Relationship between personal psychological capitals, stress level, and performance in marathon runners

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Abstract  Background: Marathon runners experience different levels of stress from their performance, which may vary across different people.
Objectives: This study sought to examine if stress levels could be predicted by running performance and personal psychological capitals, including optimism and self-efficacy levels in marathon finishers. It also determined the contribution of each component in a stress prediction model.
Methods: An online questionnaire and comprised validated scales were used to measure runners' performance, perceived stress levels, and personal psychological capitals.
Results: A positive correlation between runner performance and perceived stress level ($r_s = 0.256, p = 0.019$) was found, while the personal psychological capitals were negatively correlated to stress levels ($r_s = -0.580, p < 0.001$) and ($r_s = -0.618, p < 0.001$) respectively. Perceived stress levels were best predicted by personal psychological capitals ($\beta = -0.322 -0.393, p = 0.001$), but not running performance.
Conclusion: Our findings suggested that psychological factors affect stress levels the most, and marathon runners with a lower performance were more prone to stress than those who perform better.

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Introduction

Marathons have become a popular sport globally in recent years; it can be partially reflected by the rapid growing number of marathon participants all over the world. Previous research studies in the running population have been focused on musculoskeletal health, physiology, injury prevention, and rehabilitation. Yet, a recent study reported a
possible link between the symptoms of musculoskeletal injury and quality of life in a similar cohort [1]. It has been reported that mental health may be more affected because of injury in elite athletes rather than amateur athletes [2]. Such a phenomenon can be explained by differences in self-expectation and stress levels between athletes at different elite levels. Elite runners may have higher self-expectations than subelite and recreational runners. A high level of self-expectation may serve as motivation for a better performance. However, tension may also build up, and expectation may eventually become a stressor [3].

Stress refers to any situation that threatens or are viewed to threaten one’s wellbeing as well as coping strategies [4], while perceived stress is defined as the degree to which situations in one’s life are appraised as stressful [5]. The experience of stress depends on subjective interpretation and appraisal of the event noticed [6,7]. According to the social cognitive theory, appraisal will be the result in relation to personal standards and environmental circumstances, which means personal psychological capital (PPC) should have an effect on that [8].

Different people react differently to the same life events, and this is mainly attributed to differences in their PPC. Optimism is classified as one of the positive PPCs in that it has a positive effect on a person’s psychological state. Optimism reflects people making a positive attribution with regards to succeeding now and in the future [9]. When facing a challenge, optimists will be able to sustain positive psychological wellbeing and expect a positive outcome because they use problem-focused coping skills rather than emotionally cope which pessimists do, and this is always related to a better subjective wellbeing in time of adversity [9]. With this more positive appraisal, runners with a greater optimism level should be less stressful at any point during their training. It is logical to assume the more optimistic an individual is, the lower their stress levels are.

Self-efficacy is another important component in positive PPCs, which is the positive belief or confidence in one’s ability to perform specific tasks [10]. It has been suggested that self-efficacy is a key factor in affecting an individual’s ability and willingness to exercise control, especially in unfavourable situations [11]. Self-efficacy beliefs are suggested to be a major determinant of behaviour such as performance, sports adherence, and compliance when a person possesses the requisite skills [12,13]. The higher self-efficacy of oneself, the more effort they indulge in sports. In other words, someone with higher self-efficacy should have a better mastery in sports, i.e., a more elite level. This concept is also supported by the fact that self-efficacy is actually built on different factors, i.e., past successful experience, social modelling, and physiological arousal in which past successful experiences are the most influential [13]. When a runner gains satisfactory results in their performance, their self-efficacy continuously increases. As mentioned, physiological arousal is one of the determinants in self-efficacy; it is thus directly related to the stress level of a person. High self-efficacy improves the tolerance of a runner to difficult or challenging conditions, and this affects their cognitive appraisal to the situation and as a result affecting their stress level.

