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OPTIMISING YOUNG TENNIS ATHLETES' PERFORMANCE AND MENTAL STRENGTH IN COMPETITION - THE ROLE OF SPORTS PSYCHOLOGY

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ABSTRACT

Tennis, a widely played and highly competitive sport, has become increasingly popular globally. In Malaysia, ROG, a new tennis junior development programme collaborating with the International Tennis Federation (ITF), had been introduced in 2024 to provide foundational tennis education, targeting children aged 8 to 10. Young tennis players face various obstacles, including demanding training loads, academic requirements and expectations from parents and coaches. In this context, sport psychology, which applies the psychological expertise in promoting athletes' mental well-being, plays a pivotal role in optimizing athletic performance and mental strength in competition. This narrative review aims to evaluate the effectiveness of mental health assessment methods and mental health interventions. A total of 19 articles addressing the objective of this review were included. The study results suggested that various tools and interventions, particularly the Sport Anxiety Scale-2 and motor imagery training, can be implemented in current training routine. However, further research needs to be conducted as there is a lack of studies focusing on Malaysian-translated versions of mental health assessment tools and mental health interventions for young tennis players in Malaysia.

Keywords: *Athletic performance, Mental Strength, Sports psychology*

INTRODUCTION

Over the years, tennis has become an increasingly popular sport globally. Based on the latest statistics published by the ITF on tennis participation in 2021, there was a substantial increase in the population involvement in tennis as compared to that in 2018, by 4.5%, which makes up to a total of 87 million players (International Tennis Federation [ITF], 2021). The substantial increase in the playing population of tennis is reflected by the various strategies implemented by the ITF in growing and developing the sport. Compiling data from 41 different countries, it is seen that tennis access to the playing population was improved significantly given that adequate funding was provided for coaching sessions, various tennis training programs, competitions and tournaments, to be carried out (ITF, 2021). Furthermore, regular expansion and upgrading of facilities, such as increasing the number of tennis courts, had also contributed to an improved tennis access (ITF, 2021; ITF, 2023a).

Another effort to promote further development of this sport include the execution of ITF's Tennis Play and Stay Campaign, where a new, "ROG" tennis ruling is implemented, allowing individuals of all ages, including children as young as five years of age, to play tennis (ITF, 2023b). The term, "ROG" stands for red, orange and green, which represents the colours of the tennis balls used in this new tennis ruling. Each of these coloured tennis balls differs between one and another, in terms of their material, which alters their characteristics, including their speed and elasticity. The game rules for each different coloured tennis ball varies from the perspective of the size of the tennis court, height of the tennis net, as well as the surface area of the tennis racquet, based on the average height of different children's age group (Tennis Malaysia [TM], 2024a; ITF, 2018). The red ball has the slowest speed and lowest elasticity, resulting in an overall, easier control of the ball, making it suitable for children aged eight years and below. Following the sequence of red, orange and green, the speed and elasticity of these balls vary in ascending order, where orange ball is suited for children aged nine years and below, and green ball suited for children aged 10 and below. On an average, one competition match may last for approximately 20 minutes, but sometimes, it may also prolong to about three-to-five hours, especially in orange and green tennis (NH Kid's Tennis, n.d.; United States Tennis Association [USTA], 2016a).

Figure 1: Summary of the "ROG" tennis ruling, including the characteristics of different coloured balls, alongside their respective racket size, court size, net height and scoring system (ITF, 2018).

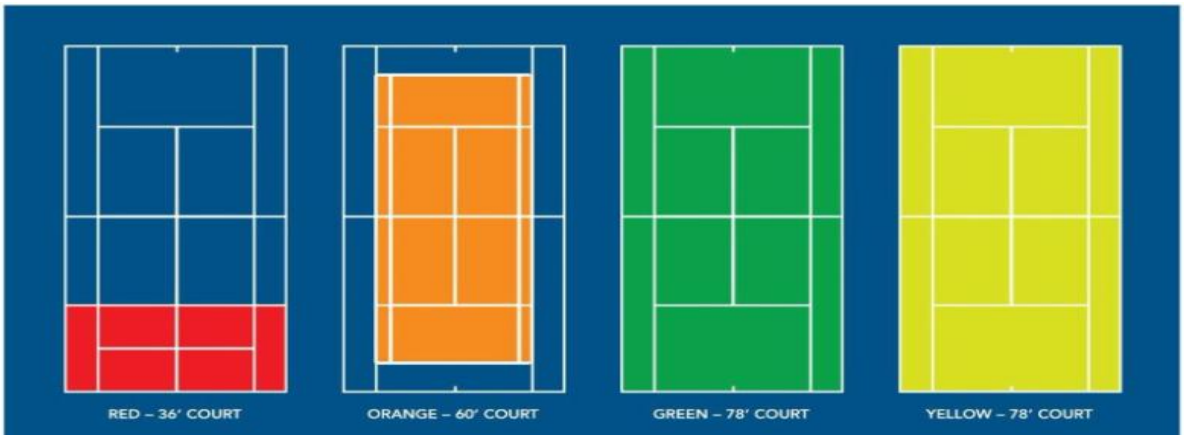

Figure 2: Different tennis court sizes coupled with the respective coloured tennis balls in the different age group of players (ITF, 2018).

In Malaysia, the national tennis association, Tennis Malaysia, and other Malaysian sports associations, including the Sukan Malaysia (SUKMA) and Majlis Sukan Sekolah Sekolah Malaysia (MSSM), hold tournaments for young tennis athletes under various categories through different competitions, at state, regional, and national levels, such as the R.O.G tournament, the Tennis Malaysia Junior Tour (TMJT), the Tennis Malaysia Junior Championship (TMJC), SUKMA Games, and MSSM. The tables and graphs below show the various tournaments held in Malaysia, and in other countries, which are participated by Malaysian young tennis athletes, based on different age group categories, according to Malaysia's tennis tournament schedule in 2024 (TM, 2024b).

Table 1: Junior tennis tournaments joined by young tennis athletes in Malaysia (TM, 2024b).

Tournament	Age group	Organizer	Location (local / overseas)	Frequency per year
Tennis Malaysia Junior Tour (TMJT)	16U, 14U, 12U	tennis MALAYSIA	local	6
Tennis Malaysia Junior Championship (TMJC)	16U, 14U, 12U	tennis MALAYSIA	local	2
R.O.G Regional	10U, 9U, 8U	tennis MALAYSIA	local	2
R.O.G National	10U, 9U, 8U	tennis MALAYSIA	local	2
SUKMA	21U	SUKAN MALAYSIA	local	1
MSSM	18U, 15U, 12U	MSSM	local	1

Junior Billie Jean King Cup 16&U	16U	ITF International Tennis Federation	Overseas (Shymkent, Kazakhstan)	2
Junior Davis Cup 16&U	16U	ITF International Tennis Federation	Overseas (Shymkent, Kazakhstan)	2
ITF World Tennis Tour Juniors (WTTJ)	16U, 14U	ITF International Tennis Federation	Overseas (Japan / Czech Republic)	8
ITF World Junior Tennis Championship (WJTC) Asia/Oceania 14&U Boys	14U	ITF International Tennis Federation	local	2
ITF World Junior Tennis Championship (WJTC) Asia/Oceania 14&U Girls	14U	ITF International Tennis Federation	local	2
ITF 12&U Team Competition - SEA Boys & Girls	12U	ITF International Tennis Federation	Overseas (Kazakhstan and Uzbekistan)	1
ATF 14&U Grade A SEA	14U	Asian Tennis Federation	Overseas / local	6

Table 2: Number of tournaments held in Malaysia and overseas (TM, 2024b).

