The Psychological Indicators of Success in Ultrarunning - A Review of the Current Psychological Predictors in Ultrarunning

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Systematic Review

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Abstract

Ultrarunning has grown over 345% in the last ten years alone. During these events, which typically last between 6 hours and multiple days, athletes of varying experience and ability must cope with the psychological means of endurance while managing intense emotions and fatigue. Despite rapid growth in the sport, research on ultrarunners psychology has yet to be performed. No review has analyzed the psychological advantages indicating success in ultra-running. This review summarizes the current literature on the psychological indicators of ultrarunning success. Four databases were electronically searched between December 1, 2022, and January 1, 2023, to help coaches, physicians, sports therapists, athletes, and everyday people understand how to cope with and overcome psychological challenges amidst life and racing while identifying research gaps. Successful ultramarathoners had higher levels of self-efficacy, mental toughness, emotional intelligence, and lower mood variability. These findings suggest that having cognitive strategies to maintain mood stability and a common total mood disturbance may be vital to success in ultra-running. Although existing literature investigates ultra-athletes' mindsets, further research, specifically on psychological traits of success in endurance sports, is warranted to gain greater depth on each psychological indicator that constructs successful ultrarunners' great mindset.

1. Introduction

An ultra-marathon is an endurance event in which runners compete over the typical marathon distance (42.195 km), commonly over undulating and varying topography for many hours to multiple days, aiming to race for the fastest time. The sport has gained recent popularity over the last ten years, attracting elite athletes and a large pool of amateurs. With an increase of 345% in the last ten years [1], the growing field of a typical ultramarathoner is 45 years old, starting at the marathon distance and progressing to run their fastest times between the ages of 30-49 years old [2]. Due to the enduring nature of the event, ultra-marathoning most likely requires a high threshold of mental "toughness" to coincide with physical muscular strength and aerobic endurance [3]. Because of the extraordinary limits pushed by ultrarunners, typical dropout rates can reach 50% [4], coinciding with pieces of literature suggestions that successful athletes must cope with physiological and psychological factors to complete the race [5]. The ultramarathon has gained the interest of researchers due to the unique demands that endurance sports have on the human body [6], forcing participants into self-willed, sustained mental and physical endurance for extended periods.

Typical stressors of the ultramarathon include negative emotional states such as sleep deprivation and intense fatigue [7]. Due to the challenges associated with ultrarunning, this review aims to gain a deeper understanding, based on current scientific literature, of how the mental feats in ultrarunning are overcome. Recent research has focused on the psychological component of the sport, considering aspects such as mental toughness and self-efficacy [3], stress responses and emotional intelligence of ultra-endurance athletes [8], and the enhanced performance of athletes with low mood variability [9].

Because ultrarunners are known to use multiple cognitive strategies [4] to overcome the challenges they encounter, analysis of these traits is of interest for future success for ultrarunners.

Among the endurance, the community commonly said that it takes "*90% mind, and 10% body*" to complete an ultra-marathon. Athletes, amateur, and elite push the limits of their bodies, running against debilitating muscle cramps, gastrointestinal pain, and total body fatigue [10]. There needs to be more research on what psychological advantages improve performance, as most research has been regarding physiology. However, despite this, significant evidence suggests that motivation and psychological aspects influence runners' performances [11]. This defying nature of successful athletes leads to the question, what psychological characteristics of an ultra-marathon runner define success? This question is critical for the performance and improvement of aspiring endurance athletes, though just as necessary for the average person, understanding what mindsets are most effective to lead a life with the strength to endure.

Scientific literature has investigated the psychological basis of ultrarunning, though no review has synthesized these findings to draw critical conclusions about the success indicators of these runners. This review aims to summarize and draw conclusions on current findings of psychological indicators of ultrarunning success while identifying missing literature components and suggesting a direction for future research.

2. Strategies And Terminology

2.1. Search Strategy

This review was conducted to analyze peer-reviewed scientific literature on English, investigating the psychological indicators of ultrarunning success. Studies included in this review analyze 49 articles over the last 20 years. Due to the subjective nature of psychology, quantitative and qualitative data were analyzed.