However, all the aforementioned relationships between performance, PCCs, and stress levels in runners remain speculative. Better understanding of such relationships will improve rehabilitation strategies and psychological health in this growing population. The objective of this study was to examine whether stress levels can be predicted by the runners’ performances, level of optimism, and self-efficacy level in marathon finishers; and (2) determine the contribution of each component in the stress prediction model. We hypothesized that stress levels in marathon runners would associate with runners’ previous performances, level of optimism, and self-efficacy level. We also expect the attributes in the PPC would better predict stress levels than the runners’ performance.

Methods

Participants

Eighty-three marathon finishers (26 females; mean age of 38.0 ± 8.7 years) were recruited from running clubs and some were marathon participants in the International Association of Athletics Federations. Runners who regularly ran < 10 km/wk and started running < 6 months ago were excluded, as we aimed to study experienced distance runners only. The experimental protocol was reviewed and approved by the Departmental Research Committee, Department of Rehabilitation Sciences, Hong Kong Polytechnic University, and written consent was obtained from each participant through the same online platform. Participants had an average of 5.7 ± 3.1 years of running experience, a monthly average running distance of 130.66 ± 123.59 km, and a mean full marathon best record time of 3:55:57 ± 0:45:56 hours.

Online assessments

An online questionnaire was shared from January 2014 until July 2014. All the participants were asked to report their background demographical data and running-specific portfolio, e.g., previous personal best record, running experience, monthly distance, average pacing, and three validated instruments concerning their stress level, optimism level, and self-efficacy level.

Instruments

Stress: Perceived Stress Scale

Perceived Stress Scale (PSS) was designed to measure the cognitive evaluation of the perceived stress of an individual [5]. The original scale consisted of 14 items [5], but was modified later to 10 items, and a 5-point Likert-scale (0 = never; 4 = very often) with scores ranging from 0 to 40 was used [14]. This scale was shown to have a high internal consistency and test–retest reliability [5,15,16].

Optimism: Life Orientation Test (LOT)

Life Orientation Test (LOT) was established to measure the generalized expectancies for positive versus negative outcomes [17]. It consists of eight self-report items. Respondents have to indicate their degree of agreement with a 5-point Likert-scale (0 = strongly disagree to 4 = strongly agree).
agree). Among the eight items, four items are positive while the other four items are in a negative direction. After reversing the negative items score, an overall score can be yielded. The higher the score, the more optimistic the individual is. Scores ranged from 0 to 32. The original internal consistency and test–retest reliability are 0.76 and 0.79 respectively [17].

Self-efficacy: General Self-efficacy Scale

General Self-efficacy Scale (GSE)-10 is a 10-item scale designed to assess optimistic self-beliefs and self-efficacy, i.e., the belief that one’s actions are responsible for successful outcomes [18,19]. The score for each question ranges from 1 to 4. The overall score lies from 10 to 40; the higher scores indicate stronger individual beliefs in self-efficacy. High internal consistency and reliability have been reported in previous studies [18,20–22].

Statistical analysis

Data are presented as mean ± standard deviation (SD). Spearman’s rank correlation coefficient (rs) is a linear multivariate regression analysis, and an enter regression model was performed to assess the contribution of the predictive factors PSS. Scores in LOT, GSE, and personal best record time (HH:MM:SS) were chosen for the correlation and regression analysis. Additionally, the variables sex and age were included as potential confounding variables for model adjustment. The statistical package, PASW for Windows, version 20 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. The alpha level was set at 0.05.

Results

We found a significant correlation between PSS and full marathon performance (rs = 0.256; p = 0.019), LOT (rs = –0.580; p < 0.001), GSE (rs = –0.618; p < 0.001) (Table 1; Fig. 1). As higher PSS scores indicate higher stress levels, it can be interpreted from the findings that slower runners may have higher stress levels, while runners with a greater level of optimism and self-efficacy would have lower stress levels.