Location of tournaments	Number of tournaments
Malaysia	18
Other countries	19

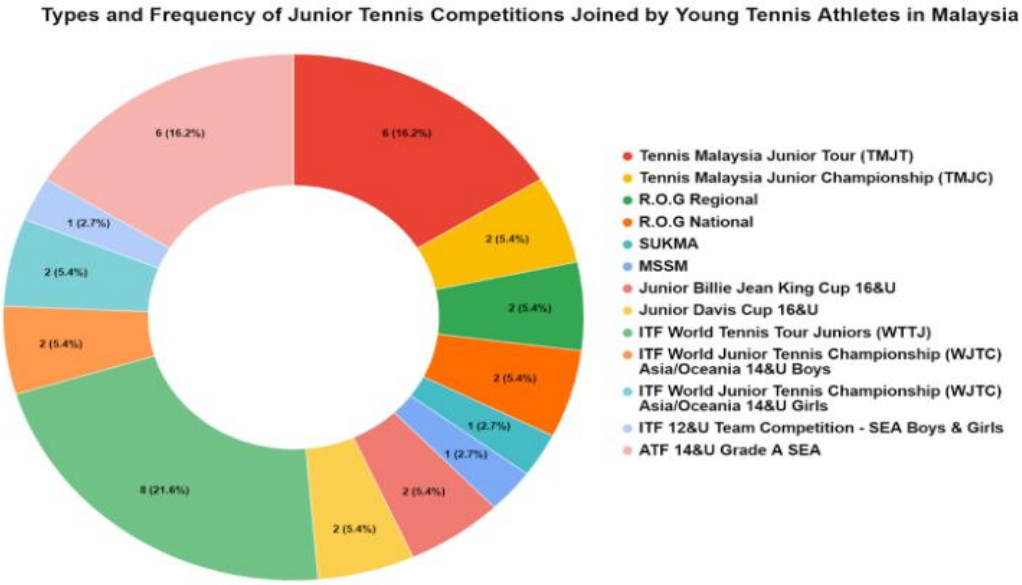

Figure 3: Pie chart displaying the different types and frequency of junior tennis competitions joined by young tennis athletes in Malaysia (TM, 2024b).

Based on tables and charts, it is shown that young tennis athletes in Malaysia join junior tennis tournaments organized locally, by Tennis Malaysia, SUKMA, and MSSM, as well as those organized internationally,

by the ITF and the Asian Tennis Federation (ATF), and the proportion of tournaments held locally is lower than that of tournaments held in other countries at a percentage of 48.6% in the former, and 51.4% in the latter (TM, 2024b). Young athletes aged 10 and below are eligible to participate in locally organized tournaments including the R.O.G Regional, R.O.G National, TMJT, and TMJC, and young athletes who do not fall under the mentioned age groups, are eligible for all the tournaments listed in the tables above. Although aged 10 and under junior tennis athletes only compete locally, they are still required to do interstate traveling, which may require up to a few hours of bus rides.

Apart from Malaysia, other Asian countries, including Singapore, Thailand, Indonesia, India, and Hong Kong, implemented the "ROG" tennis ruling into their junior tennis tournaments, where the youngest player eligible for tournaments, is as young as the age of four, in Hong Kong (China Tennis Association, 2024; Singapore Tennis Association, 2024, Peringkat Nasional Pelti, 2024; Lawn Tennis Association of Thailand, 2024). Likewise, with other countries including the United Kingdom, the United States, and Australia, a younger age group category for tennis tournaments was established, and players as young as the age of six can compete locally, as well as at state and regional levels in these countries (Lawn Tennis Association, 2024; USTA, 2016b; Tennis Australia, 2024)

Table 3: Training duration of junior tennis players based on the Johor Tennis Junior Development Program (ROG) Training Schedule. (Johor Tennis Association, 2024)

Tennis Players Category (Red, orange, green)	Training day each week	Training duration each session (hour)	Training duration per week (hours)	Training duration per month (hours)
Red	Monday, Friday, Saturday	1	3	12
Orange	Monday, Friday Saturday	1	3	12
Green	Monday, Tuesday, Friday, Saturday	2	8	32

Figure 4: Bar chart displaying the differences in training duration in different tennis players category of various age groups based on the training schedule of Johor Tennis Association. (Johor Tennis Association, 2024)

According to the Johor Tennis Junior Development Program (ROG) Training Schedule, it is shown that tennis players within the age range of eight to ten, are required to undergo training for an average of 12 up to 24 hours per month, consistent with recommendations of training hours in young tennis athletes by the ITF, where athletes of eight to ten years of age are recommended to train for approximately 45 minutes to an hour per session with three to four training sessions per week (Johor Tennis Association, 2024; ITF, 2018). The study population in this study is focused on young tennis athletes as coaches and athletes themselves tend to focus primarily on improving the athletes' physical endurance, with less attention given to their mental health. These athletes may be predisposed to mental stress, having been exposed to such demanding training volume, and tournament requirements besides being away from family.

OBJECTIVE

This study aims to explore the role of sports psychology in young tennis athletes in optimizing athletic performance and mental strength in competition. Our objective is to identify the mental health assessment tools to evaluate their mental state and suggest effective interventions. By doing so, valuable guidance can be provided to parents, coaches, and psychologists to promote a healthy training environment.

METHODOLOGY

Articles reporting on the role of sports psychology in optimizing athletic performance and mental strength of young tennis athletes in competition, published between 1990 and 2024 were sought using various databases including PubMed, Ovid MEDLINE, Google Scholar, and Scopus.

Keywords utilized in the search process included terms such as “tennis”,” young athletes”, “young tennis athletes”, “sport psychology”, “mental health”, “mental strength”, “mental health intervention” and “athletic performance”. These keywords were combined using operators such as “AND” and “OR” as appropriate to refine the search for relevant literature.

Articles reporting on the role of sport psychology, assessment methods of young tennis athletes’ mental health status and mental health interventions were included, and articles focusing on the similar topic as above but does not include the term, “young” or athletes aged 21 years old and above as their study population were excluded.

A total of 19 relevant articles were analyzed and included in the study.