In this review, psychological indicators were searched by the keywords, including perseverance (3.1), motivation (3.2), psychopathology (3.3), emotional intelligence (3.4), and mood variability (3.5). These indicators were analyzed electronically using PubMed, Scopus, ScienceDirect, and MDPI databases between December 1, 2022, and January 1, 2023.

2.2. Terminology and Parameters

We defined psychological indicators as the mental barriers ultrarunners must overcome to compete in and have success in completing an ultramarathon and positive traits (traits ultramarathoners have in addition to standard psychological traits) that express high levels of mental endurance. Completing the ultramarathon within the allotted time frame was considered ultrarunning success in this review, as both elite and amateur ultramarathon runners may implement these strategies to enhance the likelihood of success (completion and improvement) of their ultramarathon races. Measuring the level of success was

investigated by finishing time, e.g., the faster the time, the "greater the success," if the participant did not finish, the result was "no success."

The mental barriers searched for, and eligible for this review included perseverance (3.1) and motivation (3.2). Positive traits, defined as an additional successful trait ultrarunner possess, studied in this review include psychopathology (3.3), emotional intelligence (3.4), and mood variability (3.5). Studies analyzed in the Findings section (3) specifically analyze and conclude ultrarunners.

Ultrarunners competed in events over the 42.195 km distance, including those who "walked/ran" the events. The walk/run is where participants are permitted to either walk or run as long as the registered participant competes in the event within the allotted time frame [6].

2.3. Analysis and Organization

In this review, we analyzed how ultrarunning success, the ability to complete an ultramarathon, varies and may be critically influenced by psychological aspects of the sport. We attempted to categorize these indicators into five significant sections, the introduction (1), methods (2), findings (3), limitations (4), and conclusions (5).

The introduction reviews the recent questions while summarizing the demographics of the current ultrarunning community. In the methods section, we outlined the procedures and resources we used to conduct this review while defining indicators of ultrarunning success, breaking the sections into categories (positive traits and mental barriers), and outlining the navigation of this review. Within each sub-section, this review attempts to define the importance of each indicator, review the current literature on the subject, and draw conclusions on the particular discipline. In the conclusions section, this review drew the overarching themes from each section and identified the major characteristics of a successful mindset in ultrarunning.

3. Indicators Of Ultrarunning Success

3.1. Perseverance

Perseverance in this review is the action and means taken when ultrarunners confront difficulty. Measurements of perseverance in this review include self-efficacy and mental toughness.

Self-efficacy is one's belief in their ability to do a behavior [12], such as completing an ultramarathon. Limited self-efficacy is associated with ultramarathon runners applying less effort when they feel less likely to succeed instead of persisting in improving their ability [3].

Mental toughness (MT) is the personal capacity to produce consistently high performance or objective goals, used as a psychological determinant of success [13]. Higher MT correlates with higher levels of performance, sleep quality, health, and emotions, each resulting in better lifestyle choices [13].

The Mental Toughness Questionnaire (SMTQ) and Endurance Sport Self-Efficacy Sale (ESSES) [14] were each taken by ultrarunners in the Hawaiian Ultra Running Teams Trail 100-mile endurance run (HURT 100), resulting in a suggested threshold of MT and self-efficacy for successful ultra-trail performance [3]. Because self-efficacy is belief in one's abilities, it may contribute to higher confidence levels [15]. Anthony W. Brace et al. determined that ultramarathon elite athletes had significantly higher mental toughness than professional mixed martial artists, tennis players, and other high-performing male athletes [3], suggesting high levels of persistence and belief in oneself are required for success in ultra-running. A strong relationship was found between successful ultrarunners and self-efficacy and mental toughness, possibly due to the endogenous opioids released by athletes with higher pain tolerance [3].

Previous studies have indicated that cognitive strategies such as active thought have helped endurance athletes successfully [16]. Regarding ultrarunners, coping strategies have been evaluated using the French COPE Inventory [17], assessing problem-solving, avoidance, and positive thinking [4]. Finishers in ultramarathons boasted higher scores in self-efficacy, though also more significant levels of coping strategies involving seeking the support of others. At the same time, dropout risk was associated with avoidance of help [4], concluding that social support and problem-solving were the most predominant ways successful ultrarunners persevered through a race.