The linear multivariate regression model yielded statistical significance for stress level prediction in marathon finishers (R² = 0.422, F (5,77) = 12.971, p < 0.001). The level of self-efficacy was the strongest predictor among all the other factors in predicting the PSS score (β = –0.393, p = 0.001) while levels of optimism were of second importance (β = –0.322, p = 0.005). Performance of the runners (β = 0.094, p = 0.287), sex (β = < 0.001, p = 0.997), and age (β = –0.038, p = 0.658) were not significant predictors of stress (Table 2).

Discussion

The central premise of this study is that perceived stress levels are affected by the runner’s performance and their own PCCs, while levels of self-efficacy and optimism are major contributors in predicting the stress level of marathon runners.

Our findings indicated that stress levels decrease when an individual’s performance improves. This is not in accord with our hypothesis, but it may be explained by the psychological characteristics of distance runners. According to previous studies, elite distance runners were less anxious and depressed when compared to the general population [23], i.e., elite runners should have a more positive psychological state than nonelite runners or laypeople. People with positive psychological states differ in perceived stress levels in terms of their coping strategies. Most of the research pointed out that constructive coping processes have been associated with positive psychological states including positive reappraisal, problem-focused coping, and infusion of ordinary events with positive meaning [24,25]. Therefore, positive reappraisal is significantly associated with positive emotions [25].

Positive reappraisal refers to the cognitive process in which people search for positive light in an event that has happened [24]. During the process, individuals will discover different and new opportunities for personal growth [24]. Positive psychological wellbeing is not inborn in elite runners, as their personality traits are similar to the general population and is suggested to be a benefit from regular training [23]. Through training to become elite, a runner needs to overcome many difficulties or failures, i.e., injury or failure to break their personal best record. They learn to practice positive reappraisal and seek for improvement in their performance. Through repeated learning, elite runners have personal growth as mentioned, and they can foresee improvement from their previous experiences. In time, they may become more positive psychologically and as a result reduce their perceived stress levels when their performance is upgraded. Contrary to novice runners, who are new to the sport and do not know the possible consequences from any failure which could be a stressful event for them. As a result, perceived stress levels will be

| Measures          | LOT  | GSS   | PSS   | PBFM | Mean | SD   |
|-------------------|------|-------|-------|------|------|------|
| LOT               | —    | 0.610** | –0.580** | 0.206 | 19.58 | 4.20 |
| GSS               | 0.610** | —       | –0.618** | –0.252* | 29.10 | 4.27 |
| PSS               | –0.580** | –0.618** | —       | 0.256*  | 17.12 | 6.45 |
| PBFM              | –206 | –0.252* | 0.256*  | —      | 3:54:14 | 0:48:20 |

* p < 0.05.  
** p < 0.01.  
SD = standard deviation.
increased. This can explain the positive correlation in personal best records and the PSS score in our study.

Our results also showed that optimism levels diminish the perceived stress levels of a runner, as optimists cope with stress differently compared with less optimistic individuals. They use more adaptive ways to face the challenges in their life rather than avoidance used by pessimists [26]. Pessimists may disengage in the activity that they encountered failure and can be preoccupied with the negative emotions resulting from it. As such, they show

![Figure 1](A) Relationship between Perceived Stress Scale score (PSS) and Life Orientation Test score (LOT); (B) relationship between PSS and General Self-efficacy Scale score (GSS); and (C) relationship between PSS and personal best record for a full marathon.

| Table 2 | Linear multivariate regression analyses predicting Perceived Stress Scale score (PSS), from Life Orientation Test score (LOT), General Self-efficacy Scale score (GSS), and Personal Best Record for Full Marathon (PBFM). |
|---------|---------------------------------------------------------------------------------|
| Predictors | B | t  | Δ R² | Beta | VIF | p   | 95% CI of B |
|----------|---|----|------|-----|-----|-----|-------------|
|          |   |    |      |     |     |     | Lower bound | Upper bound |
| GSS      | -0.593 | -3.470 | 0.382 | -0.394 | 1.815 | 0.001 | -0.933 | -0.253 |
| LOT      | -0.495 | -2.871 | 0.066 | -0.316 | 1.778 | 0.005 | -0.838 | -0.152 |
| PBFM     | 2.09 × 10⁻⁴ | 1.071 | 0.008 | 0.088 | 1.088 | 0.287 | -1.79 × 10⁻⁴ | 0.001 |
| Age      | -0.029 | -0.444 | 0.002 | -0.043 | 1.066 | 0.658 | -0.157 | 0.100 |
| Sex      | 0.005 | 0.004 | 0.002 | 0.033 | 1.131 | 0.997 | -2.454 | 2.464 |