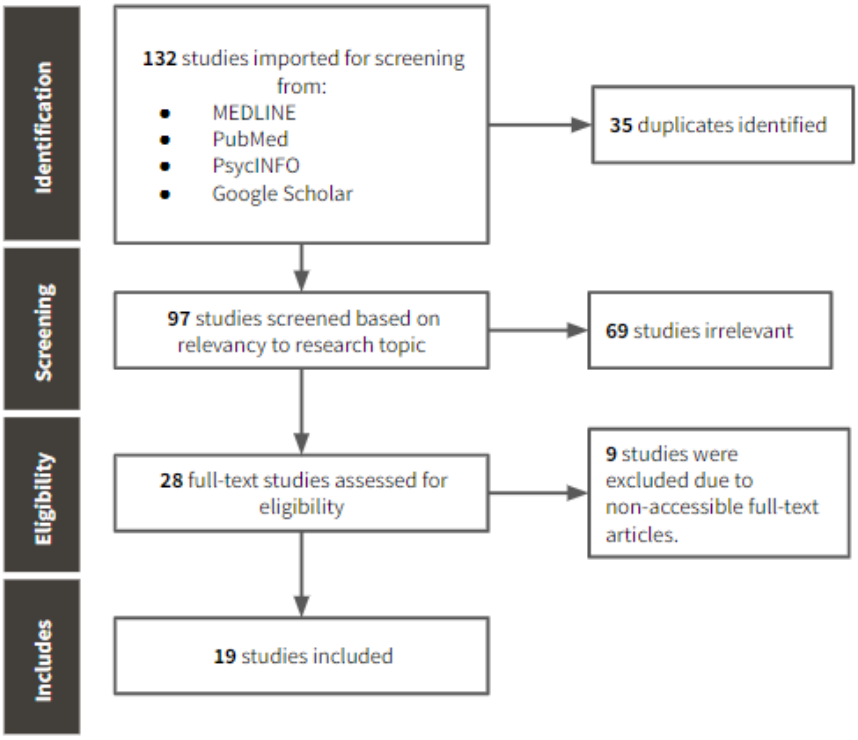

Figure 5: PRISMA chart illustrating the process of choosing relevant articles for review.

1.1 Sport Psychology

In highly competitive sports, mental health plays a crucial role in determining an athlete's trajectory toward success or setback (Malik & Davi, 2023). Athletic performance indicates the accomplishment of an athlete's optimal physical and mental skills in sports. It encompasses multiple aspects, including physical fitness, absence of injury, technical and tactical proficiency as well as mental strength (Jun et al., 2023; Bangsbo, 2015). Apart from physical strength and technical skill, the state of an athlete's mental well-being significantly impacts their own performance on the court.

Sports psychology, defined by the American Psychological Association, is a specialized field that utilizes psychological knowledge and expertise to promote athletes' performance and well-being. It addresses the developmental, social, and systemic challenges within the sports environments (American Psychological Association, 2008).

Sports psychology plays an important role in promoting mental well-being among young tennis athletes, especially those who are in the developmental stages of their careers. According to Erikson's stages of psychosocial development, children aged 6 to 11 are required to cope with new academic and social demands. This stage is crucial for young athletes as they need to balance their training and competition with schoolwork and social interactions, which can impact their self-esteem. For adolescents aged 12 to 18, they need to navigate the challenges of establishing their identity while managing the pressures of competitive sports.

Stage	Basic Conflict	Important Events	Key Questions to be answered	Outcome
Infancy (0 to 18 months)	Trust vs. Mistrust	Feeding/ Comfort	Is my world safe?	Children develop a sense of trust when caregivers provide reliability, care and affection. A lack of this will lead to mistrust.
Early Childhood (2 to 3)	Autonomy vs. Shame and Doubt	Toilet Training/ Dressing	Can I do things by myself or need I always rely on others?	Children need to develop a sense of personal control over physical skills and a sense of independence. Success leads to feeling of autonomy, failure results in feelings of shame and doubt.
Preschool (3 to 5)	Initiative vs. Guilt	Exploration/ Play	Am I good or bad?	Children need to begin asserting control and power over the environment. Success in this state leads to a sense of purpose. Children who try to exert too much power experience disapproval, resulting in a sense of guilt.
School Age (6 to 11)	Industry vs. Inferiority	School/ Activities	How can I be good?	Children need to cope with new social and academic demands. Success leads to a sense of competence, while failure results in feeling of inferiority.
Adolescence (12 to 18)	Identity vs. Role Confusion	Social Relationships/ Identity	Who am I and where am I going?	Teens need to develop a sense of self and personal identity. Success leads to an ability to stay true to yourself, while failure leads to role confusion and a weak sense of self.
Young Adult (19 to 40)	Intimacy vs. Isolation	Intimate Relationships	Am I loved and wanted?	Young adults need to form intimate, loving relationships with other people. Success leads to strong relationships, while failure results in loneliness and isolation.

Figure 6: Diagram showing the Erikson's Stages of Psychosocial Development (Klammer, 2020).

Young tennis athletes need to encounter various challenges that extend beyond the court. For instance, they need to withstand mental pressure from trying to balance academic achievement, overcome peer pressure, and meet their parents' expectations. These obstacles have strongly suggested that sports psychology plays a pivotal role in offering tailored mental health intervention to empower young athletes in their road to a successful career (Holden et al., 2019; Surujlal et al., 2013). Previous meta-analyses have also revealed the positive impact of various psychological interventions in enhancing sports performance (Brown & Fletcher, 2017). These findings have emphasized the importance of prioritizing the mental health of young athletes.

1.2 Mental Health Assessment

Mental health symptoms and disorders become increasingly prevalent, evidenced by a recent systematic review which revealed that 20% of adults experienced a mental health disorder in the past year and nearly one out of three did so at some point in their lifetime. Over the past decade, there has been a growing focus on mental health symptoms and disorders in young athletes. Evidence from meta-analyses shows that the prevalence of mental health symptoms and disorders among current young athletes ranges from 19% for alcohol misuse to 34% for anxiety and depression (Gouttebarge et al., 2019).

Mental health assessment involves using instruments which are specifically designed to evaluate various aspects of an individual's mental well-being (Psychology Tools, 2018; Newson et al., 2020). Mental health assessment tools enable early detection of mental health issues and provide guidance on the implementation of tailored interventions to support their mental well-being (Mountjoy et al., 2023). Various mental health assessment tools have been reviewed in this study to assess the mental health status of young tennis athletes.

1.2.1 Revised Competitive State Anxiety Inventory-2 (CSAI 2R)

The CSAI-2R is a well-validated and reliable measuring tool extensively used in sport psychology research. It is designed to evaluate situational anxiety levels in athletes during competitive events (Putra & Guntoro, 2022). The CSAI-2R questionnaire can be administered before, during and after competitions to track changes in anxiety and self-confidence, aiding coaches and psychologists in tailoring coping strategies for optimal performance.

The CSAI-2R consists of 17 questions, assessing three dimensions of athlete anxiety which include cognitive anxiety, somatic anxiety and self-confidence. Athletes need to respond to the questions on a 4-point Likert scale, with scores calculated for each subscale (Putra & Guntoro, 2022; Domínguez-González et al., 2024).