Based on the current literature, higher levels of MT and self-efficacy indicate better perseverance and higher rates of success in ultrarunning [8, 13, 14, 18]. The ability to problem solves and ask for help are the predominant ways in which successful ultrarunners persevere.

In similar events to the ultramarathon, such as endurance events involving swimming, cycling, or rowing, research has shown priming (the display of happy faces) and self-talk, which found swimmers swam faster training times with positive self-talk. Pre-performance statements involving motivational statements in middle-distance running have each resulted in above-average performance [19]. Psychological skills training such as self-talk, imagery, and goal setting may improve ultrarunning performance [20]. Further research should be conducted on ultrarunning performance to evaluate the success of the listed techniques during an ultramarathon, which may typically host a more technical, lonely, and demanding terrain [5].

3.2. Motivation

Why and how individuals run the ultramarathon distance [1]. Motivation for ultramarathon runners can be defined by eight commonly analyzed elements in the current literature: health, weight, goal achievement, recognition, coping, life meaning, self-esteem, and social. Moreover, ultramarathon runners are diverse in sex and age. Previous studies have isolated those identifying traits and analyzed how differences in identities can impact sources and strength of motivation. Successful finishers of ultramarathoners typically score very highly in being motivated by personal achievement and goal achievement, whereas withdrawers tend to score higher in psychological coping [4]. Higher levels of the motivation behind social support are also noted in finishers [16]. Another study also found that goal achievement tended to be the

strongest motivator and recognition as the weakest motivator across all ultramarathoner affinity groups [21].

While all ultramarathoners tended to score high for being motivated by goal achievement, the categorical breakdown for each motivator between the sexes is not identical. In a study consisting entirely of women, some of the most substantial motivational factors reported were general health concerns and psychological coping [22]. Female marathon finishers exceeded men on the motivational scales for weight concern, social, coping, life meaning, and self-esteem [21].

This corroborates findings that self-esteem, health, and finding life meaning were strong motivations in many runners, but especially in women [22]. On the opposite end of the scale, one of the lowest-scoring motivators was ego– ultramarathon women are not typically motivated by beating opponents or placing in the top three [21, 22]. Conversely, men indicated higher motivation levels for competition and recognition [21].

Younger runners (<40 years old) are most motivated by goal achievement and more motivated than their older peers to be motivated by recognition [23]. It has been found that ultramarathoners have different motivations than marathon runners, having more robust relationships with the meaning of life while not worrying about their body as much as other runners [24], implicating ultrarunner's desire to compete for the sake of self-fulfillment. Older runners (age 51+) are the least likely to be strongly motivated by weight, health, and goal achievement [21, 25]. They are most strongly motivated by self-esteem and health orientation [25]. Age negatively correlates with weight, personal goal achievement, competition, recognition, psychological coping, life meaning, and self-esteem [21]. All groups are statistically significantly motivated by goal achievement [25].

The literature noted that social support was a prime motivator for ultra-marathoners finishers [21]. Runners identified the four categories of people they have social interactions with during the race: fellow racers, race officials, family/friends/followers, and the general public. In a study with participants from an ultra-race, it was found that the most beneficial motivation for ultra-runners can come from a coalition of their families, friends, and followers, from their teammates, and the general public [7].

Runners generally report that the support of strangers cheering along the sidelines boosts runners’ self-esteem [26]. Similarly, families, friends, and followers motivate runners with direct support [26]. Direct support generally increases emotional stability and encourages the runner. Direct support is contact with the family member, whether through a phone call or other means. However, indirect influence from family, friends, and followers can be harmful to the runners' race-time motivation levels, as some racers noted that their loved ones can actually make them feel the physical and emotional toll of running more and would instead strictly regulate or eliminate all communication during the race [7, 10]. The online presence of loved ones can emotionally encourage and support the runner, but it can also increase the pressure and nerves of runners and other athletes [7, 27].