CI = confidence interval; VIF = variance inflation factor.
no advancement in their performance and their stress levels increase [27]. Optimists hold positive expectancies towards their future, and this can be reflected in their actions. When an optimistic novice runner experiences a negative event in their running life, they treat it as a learning process and gain positively from the bad experience [26].

Another factor that affects the perceived stress level of a runner is self-efficacy. Our findings indicated negative correlations between the perceived stress level and self-efficacy level. It is mentioned that self-efficacy is the belief of an individual on how well they might master an activity or challenge. High level self-efficacy leads to a positive self-concept and results in more confidence in their overall ability in the face of challenges. It is logical that stress levels would be reduced if one is having a positive self-evaluation. As mentioned, high self-efficacy will improve their adhesion to sports. An individual with high self-efficacy would not give up during their difficult time in running, but in turn would face it more actively.

Among the three factors, performance fails to predict the perceived stress level. This could be due to the underlying mechanism as mentioned before. Since performance affects a person’s stress level through psychological wellbeing, the relationship between performance and stress levels may not be as directive as the two PCCs.

Limitations

Though the results of the study have supported our hypotheses, there were several limitations in this study. The data was collected through an online questionnaire, so the accuracy of the data was difficult to verify and recall bias was possible. It was a cross sectional study, so it is unknown whether any causal relationship exists between the factors studied. Though literature showed the baseline of the personality of elite distance runners is the same as the general population and the better psychological state is the result from regular training [23], there is no prospective information about the PCCs of the runners.

Future studies could be done to investigate if causal relationships exist between PCCs and stress levels. Apart from studying the causal relationship, more factors could also be included to study among the same elite level of runners. Additional factors included could be the history of injury and running distance per month, to see if runners exert certain effects on perceived stress level. The stress and sport injury model suggested psychological risk factors have an effect on injuries [28–30] but the vice versa relationship has been less discussed. It would be worthwhile to know if injury would further affect one's stress level in order to develop a more effective remedial plan for injured runners.

Moreover, our model can only obtain less than 50% predictability due to the fact that our participants were full marathon runners and not any other type of runner, i.e., half marathon runners or noncompetitive/recreational distance runners. The psychological state or personality of these types of runners are probably different to full marathon runners, due to differences in the demand, both psychologically and physically, of the sport they are in.

Implications

The result of this study gives insights to trainers, medical professionals, and those who would like to start distance running. If knowing that a positive psychological state would help to reduce the stress level of oneself, runners should, other than physical training, also focus on training their psychological state together with regular running. As mentioned, the two PCCs are not only solid but are more of a state-like attribute [31–33]. Programs can be set up to boost the psychological wellbeing of novice runners, as it is anticipated that they would overcome a lot of different challenges at the beginning of their training. Through this kind of program, optimism and self-efficacy levels would be changed and in turn would gradually change the perceived stress level. When stress levels decrease, the overall performance would be improved; as it was proved they have a positive correlation.

Conclusion

Stress is inevitable in any runner’s life. But the psychological wellbeing and performance of a runner may change along with different dimensions, including optimism and self-efficacy. This research was done within numbers of full marathon finishers, and results showed that all three components were highly correlated with the perceived stress levels while the two psychological components were identified as predictors of stress. The relationship shown could be attributed to the different coping strategies among different individuals. Practical implications of this study include having programs for improving one’s psychological wellbeing, which will contribute to the reduction of perceived stress levels as well as improving overall performance.

Conflicts of interest

The authors have no conflicts of interest relevant to this article.

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