It is important to take into account the athlete's specific sport types, competition level and individual differences before interpreting the results. For young tennis athletes, higher scores on the cognitive and somatic anxiety subscales indicate elevated levels of anxiety, which can negatively impact their athletic performance. Conversely, higher scores on the self-confidence aspect suggest greater confidence, which can optimize athletic performance. [32,33]

Revised Competitive State Anxiety–2 (CSAI-2R)

Directions: A number of statements that athletes have used to describe their feelings before competition are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel right now – at this moment. There are no right or wrong answers. Do not spend too much time on any one statement, but choose the answer which describes your feelings right now.

1. I feel jittery (somatic anxiety, 5).
2. I am concerned that I may not do as well in this competition as I could (cognitive anxiety, 7).
3. I feel self-confident (self-confidence, 9).
4. My body feels tense (somatic anxiety, 8).
5. I am concerned about losing (cognitive anxiety, 10).
6. I feel tense in my stomach (somatic anxiety, 11).
7. I'm confident I can meet the challenge (self-confidence, 15).
8. I am concerned about choking under pressure (cognitive anxiety, 13).
9. My heart is racing (somatic anxiety, 17).
10. I'm confident about performing well (self-confidence, 18).
11. I'm concerned about performing poorly (cognitive anxiety, 16).
12. I feel my stomach sinking (somatic anxiety, 20).
13. I'm confident because I mentally picture myself reaching my goal (self-confidence, 24).
14. I'm concerned that others will be disappointed with my performance (cognitive anxiety, 22).
15. My hands are clammy (somatic anxiety, 23).
16. I'm confident of coming through under pressure (self-confidence, 27).
17. My body feels tight (somatic anxiety, 26)

Note: Original CSAI-2 item number is in parentheses along with factor classification. Each item is set to a 4-point Likert scale as in the original CSAI-2.

Scoring key:

Somatic anxiety: 1, 4, 6, 9, 12, 15, 17
Cognitive anxiety: 2, 5, 8, 11, 14
Self-confidence: 3, 7, 10, 13, 16

Subscale score is obtained by summing, dividing by number of items, and multiplying by 10. Score range is 10 to 40 for each subscale. If an athlete fails to respond to an item, merely sum and divide by items answered.

Figure 7: Revised Competitive State Anxiety-2 (Putra & Guntoro, 2022)

1.2.1.1 Study Results

A total of 2 articles reporting on the use of the Malay-translated version of CSAI-2R in young athletes aged 13 to 21 in Malaysia were included. These are the only studies that focus on the use of the translated Malaysian version of CSAI-2R in young athletes in Malaysia, thereby aligning well with our target demographic. Both studies showed good internal consistency of the CSAI-2R.

A study conducted in 2020 by Liew et al, showed that the CSAI-2R is a reliable tool for assessing competitive anxiety in Malaysian state-level athletes, which is proven by its good and acceptable internal consistency with values of .741 for somatic state anxiety, .619 for cognitive state anxiety, and .775 for self-confidence (Liew et al., 2020). Another study conducted in 2016 by Hashim H et al. also revealed high internal consistency across three dimensions of the CSAI-2R (Hashim et al., 2016).

However, neither study included young tennis athletes in Malaysia which limits its applicability to our research focus on young tennis athletes. The relevance of the age group and the country does suggest that

CSAI-2R can be a useful tool in assessing the mental health of young tennis players in Malaysia by providing insights into anxiety levels that could affect their athletic performance and mental strength in competition as well as overall mental well-being.

Table 4: Results summary of articles reviewed on CSAI-2R validity

Study Title	**Author(s) / Year**	**Study findings**
The Confirmatory Factor Analysis of the Malay Language Revised Competitive State Anxiety Inventory-2 (CSAI-2R) Among Adolescent Malaysian State Level Athletes	Liew et al. (2020)	**Aims**: To validate the Malay-language translated version of the **Revised CSAI-2R** using confirmatory factor analysis. Participants: 685 state-level adolescent Malaysian athletes (14-21 y/o) from 21 different sports (62% male, 38% female), with a mean age of 17.0 years (SD = 3.6). However, *tennis was not included in this study*. **Results:** Internal consistency (Cronbach's alpha): **Somatic state anxiety: .741**; **Cognitive state anxiety: .619**; **Self-confidence: .775** **Conclusion:** The Malay version of the CSAI-2R is a reliable tool for assessing competitive anxiety in adolescent Malaysian state-level athletes.
Validating the Factorial Structure of the Malaysian Version of Revised Competitive State Anxiety Inventory-2 among Young Taekwondo Athletes	Hashim et al. (2016)	**Participants:** 267 Taekwondo athletes (58% boys, 42% girls), with a mean age of 13.2 years (SD = 3.01). However, *tennis was not included in this study.* **Results:** **Internal Consistency:** ● Somatic anxiety: α = 0.78 ● Cognitive anxiety: α = 0.76 ● Self-confidence: α = 0.83

1.2.2 Sport Anxiety Scale-2 (SAS-2)

The SAS-2, a 15-item instrument, is one of the effective tools which has been widely validated for use in assessing sports anxiety across various sport contexts. It can aid in evaluating the effectiveness of mental health interventions in young tennis athletes (Tomczak et al., 2022).

The SAS-2 is utilized in assessing sports-related anxiety in athletes aged 9 and older, specifically within the context of competitive sports. It measures three primary dimensions of trait anxiety which are similar to the CSAI-2R questionnaire, consisting of cognitive anxiety (worry and concentration disruption), somatic anxiety and self-confidence. Athletes will then rate the intensity of their anxiety level on a 4-point Likert scale (Tomczak et al., 2022; Ramis et al., 2015)

Interpreting SAS-2 scores for young tennis athletes need to consider various factors such as age, experience level and environment. Interpretation of SAS-2 score is similar to the CSAI-2R scores which lower scores of anxiety indicates lower anxiety levels and higher self-confidence, potentially correlating with better performance and psychological well-being. The SAS-2 can be administered before and during the tennis season to monitor changes in anxiety levels over time (Kaplánová, 2024).

	Original SAS-2	运动焦虑量表-2				
	Guidance in English	Guidance in Chinese	Scale in Chinese			
	Please read each question. Then, circle the number that says how you USUALLY feel before or while you compete in sports. There are no right or wrong answers. Please be as truthful as you can.	以下的问题是有关你平时在运动竞赛中的感受。请在最接近你自己真实感觉的选项上打√	一点也不	有一点	有些	非常多
1.	It is hard to concentrate on the game	我很难把注意力集中在比赛上	1	2	3	4
2.	My body feels tense	我的身体紧绷	1	2	3	4
3.	I worry that I won't play well	我担心我不能取得好的成绩	1	2	3	4
4.	It is hard for me to focus on what I am supposed to do	我很难专注于我应该专注的事物 (比赛中的)	1	2	3	4
5.	I worry that I will let others down	我担心我会让其他人失望	1	2	3	4
6.	I feel tense in my stomach	我觉得胃发紧	1	2	3	4
7.	I lose focus on the game	在比赛中我走神了	1	2	3	4
8.	I worry that I will not play my best	我担心不能发挥出自己最好的水平	1	2	3	4
9.	I worry that I will play badly	我担心我会表现得很糟糕	1	2	3	4
10.	My muscles feel shaky	我感到肌肉在颤抖	1	2	3	4
11.	I worry that I will mess up during the game	我担心我在比赛时会犯错误	1	2	3	4
12.	My stomach feels upset	我觉得胃不舒服	1	2	3	4
13.	I cannot think clearly during the game	在比赛中我不能清晰地思考	1	2	3	4
14.	My muscles feel tight because I am nervous	我感到紧张所以我的肌肉紧绷	1	2	3	4
15.	I have a hard time focusing on what my coach tells me to do	我很难集中精力做教练让我做的事情	1	2	3	4

Figure 8: Sport Anxiety Scale-2 (Li, et al., 2023).