Just as family, friends, and followers can positively and negatively impact an ultra-runners motivation, teammates are the same [28]. The current literature found that the psychological benefits of teamwork during the race can serve as a “welcome distraction” or emotional support by teammates and comrades acquired during the event [7, 28].

However, sometimes when strategized team plans or the implicit rules of a race-day encounter go awry, the opposite happens: the presence of other runners ruins the ultramarathoner’s experience [7]. Interactions with fellow racers were attributed to higher correlations of detrimental effects to the racer’s mindset– especially amongst emotionally competitive racers [21]. Before the start of the race, the cause of this negative correlation likely originates from nerves [7]. Athletes often report that the mere presence of other racers augmented their nervousness [29]. The herd of nervous races, mainly influenced by dually emotion and reason, builds off on one another through analysis of differences in gear choice and a general comparison of oneself [7, 30]. During the race, racers may be irritated by other races due to interferences to their race plans, such as pace and demoralizing events like getting passed [7]. While social support can be a favored race strategy and motivator, there is a chance that the running community around the runner may not be as helpful as expected.

3.3. Psychopathology

Psychopathology is the study of abnormal behaviors [31]. Psychopathologies that are discussed in this review include exercise addiction (EA) and eating disorders, including compulsive eating (CE), anorexia nervosa (AN), and bulimia nervosa (BN).

EA refers to an individual's strong urge to engage in physical activity that often interferes with other areas of life and can lead to a decline in physical and mental health [32-35]. Individuals with exercise addiction may experience compromised social relationships, work disruptions, and withdrawal symptoms such as mood and anxiety disorders [32-35]. Negative addiction in terms of physical activity refers to exercising nonstop, even if it becomes unhealthy for the individual [35].

The risks of EA and eating disorders in recreational and competitive runners are discussed.

Exercise pathology of non-competitive runners has also been considered. In a study examining the risk of EA in recreational runners, Lukács et al. found that 8.6% of 257 participants with at least two years of running experience were at risk of developing EA [33]. Runners’ genders were close to equally distributed [33]. Factors such as anxiety, loneliness, and low education level also contributed to increased risk [33].

Several factors may justify the reason for EA and eating disorder pathology in runners. Long-distance runners often experience a high level of commitment, which is determined by calculating the length of their run and the time spent training [32]. This strong commitment may be taken to extreme levels and lead to negative running addiction. Runners may also feel guilty for not completing desired goals [32]. Body composition and nutrition are extensively highlighted in sports competitions [32]. Engaging in endurance sports that stress leanness and believing the idea that a heavier weight harms athletic

performance may lead to the development of an eating disorder [32]. Runners who do not have the idealized leanness may try to change their body composition through abnormal eating behaviors [36].

Recent studies have illustrated that runners are at a higher risk of developing eating disorders [32-35]. In a study consisting of 167 participants from the Sports Association of Almería, Hernández et al. found that federated runners are at risk of developing CE, AN, and BN [32]. In the study, the SAS-40 was used to calculate sports addiction, which measured factors such as dependence, lack of control, loss of interest in other things, continuity, and concern [32]. The YFAS 2.0 and EAT-40 were used to measure CE and AN or BN, respectively [32]. Runners answered 11 questions based on the DSM-5 criteria for CE, AN, and BN [32]. Examples of the questions asked for CE include: “I have noticed that when I start eating certain meals, I end up eating more than what I had planned” and “I have spent a lot of time feeling sluggish, heavy, or tired from overeating [32]." Participants had the following answer options: "never," "almost never," "sometimes," "quite often," "almost always," and "always [32].” It was found that 97.1, 97, and 100% of runners were at risk of developing CE, AN, and BN, respectively [32]. 65.9% of those at risk of developing CE showed engagement in at least 9 of the 11 questions asked, thus scoring highly [32]. 16.2% scored highly for BN, and 11.4% scored highly for AN [32]. Furthermore, the runners’ current weight, experiences with childhood obesity, and menstruation were also considered [32]. Those with lighter weights had a greater risk of CE and AN, and those with heavier weights had a greater risk of BN [32]. Those who were not overweight in their childhood had a greater risk of CE, and those who experienced obesity in their childhood had a greater risk of AN and BN [32]. Three months without menstruation also increased the tendency for AN [32]. Conclusively, middle- and long-distance runners were found to have the most significant risk of developing eating disorders [32], possibly correlating with the psychological traits of a successful ultramarathoner.

