibility)	Short games with various themes and recreational activities that disrupted their attention in order to illustrate attentional processing	Integrated	Attention is a limited resource Attention needs to be focused on useful cues Attention is manageable
	Week 2	Session 1 (40 minutes) Deconstruct preconceptions about mental training Discover psychological strategies of athletes in games	Debate on a list of "cliché" sentences (e.g., "Mental is innate, you can't learn it", "If I'm afraid before a game, then I won't play well") and a questionnaire about the players' psychological strategies during games	Classroom	I can perform even if I'm anxious/I don't feel confident/I'm upset The end result of a game doesn't necessarily depend on my internal state
		Session 2 (40 minutes) Introduce the fundamental principles and guidelines of goal-setting to favour commitment	Questionnaires and daily diary*	Classroom	My goal is a compass Setting goals enables me to be the pilot of my career
Module 2: Mindfulness	Week 3	Session 1 (30 minutes) Introduce mindfulness and mindfulness exercises Reminder of the importance of regular practice	Mindfulness practice and group discussions Self-confrontation interview to identify how they felt in their matches and to help them afterwards apply mindfulness principles in performance situations +The "basics"** + daily diary*	Classroom	Mindfulness is not relaxation

	Week 4	Session 1 (20 min) Develop mindfulness skills on the court	A dual-task situation during a badminton training session illustrating their limited attention capacity and how not to overload their attentional resources, by focusing on one specific attentional focus at a time while playing +The "basics"** + daily diary*	Integrated	Mindfulness can be trained in a lot of situations Using a precise attentional focus enhances the quality of the training session
Module 3: Acceptance	Week 5	Session 1 (20 minutes) Improve athletes' awareness of their avoidance strategies and develop their acceptance	Group and individual discussions during badminton training +The "basics"** + daily diary*	Both	Emotions are transient I can brood or I can accept my internal state and do my best to refocus on relevant cues Using avoidance strategies prevents me from improving my game Being performing = being in the present moment
	Week 6	Improve athlete's awareness of their avoidance strategies and develop their acceptance	Individual discussions during badminton training +The "basics"** + daily diary*	Integrated	
Module 4: Attentional Focus	Week 7	Develop/improve athlete's routines (before serving or receiving) and attentional focus according to the athlete's needs and demands of badminton	The use of routines during badminton training and individual discussions The video of an Olympic champion testimony +The "basics"** + daily diary*	Both	Refocus on the present moment when attention drifts away Maintain attentional focus on relevant cues
	Week 8		Individual championship debriefing by phone (use of performance routines, athletes' attentional foci during games and how they regulated them and managed potential disruptive stimuli) +The "basics"** + daily diary*	No direct intervention	

Note. * Participants maintained a daily diary in which they recorded their goals and experiences for each badminton training session from week two until the end of the intervention.

** The "basics" included: (a) a "body scan" (three minutes) before each badminton training session, (b) an eight-minute mindfulness exercise guided by audio (from module 2: awareness of breathing, awareness of sensations, awareness of balance and movement; from module 3: acceptance with metaphors exercise; from module 4, intermittent focus exercise, alternating one minute of breathing awareness and one minute of recreation, e.g., reading, surfing on the internet, homework, etc.) two to three times per week after the badminton training sessions and two to three times per week at home, and (c) a sustained focus of attention on a specific point (e.g., technique, rhythm, bodily sensation, breathing) during the different exercises in the physical training sessions.

*** "Integrated session" means that the session took place during a badminton or physical training session. Mindfulness skills and key messages were taught while the athletes were practicing badminton or doing physical training.

Table 2

Means and Standard Deviations of the Main Variables at Pre- and Post-Intervention, as well as Pre- / Post-intervention Differences among the MBI and Control groups, and the MANCOVA Results

Variables	MBI group (n = 18)		MBI group pre- / post-intervention difference		Control group (n = 11)		Control group pre- / post-intervention difference		MANCOVA $F_{(7,21)} = 4.23$, $p = 0.005$ partial $\eta^2 = 0.58$	
	Pre	*Post*			*Pre*	*Post*				
	Mean (SD)	Mean (SD)	$t(17)$	CI	Mean (SD)	Mean (SD)	$t(10)$	CI	F- value	p
Awareness	4.04 (0.91)	4.66 (0.71)	-2.97**	[-1.05, -0.18]	4.38 (0.76)	4.20 (0.84)	0.76	[-0.35, 0.71]	6.01	0.02
Acceptance	2.53 (1.00)	2.93 (1.16)	-1.61	[-0.92, 0.12]	2.85 (0.74)	3.16 (0.76)	-4.54**	[-0.46, -0.16]	0.08	0.78
Refocusing	3.83 (0.81)	4.26 (0.90)	-2.11*	[-0.84, .00]	3.93 (0.39)	4.07 (0.57)	-0.91	[-0.50, 0.21]	0.94	0.34
TOQS-W	2.57 (0.95)	3.13 (0.90)	-2.50*	[-1.04, -0.09]	3.51 (0.84)	3.29 (0.72)	1.02	[-0.27, 0.73]	5.46	0.03
TOQS-I	2.47 (0.87)	1.83 (0.89)	2.49*	[0.10, 1.17]	1.85 (0.53)	2.20 (0.83)	-1.58	[-0.83, 0.14]	7.05	0.01
TOQS- E	1.77 (0.58)	1.88 (0.89)	-0.67	[-0.46, 0.24]	2.02 (0.68)	2.00 (0.59)	0.07	[-0.49, 0.52]	0.21	0.65
PERF	6.06 (2.36)	6.44 (1.82)	-0.88	[-1.33, 0.55]	5.45 (2.46)	5.55 (2.34)	-0.08	[-2.77, 2.59]	0.07	0.79

Note. TOQS-W = Performance worries; TOQS-I = Task-irrelevant thoughts; TOQS- E = Thoughts of escape; PERF = Performance satisfaction; SD = Standard Deviation; CI = 95% Confidence Interval. *$p < .05$; **$p < .01$.