1.2.2.1 Study Results

There is only 1 article, conducted by Hairul et al. (2017), that reported on the validity of the Malaysian Adapted SAS-2 assessment in the young athletes' context. In Study 1 and 2, the result revealed that somatic and cognitive anxiety are inversely related to cognitive and perceptual performance, aligning with the study's hypothesis. Study 3 was focused on investigation of the factorial validity of SAS-2 and it yielded a strong support for its factor structure. Notably, Study 3 involved our target population group which is young tennis athletes in Malaysia, with a mean age of 14.1 years (Hairul et al., 2017).

Although this article supports the validity of the Malaysian-language SAS-2, suggesting the possibility of using the SAS-2 to establish anxiety amongst youth, limitations of the study including the tendency of recall bias in a survey-based research may still affect the accuracy of the results. Hence, more studies are needed to further support the validity of SAS-2.

Table 5: Results summary of validity of SAS-2 tool

Study Title	Author(s) / Year	Study findings
A Multisample Analysis of Psychometric Properties for the Malaysian Adapted Sport Anxiety Scale-2 Among Youth Athletes	Hairul et al. (2017)	**Study 1:** To evaluate criterion validity and internal consistency of Malaysian SAS-2 **Participants:** 119 developmental hockey players from various levels, mean age of 13.48 (SD=2). **Results:** ● Somatic anxiety & concentration disruption correlated significantly with sustained attention, while worry linked with depth perception. ● Significant correlations with negative mood state dimensions were also noted.
		Study 2: To assess convergent and discriminant validity by comparing SAS-2 with CSAI-2R. **Participants:** 155 (mean age: 13.61± 3.97) state level swimmers **Results:** ● SAS-2 convergent validity was supported. ● Positive associations were found between SAS-2 and somatic/cognitive state anxiety, while state self-confidence exhibited a negative correlation.

		• Gender differences in somatic anxiety were observed.
		Study 3: To examine factorial validity of the Malaysian SAS-2 through CFA **Participants:** 457 young athletes with mean age of 14.1 (SD=3.43) from various sports (Tennis, n=13) Results: • Strong support for SAS-2 factor structure was found. • Path loadings exceeding 0.5 demonstrated convergent validity, and moderate subscale intercorrelations indicated discriminant validity. **Conclusion of these 3 studies: The findings affirm the criterion and construct validity of the Malaysian SAS-2 instrument**

1.2.3 Sport Mental Health Assessment Tool 1 (SMHAT-1)

Introduced by the International Olympic Committee (IOC) in 2021, the SMHAT-1 serves as a standardized assessment tool which aims to facilitate early detection of mental health issues in elite athletes aged 16 and above and to ensure timely referrals to appropriate support or treatment (Gouttebarge et al., 2020).

The SMHAT-1 consists of three sequential steps. Step 1 is known as Triage which involves utilizing the Athlete Psychological Strain Questionnaire (APSQ) to assess sport-related psychological distress. A score of ≥17 indicates the need for further evaluation. For athletes who are required to proceed to Step 2 (Screening), they need to undergo six subsequent disorder-specific screening tools in order to identify potential mental health issues.

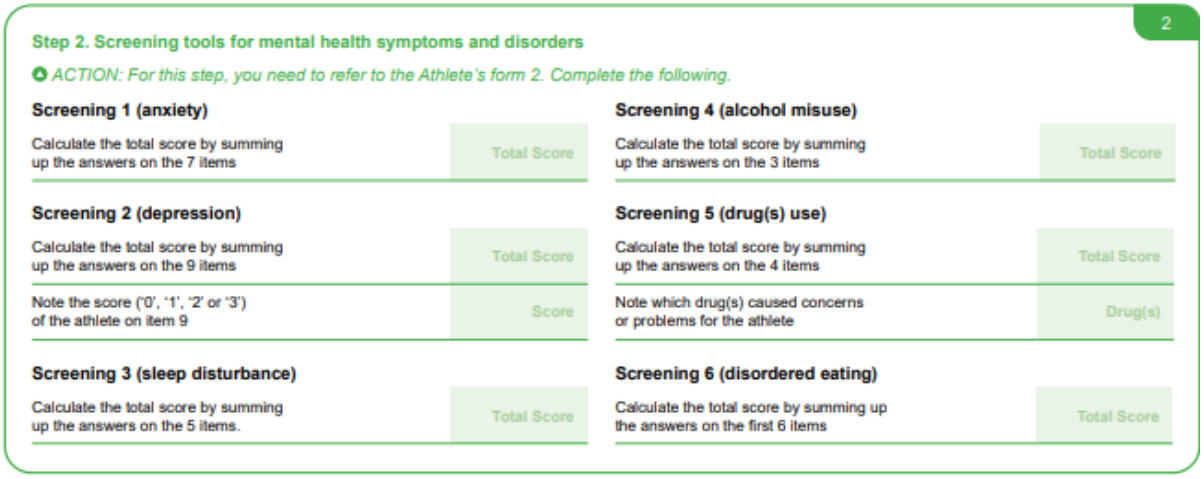

Figure 9: Six subsequent disorder-specific screening (Gouttebarge, et al., 2020).

The final step entails clinical assessment and management by a sports medicine physician or registered mental health professional to diagnose and plan interventions accordingly (Gouttebarge et al., 2020).

SMHAT-1 is ideally applied during pre-competition, mid-season, or post-season periods. It is also recommended to be used during significant events such as injury, surgery, suspected harassment, unexplained performance concerns, and other related issues. In conjunction with SMHAT-1, the IOC has also developed the Sports Mental Health Recognition Tool 1 (SMHRT-1) which is intended for use by athletes' support networks, including friends, fellow athletes, family, and coaches which can help in the early detection of mental health symptoms in young athletes (Gouttebarge et al., 2020).

1.2.3.1 Study Results

A total of 3 articles were reviewed to determine the validity of SMHAT-1 in assessing various aspects of mental health conditions in athletes. One article, conducted by Vincent et al. (2020), discussed the SMHAT-1 development by the IOC. It demonstrated good internal consistency and validity of the various questionnaires in SMHAT-1. It is also demonstrated that APSQ was able to identify 57.1% of cases progressing to step 2 (Gouttebarge et al., 2020).