Differences in the eating pathology of competitive male and female runners have also been studied. In a study involving 146 female runners who competed in the 2020 US Olympic Team Trials Marathon, Berg et al. communicated that 32% of the 146 participants self-reported either experiencing or having been diagnosed with an eating disorder in the past [37]. 67.1, 44.5, and 24.7% of participants self-reported the following: intentionally lowering caloric consumption, being discontent with their weight, and attempting to keep a certain weight three months before the competition [37]. Runners who self-reported an eating disorder were more likely to feel displeasure about their weight three months before the competition and purposely lower food consumption [37]. Runners who did not self-report an eating disorder did not experience as much body dissatisfaction and restricted eating as their counterparts [37]. Furthermore, Gorrell et al. reported that female marathoners’ have a much more significant relationship between compulsive exercise and eating disorder pathology than male marathoners [36]. However, males who had greater levels of weight suppression (WS) still had a strong relationship between compulsive exercise and eating disorder pathology (WS is the difference between an individual’s heaviest weight and their current weight [38, 36]. WS did not affect this relationship in females [36]. Similarly, Torstveit et al. found that compulsive eating was positively related to eating disorder symptoms in competitive male cyclists, triathletes, and long-distance runners [34].

Based on the literature as mentioned earlier, the psychopathology of runners is based on multiple variables, including anxiety, depression, stress, loneliness, childhood exercise and eating habits, past diagnoses with an eating disorder, current weight, weight suppression, amount of training, time until the marathon, engagement in other sports, educational attainment, financial situation, age, and sex.

There are significant positive correlations between psychopathology traits and competitive runners, as substantial percentages of competitive athletes have a self-reported diagnosis of an eating disorder. More studies are necessary to establish a clear relationship between each parameter and its association with the development of EA and eating disorders in runners. The relationship between competitiveness in sports and psychopathology is another area of interest. Current research on each of the listed parameters is limited, such as those exploring the effect of childhood sports participation and loneliness on EA, of which long-term studies are recommended to be performed [33].

Certain methods may help reduce the occurrence of psychological disorders and aid in ultramarathoners' success. Hernández et al. recommend the following for runners: implementing a psycho-educational program to reverse misinformed thoughts about physical activity and nutrition, establishing a healthy training routine with periods of rest, providing coaches with resources to address and notice eating disorders, and allowing nutritionists specializing in running to offer guidance [32].

3.4. Emotional Intelligence

Emotional intelligence (EI) refers to an individual’s differences in perception, processing, regulation, and utilization of emotional information [39].

Due to the extreme stress of ultrarunning, the psychological responses required for adaptability rely on such traits as EI. In a study examining a course of emotions (anxiety, dejection, anger, happiness, and excitement) in mountain ultramarathoners, Nicolas et al. were able to measure EI over five-time points within and following an ultramarathon [40]. After an ultramarathon, individuals with higher EI are more likely to have higher levels of happiness, and linear increases in anger, concluding there are direct and predictable stable responses to stressors in those with here levels of EI [40]: This evidence supports the hypothesis EI allows an individual to self-regulate cognitive processes through challenging situations. Predictable responses suggest higher EI in ultramarathoners results in reduced total mental disturbances (TMD), allowing the stability of emotions. TMD is heavily related to perceived effort and stress [9, 41]. Perceived stress is positively linked to psychological stress [42], supporting evidence that cognitive resources are necessary and mediate a stressful situation. After testing the stress states of finishers in a mountain ultramarathon, it was found that EI had a positive effect on pre-competition and mental preparations [8], concluding that those with higher EI may have more readily adaptable psychological states, which supports a key difference in why some athletes may more effectively adapt and succeed in recovering ultramarathons than others [43]. Because EI correspond with lower TMD, which supports greater performance [9], the greater the EI, the more likely an ultramarathoner is to succeed in their event.