Table 3

Examples of Quotes Illustrating the Main Retained Key Messages

Quote	Athlete
Attention to the task at hand	
I've made quite a lot of progress there. Sometimes, before, I was really completely thrown. I could lose 5 points in a row. Now, I lose 2 or 3 points and I tell myself to pull myself together, I'm more aware of it.	1
Focusing on the present moment, especially when we have just made a mistake and when we want to move on to the next point […]. Before, I didn't have any techniques for focusing. I didn't know what to think about.	2
"I have managed to refocus more often, in training and competitions. It's still difficult to refocus in some circumstances, such as when things make me angry, like refereeing mistakes."	5
"Now I realise earlier when I'm not focused."	8
Acceptance and non-judgmental attitude	
"You have to accept your frustration […] "OK, I did that" and it's much easier to move on."	1
"Before, I used to build a barrier, telling myself that I shouldn't have negative thoughts, but it actually made things worse. The more you fight a thought, the more you think about it."	2
"I get stressed, I can feel it but then I let it go, I accept that I'm stressed and then it gets better."	5
"Never dwell on the past. If you have thoughts that come up, you shouldn't try to get rid of them. You should just let them go."	6
"I have to play, even if I feel really bad, I have to get on with it. Even if I can't change things right away, they'll get better bit by bit."	14

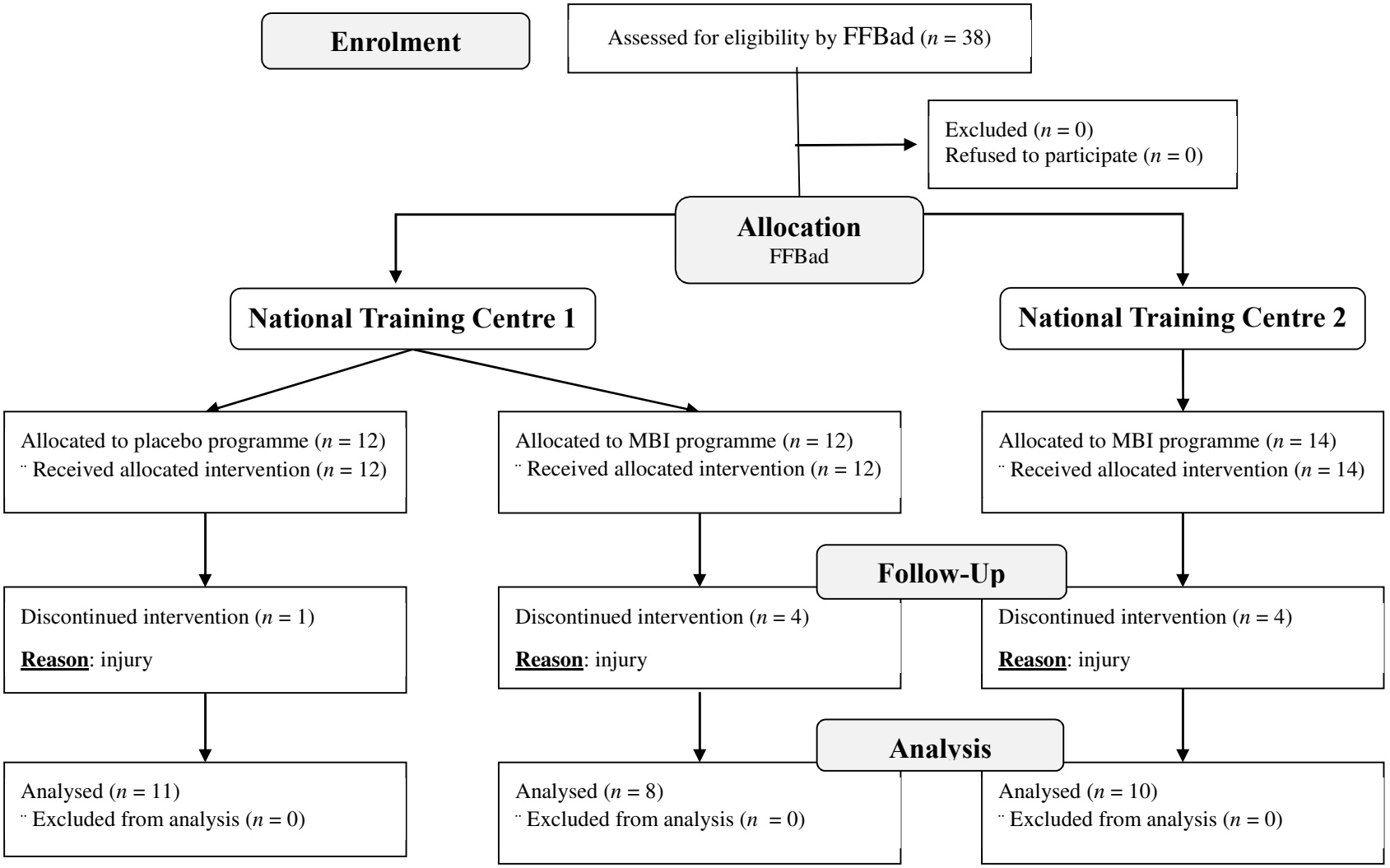


Figure 1. CONSORT chart for the present study demonstrating group sizes for enrolment, allocation, follow-up, and analysis.