However, subsequent research highlights the need for further validation. A study conducted by Anderson et al. (2023), revealed an overall high false negative rate of 67.5% when relying solely on APSQ, recommending the necessity of completing APSQ in conjunction with other questionnaires. Another study which was conducted by Mountjoy et al., showed good internal consistency across various questionnaires. Nevertheless, this study was conducted during the COVID-19 pandemic whose effects could have impacted mental health outcomes and was not examined in the research.

Table 6: Results summary of studies investigating the efficacy of MBIs in improving tennis athletes' performance

Study Title	Author(s) / Year	Study findings
International Olympic Committee (IOC) Sport Mental Health Assessment Tool 1 (SMHAT-1) and Sport Mental Health Recognition Tool 1 (SMHRT-1): towards better support of athletes' mental health	Vincent et al. (2020)	Results: **Nearly 90%** of participants in the International Federations Medical Commission Chairpersons Meeting agreed that SMHAT-1 **is effective with good internal consistency and validity across various measures** and **supported the three-step structure.**
Analysis of the Sport Mental Health Assessment Tool 1 (SMHAT-1) in Team USA athletes	Anderson et al. (2023)	The SMHAT-1 consists of three sequential steps (triage, screening and clinical assessment). Step 1 (Triage) involves utilizing the Athlete Psychological Strain Questionnaire (APSQ) to assess sport-related psychological distress. A score of ≥17 indicates the need for further evaluation. For athletes who are required to proceed to Step 2 (Screening), they need to undergo six subsequent disorder-specific screening tools. **Results:** ● For athletes who screened positively on subsequent questionnaires but had an APSQ score of <17, False Negative Rates (FNRs) ranged from 4.8 to 66.7% **(Overall FNR: 67.5%)** ● **Female, Paralympic and Winter sport athletes scored higher on ≥1 questionnaires** compared to male, olympic and summer sport athletes (P<0.05) **Conclusion:** It is recommended that athletes should complete

		APSQ along with all subsequent questionnaires in SMHAT-1 instead of relying solely on APSQ for initial screening,
Implementation of the International Olympic Committee Sport Mental Health Assessment Tool 1: Screening for Mental Health Symptoms in a Canadian Multisport University Program	Mountjoy et al. (2023)	In step 2 (screening), participants are required to answer the following screening tools to identify any specific mental health concerns, which include: ● General Anxiety Disorder-7 (GAD-7), which screens for the presence of anxiety symptoms ● Patient Health Questionnaire-9 (PHQ-9), which determines the presence of depression symptoms ● Athlete Sleep Screening Questionnaire5 (ASSQ), which assesses the presence of potential sleep disturbances ● Alcohol Use Disorders Identification Test-Concise (AUDIT-C), which determines the presence of alcohol misuse ● Cutting Down, Annoyance by Criticism, Guilty Feeling and Eye Openings Adapted to Include Drugs (CAGE-AID), which determines the presence of drug misuse ● Brief Eating Disorder in Athletes (BEDA-Q), which screens for eating disorders **Results:** ● Internal consistency was good for the APSQ (α = 0.84), GAD-7 (α = 0.90), PHQ-9 (α = 0.87), AUDIT-C (α = 0.81), and BEDA-Q (α = 0.70) and moderate for the ASSQ (α = 0.66) and CAGE-AID (α = 0.69)

1.3 Mental health interventions

1.3.1 Mindfulness based intervention (MBIs)

Mindfulness can be defined as the act of paying attention in a particular way, intentionally and without judgment, while being fully present in the current moment. Key aspects of mindfulness include self-regulating one's attention, directing awareness to internal or external experiences, and cultivating an accepting attitude towards experiences (Hoja & Jansen, 2019).

MBIs in sport include the Mindfulness-Acceptance-Commitment approach which integrates mindfulness exercises with acceptance techniques over a 7-week course, and the Mindful Sports Performance Enhancement (MSPE) which offers a 4-week course program, to enhance performance by integrating mindfulness practices. Mindfulness Meditation Training in Sports (MMTS) and Mindful Performance Enhancement, Awareness, and Knowledge (mPEAK), are other examples of BMIs in sports, where they each offer unique approaches to mindfulness practices (Hoja & Jansen, 2019).

1.3.1.1 Study results

A total of three articles on the efficacy of MBIs in improving tennis players' performances were reviewed. Two of these articles, conducted by Wang et al. (2023) and Yousuf et al. (2016), have revealed that MBIs are effective in promoting athletic performance in young tennis players, by improving their emotional control and increasing their sense of self-awareness.

However, the article conducted by Hoja et al (2019), has shown that there were no significant improvements in tennis athletes' athletic performance post-MBI, possibly due to small sample size. Despite that, it is

shown that tennis athletes who received at least 6 sessions of MBIs for 7 weeks have relatively improved psychological performances than the control group. MBIs are found to be able to assist athletes in compartmentalizing their emotions and thoughts which result in decreased mental stress.

Table 7: Results summary of studies investigating the efficacy of MBIs in improving tennis athletes' performance

Study Title	Author(s) / Year	Results
Effects of Mindfulness Based Interventions on Promoting Athletic Performance and Related Factors among Athletes: A Systematic Review and Meta Analysis of Randomized Controlled Trial	Wang Y, et al. (2023)	**MBI were effective in promoting athletic performance, mindfulness-level** (n = 3; SMD = 0.50, 95% CI = [0.17, 0.83]; I2 = 45%, p = 0.16) and **mindfulness related psychological components** (n = 5; SMD = 0.81, 95% CI = [0.53, 1.10], I2 = 77%, p =0.001), However, no significant intervention effects were found on the mental health of athletes (n = 4; SMD = −0.03, 95% CI = [−0.35, 0.29], I2 = 89%, p < 0.001).
Mindfulness and tennis performance: A review of literature and practice	Yousuf S, et al. (2016)	Tennis athletes who practise **mindfulness meditation (MM**) had improved performance, where they have **higher winning rate**s, are **more accepting of performance-related anxiet**y and had **fewer negative thoughts**. Mindfulness training **increases self-awareness**, changes the relationship to an experience, and provides **better emotional control**, which is effective in **optimising athletes performance.**
Mindfulness-based intervention for tennis players: a quasi-experimental pilot study	Hoja, et al. (2019)	Tennis players who **received ≥ 6 sessions of MBI for 7 weeks** (120 mins each) in addition to their normal tennis training have a **better performance** in the **sport-related anxiety factors,** the **concentration disturbance index**.

1.3.2 Motor Imagery Training (MIT)

Motor imagery refers to a lively mental state where individuals practice a specific motor movement by imagination, without physically conducting it. MIT involves methodically using visually descriptive language to privately rehearse movements, resulting in enhanced motor performance, particularly in tennis (Moran, 2020).

During training sessions, athletes are required to complete the Revised Movement Imagery Questionnaire to assess their ability to imagine. They then do MIT on the tennis serve before each physical practice evaluation. At the start of each session, a script consisting of a concise description of the tennis serve is read aloud to the tennis athletes (Guillot et al., 2013).