Literature has analyzed psychological and cortisol reactivity [39], finding that the higher the EI of an individual, the less reactivity to stress they presented (less reactivity to cortisol levels and less mental deterioration); these findings suggest that EI may predict stress reactivity. Interestingly, in 2019, with application to ultramarathoners, Christopher C F Howe et al. studied the trait of EI and cortisol in an 80.5 km treadmill ultramarathon [41], observing the TMD and EI of individuals. The treadmill ultramarathoners with greater EI had a significantly greater cortisol concentration than those with lower EI, suggesting that individuals with higher EI were significantly more effective at the management of their emotions and mood due to their TMD and perceived effort to be lower than those with a lower EI [41].

The relationship between successful ultramarathoners and higher levels of EI and cortisol suggests the level at which ultrarunners with high EI are able to cope with and mobilize personal cognitive resources [41]. EI's primary purpose is to have a fine-tuned sense of internal states, which is essential in an ultramarathon: Literature has suggested that reducing stress is not the goal for success, rather reaching a balance between stress and recovery states through psychological adaptation, adjusting to extreme situations [8].

Coach, ultrarunners, and the everyday person should understand the importance of EI in their lives, as the greater the EI, the lower the TMD, resulting in better cognitive judgment and performance. Further research is suggested to evaluate the paradox between ultrarunners with higher EI and higher levels of cortisol further to understand the coping mechanisms on molecular and psychological levels.

Practically applied, it has been suggested that individuals looking to achieve higher levels of EI should seek interventions [8]. Steps to improving EI include understanding emotional information to form awareness. Later, individuals can slowly gain self-awareness, using this knowledge to transform awareness into practice [8, 44].

3.5. Mood Variability

It is widely believed that mood fluctuations in ultrarunning play an important role in performance during an ultramarathon [8, 9, 18]. Studies have analyzed mood states in ultrarunning using the *Profile of Mood States* (POMS) or the *Brunel Mood Scale* (BRUMS), finding that between one week and one month of running an ultramarathon, substantial mood alterations took place [6]. Quantifying anger, confusion, depression, fatigue, tension, and vigor suggested a high consistency between ultramarathon running and increased fatigue through decreased tension [6]. This evidence concludes the average ultrarunner, though what findings suggested higher levels of success in the ultramarathon?

Mood variability in this review is defined as the frequency of emotional change between seconds to weeks in length. A critical measurement of mood variability is the Total Mood Disturbance (TMD), a score that is positively correlated with completion time in an ultramarathon [8, 9]. TMD takes data on anger, confusion, depression, fatigue, tension, and vigor throughout the race using the BRUMS score [45]. In 2021, Daniel T. Smith et al. measured mood fluctuations in athletes competing in a 100 km trail

ultramarathon, examining mood variability concerning performance [9]. Measurements via the BRUMS score were taken the week before at 0 km, 35.3 km, 66 km, and 100 km (the finish).

Daniel T. Smith et al. found that the less experience an athlete was, the higher the TMD was expressed at the pre-race stage, though interestingly, during the pre-race stage, most athletes had the lowest measurements of anger and depression due to the enhanced feelings of euphoria before the start of the race [9]. It is unclear whether the mitigation of depression and anger during the race is due to euphoria or the presence of other athletes.

The negative relationship between TMD and performance, based on the Psychobiological model of performance, suggests that the higher the mood variability in an athlete, the greater the cost of self-regulation is, creating mental fatigue [9]. Mental fatigue is one explanation for runners with high TMD, due in part to the increased perception of effort, which is correlated with reduced endurance performance [18].

In 2014 Christopher R D Wagstaff performed a single-blind study measuring the emotional self-regulation of endurance athletes [46], further supporting Daniel T. Smith et al. [9]. The athletes concealed their emotions and watched a disturbing video, afterward, running a 10 km time trial. Performances of those who watched the video resulted in poorer performance, suggesting that emotional self-regulation impaired performance, increasing the levels of perceived exertion and sports performance [46].

Finishers and withdrawers (those who do not finish, or DNF) each have different emotional barriers and adaptational coping mechanisms throughout an ultramarathon. Successful ultramarathoners reported good moods and enjoyment throughout the event [47]. Those whom DNF worried about time barriers hoped to feel better and worried about past injuries, as opposed to those who finished feeling relaxed, splitting their races into smaller segments [47]. Literature has supported that race outcomes are shaped early on in a race due to a chain event of vitality gain or loss [47, 48]. The experience of ultrarunning is composed of many different feelings [49], which compose a stable state of preservation. Ultramarathoners who change mindsets and moods or have irregularity in their emotions fail to continue or succeed in a race due to falling into a difficult rut from which they seem difficult to remove themselves [47].

Scientific literature has suggested that the greater the TMD and emotional variability, the worse the performance of athletes [9, 18, 46]. Regarding mood variability, athletes who maintained the least emotional variability had greater success than those who did not. These findings suggested that the greatest way to lower TMD was to gain experience in ultramarathon racing [9]. Secondary approaches to improving success in ultrarunning, regarding emotional variability, include maintaining positive feelings of emotion within a stable state of relative ease [47].

Regarding emotional variability, it is important to note that literature has referenced inadequate food intake during an endurance event as a negative effect on ultra running. Compared with ultrarunner dropouts, successful racers tend to have an adequate nutrition plan [47]. Because ultrarunners with

higher success rates have less emotional variability and better nutrition plans, there may be a relationship between psychological stability in ultrarunning and adequate nutrition.

Further research is highly recommended to establish a relationship between TMD and adequate nutrition during an ultramarathon.

4. Limitations

Due to the limited resources regarding research on ultrarunning traits of success within psychology, literature was less plentiful than in other subject areas of ultrarunning, resulting in a narrower scope of information.

It is important to note that many of the preceding studies are cross-sectional and based on self-reported data. Therefore, causal relationships among the variables cannot be determined. Participants' recall bias and potentially under-reporting behaviors may have influenced results.

5. Conclusion And Future Research

5.1. Future Research Recommendations

Future research is highly recommended on the psychological indicators of ultrarunning success. Limited research has been conducted, and there is still much to understand. The following will address a summary of research questions that this review has discussed and recommends for bettering literature and applied ultrarunning success.

Research in many other of endurance has indicated that the practice of self-encouragement has led athletes to success [19], though little effort has been made to replicate such experiments in ultramarathoners. Further investigation is recommended on how ultramarathoners may better improve their success through psychological practice and routine and the effects of such goal-setting statements as “I will finish in (X) hours.”

Higher cortisol levels were found in ultramarathon runners with greater success [41], though little is known about the mechanisms in which this occurs and why. Proposed questions include: Why would these cortisol levels be higher than individuals running slower times? Are more successful ultrarunners enduring more stress? Are successful ultrarunners simply able to cope with the greater stress more effectively due to higher EI?

Inadequate nutrition is known to result in poor performance in ultrarunning [47]. However, little research has determined if TMD becomes unstable or if the greater the EI, the greater resistance to fatigue during an ultramarathon. Research is recommended to understand the relationship between TMD and ultramarathoner's nutrition strategies.

Preliminary research has been completed on ultramarathon psychosocial factors such as teammate interaction or being passed by other ultramarathoners. Further research would help better understand how the effects of interpersonal relationships and competition determine ultrarunning success.

5.2. Conclusion

Ultrarunning is a rapidly growing field, warranting the analysis and research of the traits of those who succeed in such endurance events. This review examined the current scientific literature on traits correlated with success in ultramarathons. Successful ultramarathoners were found to possess high mental toughness and emotional intelligence rates, likely due to high levels of perseverance and greater coping strategies used to assess and problem-solve during endurance events. Ultramarathoners had high levels of self-efficacy and lower mood variability while primarily being motivated by social interaction and self-fulfillment. Ultrarunner's unique sense of self-confidence and control of their emotion possibly allowed runners to focus on the event without deviating, ultimately leading to success. These findings suggest that cognitive strategies, social motivation, and emotional stability are vital to success in ultramarathons.

Declarations

Author Contribution

All authors contributed to the study conception and design. Material preparation, data collection and analysis were equally performed by all authors. The first draft of the manuscript was written by Owen R. Thornton and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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