1.3.2.1 Study Results

A total of 5 articles were reviewed to determine the effectiveness of motor imagery training in enhancing young tennis athletes' performance and mental strength. The findings of all 5 articles were coherent, where they have found that MIT can significantly improve tennis service performance, from the perspective of the serve accuracy and velocity, as well as the percentage of a successful serve.

One study, conducted by Guillot et al. (2013) has shown that the percentage of successful serve increased by 4% following MIT. The accuracy score and mean velocity also increased significantly after training. Besides, another two studies, conducted by Fortes et al. (2019) and Robin et.al. (2022), have shown statistically significant improvement in serve accuracy, stroke speed, and technical proficiency in the MIT group compared to the control group. Furthermore, It is found that motor imagery activates regions of the brain that are involved in motor execution, besides modulating synaptic activity at the spinal level, which indicates that imagined movements are similar to that of the executed ones, in terms of the intention, planning and engagement of the neural circuitry.

Table 8: Results summary of studies investigating the efficacy of MIT in improving tennis athletes' performance.

Study Title	**Author(s) / Year**	**Results**
Effects of Motor Mental Imagery Training on Tennis Service Performance during the Ramadan Fasting: A Randomized, Controlled Trial	Fekih et al. (2020)	38 young male tennis players were randomly divided into two groups: ● Imaging Training (IMG, n = 18) ○ Followed a training program in motor imagery ● control group (CG, n = 20) ○ Watched videos on history of the Olympic Games The **effect of group/time interaction** ($p < 0.01$) was identified for **all performance indicators** (accuracy, running speed and performance (speed × precision)), with **improvement only in IMG** ($p = 0.01$). **Motor imagery training** could be an **effective strategy** for mitigating/counteracting the negative effects of Ramadan on the **tennis service performance**
Motor Imagery and Tennis Serve Performance: The External Focus Efficacy	Guillot et al. (2013)	Sample size: 5 girls and 7 boy elite tennis players (age: 11 yrs;; weekly tennis training: 7 ± 1 h; weekly conditioning training: 2 h) ● Prior to the experiment, everyone completed the Revised Movement Imagery Questionnaire ● During the last 8 weeks of the protocol, motor imagery (MI) exercises were added twice per week, where participants mentally rehearsed the serve once before each subsequent physical practice trial The **percentage of successful serve** increased by 8% following regular training (RT), and by another **4% following MI training.** The **accuracy score** remained similar after RT, but **increased significantly after MI training**. The **mean velocity** decreased significantly by 3.5% after RT and i**ncreased significantly by 6.2% after MI training** The **percentage of points won after a first-ball serve i**ncreased by 10% after RT, and had further **increased by 30% after MI training**

Does Motor Imagery Training Improve Service Performance in Tennis Players? A Systematic Review and Meta-Analysis	Deng et al. (2020)	9 articles were reviewed with participants in the age range of 9 to 19 years old. The motor imagery training showed **no change** ($p = 0.076$) in **service speed** and **service return accuracy.** **Greater values of service accuracy** ($p < 0.001$) were observed after motor imagery training ($p = 0.007$) with **moderate effect** and moderate heterogeneity. The motor imagery training showed an **increase** ($p = 0.003$) of **service technique** with moderate effect and low heterogeneity.
Effect of motor imagery training on tennis service performance in young tennis athletes	Fortes et al. (2019)	Sample size: 28 young male tennis players (age: 15 to 16 years, training volume: 4 times per week, 2 hours per day) ● Prior to the experiment, everyone completed the Movement Imagery Questionnaire for Children (MIQ-C) ● Participants were randomly divided into imagery training group (ITG) and control group (CG). There was a **statistically significant improvement of tennis service performance, service accuracy and stroke velocit**y in the ITG, while there was no statistically significant change observed in the CG.
Effects of motor imagery training on service performance in novice tennis players: the role of imagery ability	Robin et al. (2022)	Sample size: 33 young male tennis players (age: 9 to 13 years, training volume: 4 times per week, 2 hours per day) Participants who performed MI before serving (Good imager and Poor imager groups) had **significantly higher performance (percentage of success, service speed and technical quality)** than those of the Control group who performed a neutral task before serving.

1.3.3 Mental skills training (MST)

Mental skills encompass techniques that assist athletes in effectively controlling their actions, thoughts, emotions, and physical sensations to maintain their mental health and achieve their desired performance goals. Evaluating mental skills before commencing a training program is crucial to personalize the mental skills training program based on each athlete's equipped mental skills. There are several areas for evaluation, including goal setting, personal motivation, practice intensity, imagery skills, positive self-talk, confidence, concentration, stress management, arousal control, and others. Participating in a mental skills training program enables young tennis athletes to develop self-confidence, enhance concentration, foster a positive approach to competition, set goals, and create a positive long-term vision (Park & Jeon, 2023; Booras, 2001).

1.3.3.1 Study Results

A total of 4 articles were reviewed to establish the effectiveness of MST in improving young tennis athletes' performance. Of these articles, 2 articles found that MST was useful in improving athletic performance, where tennis athletes who practiced pre-service routines, and coping skills including emotional calming and active planning strategy, had better results than others who did not undergo MST.

The article conducted by Wang et al. (2020), only mentioned that MST such as cognitive restructuring, active planning and emotional calmness, were the preferred psychological coping method in professional

tennis athletes, without revealing the efficacy of these methods in enhancing their performance. The last article conducted by Booras et al. (2001), however, has shown that there were no significant differences in athletic performance, between athletes with and without MST. Future research is needed to explore more on the effectiveness of MST in young tennis athletes in Malaysia.

Table 9: Results summary of studies investigating the efficacy of MST in improving tennis athletes' performance.

Study Title	Author(s) / Year	Results
Pre-service routines, mental toughness and performance enhancement of young tennis athletes	Morais et al. (2019)	The implementation of **pre-performance routines,** which is the combination of **cognitive** and **behavioral strategies** prior to performing motor skills, was **effective** in **enhancing athletes' performance (reduced chances of double-faults, improved performance efficacy).**
Autonomy, Coping Strategies and Psychological Well-Being in Young Professional Tennis Players	Carrasco et al. (2013)	Mental health coping skills in young tennis players include emotional calmness, active planning, seeking social support, and mental withdrawal Adolescent competition tennis players' preferred mode of mental health coping skills are the **emotional calming** and the **active planning** strategy, where they are the **most effective** in **improving performance**
Tennis Player's Coping Strategies at Duta International Tennis Academy During Their Different Career Phases: A Narrative Review	Wang et al. (2020)	One of the studies have shown that the preferred psychological coping strategy in professional tennis athletes (mean age: 14.6 years) are ● **cognitive restructuring** ● **emotional calmness** ● **active planning** ● **social support.**
The relationship of mental skills to performance on a tennis accuracy task under fatigued and non-fatigued conditions.	Booras et al. (2001)	Mental skills: ● Sports psychological skills: **goal setting, imagery training, arousal management, attentional focus,** and **coping with stress and anxiety** ● Sports psychology interventions to control anxiety and enhance performance: **increasing self-awareness, progressive muscle relaxation, mental relaxation training, breath control,** and **self-talk** There were **no significant differences** in performance scores between groups with high and low mental skills. ($p>0.05$) However, the group with **high mental skills had less in decrease in performance scores (9%)** as compared to the group with low mental skills (19%)

1.3.4 Mental toughness

Mental toughness serves as a comprehensive term denoting an athlete's capability to effectively navigate the demands of training and competition, aiming to uphold resilience and strength in the face of challenges.

The Mental Toughness Inventory (MTI) comprises 60 items, assessing twelves dimensions including potential, perseverance, focus, self-efficacy, mental self-concept, goal commitment and others. Each item is then rated on an 8-point scale ranging from 1 (false) to 8 (true). Key attributes of mental toughness include having concrete faith in oneself, a continuous commitment to involvement, the ability to respond positively to situations and the capacity to remain calm under pressure (Liew et al., 2019).

1.3.4.1 Study Results

There is only one article reported on the role of mental toughness in promoting performance in young tennis athletes. Upon reviewing the study conducted by Cowden et al. in 2016, it is found that athletic performances and winning rate of tournaments were promoted in tennis athletes who have higher degree of mental toughness, which was assessed using the Mental Toughness Inventory.

Table 10: Results summary of studies investigating the efficacy of mental toughness in improving tennis athletes' performance.

Study Title	Author(s) / Year	Results
Competitive Performance Correlates of Mental Toughness in Tennis: A Preliminary Analysis	Cowden et al. (2016)	Mental toughness may contribute to successful performance during tennis competition, although the importance of the construct appears to depend on specific match situations **Higher scores on mental toughness** were associated with **better intra-match performance** in selected areas and an **increased** likelihood of **winning** matches.

RESULTS AND DISCUSSION

This narrative review underscores the significant role of sport psychology in addressing the mental health needs of young tennis athletes by utilizing validated mental health assessment tools and effective interventions. Among the tools reviewed, the SAS-2 was identified as the most suitable for evaluating mental health in Malaysian young tennis athletes. This conclusion aligns with previous research highlighting SAS-2 as a reliable measure for performance-related anxiety across various youth sports. Studies such as those by Hairul et al. (2017) validate SAS-2's psychometric properties, including its ability to assess anxiety subscales effectively in young athletes. Its simplicity and adaptability to younger cohorts make it a robust tool for routine use in Malaysia. In contrast, while the SMHAT-1 offers a comprehensive framework, its restriction to individuals aged 16 and above presents a limitation. This finding diverges from research advocating for early mental health screening in younger age groups. Future adaptations to accommodate children aged 8 to 15 years would address this gap.

In terms of interventions, MIT demonstrated consistent and significant improvements in serving performance among young tennis athletes, supported by findings in all five reviewed studies. These results are corroborated by Guillot et al. (2013), who reported improvements in serve accuracy and velocity after implementing MIT. Such improvements are attributed to MIT's ability to engage neural circuits involved in motor execution, aligning with broader literature on the neuropsychological benefits of imagery techniques. Similarly, MBIs have shown effectiveness in reducing stress and anxiety, enabling athletes to compartmentalize their emotions and enhance their self-awareness. This aligns with findings by Wang et al. (2023), who emphasized the role of MBIs in improving psychological resilience and emotional regulation. However, contrasting results from Hoja et al. (2019), which reported insignificant improvements in performance metrics, highlight the need for further exploration into contextual factors, such as session duration and participant engagement, that may influence the outcomes.

Conversely, findings on MST revealed mixed results. While some studies identified significant benefits, such as enhanced focus and coping strategies, others, like Booras et al. (2001), found no substantial improvements in performance metrics. This inconsistency aligns with broader research indicating that the effectiveness of MST may depend on individualized approaches and the athlete's baseline mental skills. As such, a tailored approach that considers the unique needs of each athlete is recommended.

This review also underscores the importance of collaboration among stakeholders, including coaches, sport psychologists, and parents, to foster a supportive environment. Coaches should incorporate validated tools like SAS-2 for routine anxiety assessments and consider implementing MIT and MBIs as part of regular training. The consistent findings on MIT's efficacy, particularly in enhancing serve accuracy and velocity, make it an essential addition to training regimens. Similarly, MBIs can equip athletes with the emotional resilience needed to navigate competitive pressures effectively.

Interestingly, this review also identified discrepancies with prior studies. For example, while SAS-2 and MIT were broadly validated, the lack of extensive research on younger age groups using tools like SMHAT-1 highlights a divergence from the broader push for inclusive assessment methodologies. Moreover, while MBIs were generally supported, the variability in outcomes suggests a need for standardized implementation guidelines.

In conclusion, this review highlights the significant contributions of sport psychology to optimizing both mental health and athletic performance among young tennis athletes. While many findings align with previous research, notable gaps remain, particularly in adapting assessment tools for younger populations and standardizing mental health interventions. Addressing these gaps through targeted research and collaborative efforts will ensure a comprehensive framework for supporting young athletes' mental well-being and performance.

CONCLUSION

While it is important to optimize young tennis athletes' physical fitness from the perspective of their physical strength, endurance and speed, to ensure good performance, it is equally as essential to improve or maintain good mental health in athletes to optimize their performance. There are several mental health assessment tools which could evaluate the mental health fitness of young tennis athletes in Malaysia. These effective tools should be utilized by coaches and sports psychologists to monitor the mental health of young tennis athletes from time to time because they are often exposed to a high amount of stress, given the high physical demands and academic requirements. Various mental health interventions have been found to be useful in improving performance in young tennis athletes. Although there have been several reviews which reports on the efficacy of mental health intervention in improving athletic performance, there is only one article which reported on this topic in the Malaysian population, which highlights the information gap for future research to be carried out to not only better determine the effectiveness of mental health interventions in improving performance, but as well as to determine the validity and accuracy of various mental health assessment tools in detecting mental health issues in young tennis athletes.

SUGGESTION

The limited amount of literature available, coupled with some studies showing contradictory or statistically insignificant results, highlights the clear need for further investigation in the importance of sport psychology. Future research should focus on developing more Malaysian-translated versions of mental health assessment tools and include larger sample sizes to validate these tools. Additionally, more studies are needed to establish the correlation between mental health interventions and improvements in athletes' performance and mental health. Research should involve younger age groups, starting from 8 years old, to foster a mentally healthy environment for young tennis athletes, particularly those in the ROG program.

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CONFLICT OF INTEREST

The authors of this article declared no conflict of interest among them.

AUTHORS CONTRIBUTIONS

Sor conducted the literature review and background search of the topic, wrote the research methodology, gathered results from reviewed articles, and did the write-up of the article. Dr. Rosdara Masayuni and Mr. Luqman Nul Hakeem supervised the article writeup and advice on the situations of young tennis athletes in Malaysia, in terms of their training schedules and competitions that are available, as well as giving relevant feedback on the relevancy of results obtained from the various reviewed articles. Wong has made contributions to the research methodology, as well as the scoping of relevant articles to be reviewed in this study.

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