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Not so rebel after all: Profiling personality traits in mountain running athletes
Ni tan rebeldes: Perfil de personalidad de los corredores de montaña

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Abstract. In the field of sport psychology, trait theories view personality characteristics as the main determinants of behavior. This study explored personality traits in athletes of a growing sport, trail or mountain ultrarunning, a group for which previous studies have yielded inconclusive results regarding the dominant traits and which traits are associated with sporting success. The NEO-FFI questionnaire by Costa and McCrae (1992) was applied online to a sample of 86 trail runners (60 men and 26 women), who participated in a competition in Chile. It sought to determine what the personality profile of these athletes was like; to identify if there were significant differences between this population and the normal population; and if there were differences among them according to gender, the distance in which they competed, the results in the competition, and the motivations they stated for running. For each comparison, a Wilcoxon Rank Sum Test was performed to measure its differences and respective statistical significance. Results showed that the personality profile of the mountain runners matched that of successful athletes in terms of high Conscientiousness and low Neuroticism, however, Openness to Experience scores showed no significant differences with the normal population. Neither did significant differences appear in any of the traits between ultradistance and shorter distance runners, nor according to their motivations for running, nor between male and female runners (except in the Agreeableness dimension). Finally, a clustering of the runners was outlined according to their personality profiles and performance, to see if they fit existing classifications that distinguish between recreational and results-oriented athletes, observing that it was possible to establish distinct profiles among runners. These results are of relevance to sports practitioners, who can design tailored interventions according to athletes′ personality profiles and prevent negative consequences when these traits become associated with unhealthy behaviors. The modest gender differences found, allow questioning gender stereotypes within the sport and fostering a more equitable approach to athlete training. This knowledge can contribute to further growing the sport of trail and ultrarunning in Chile and Latin America.
Keywords: trail runners; ultrarunners; endurance sports; personality; Big Five

Resumen. En el campo de la psicología del deporte, las teorías de rasgos ven las características de la personalidad como los principales determinantes del comportamiento. Este estudio exploró los rasgos de personalidad en atletas de un deporte en crecimiento, trail o ultramaratón de montaña, un grupo para el cual estudios previos han arrojado resultados no concluyentes con respecto a los rasgos dominantes y qué rasgos están asociados con el éxito deportivo. El cuestionario NEO-FFI de Costa y McCrae (1992) se aplicó en línea a una muestra de 86 corredores de montaña (60 hombres y 26 mujeres), que participaron en una competencia en Chile. Se buscó determinar cómo era el perfil de personalidad de estos deportistas; identificar si había diferencias significativas entre esta población y la población normal; y si había diferencias entre ellos según el género, la distancia en la que compitieron, los resultados en la competencia y las motivaciones que manifestaron para correr. Para cada comparación, se realizó una prueba de suma de rangos de Wilcoxon para medir sus diferencias y la significación estadística respectiva. Los resultados mostraron que el perfil de personalidad de los corredores de montaña coincidía con el de los atletas exitosos en términos de alta Escrupulosidad y bajo Neuroticismo, sin embargo, los puntajes de Apertura a la Experiencia no mostraron diferencias significativas con la población normal. Tampoco aparecieron diferencias significativas en ninguno de los rasgos entre corredores de ultrafondo y de fondo, ni según sus motivaciones para correr, ni entre corredores y corredoras (excepto en la dimensión Amabilidad). Finalmente, se delineó un agrupamiento de los corredores según sus perfiles de personalidad y rendimiento, para ver si encajaban en las clasificaciones existentes que distinguen entre deportistas recreativos y orientados a resultados, observando que era posible establecer distintos perfiles entre los corredores. Estos resultados son relevantes para quienes trabajan con deportistas, que pueden diseñar intervenciones adaptadas a los perfiles de personalidad de los atletas y prevenir consecuencias negativas cuando estos rasgos se asocian con conductas no saludables. Las modestas diferencias de género encontradas permiten cuestionar los estereotipos de género dentro del deporte y fomentar un enfoque más equitativo del entrenamiento de los atletas. Este conocimiento puede contribuir a seguir haciendo crecer el deporte de trail y ultrarunning en Chile y América Latina.
Palabras clave: corredores de montaña; ultracorredores; deportes de resistencia; personalidad; Cinco Grandes

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Introduction

In the field of sport psychology, one of the approaches to the study of athletes' motivations, attitudes and behaviors has been through trait theories, which view personality characteristics as the main determinants of behavior (Greenlees & Jones, 2013). According to Self and Findley (in Booth & Thorpe, 2007), these foundational elements are stable and consistent over time and in a variety of situations.

The popular image of outdoor athletes in lifestyles or action sports is usually hedonistic, carefree and representing alternative, anti-establishment subcultural styles (Poulson, 2016), but on the other hand, these sports have become more popular and commodified in the last decades (Atkinson, 2008; Thorpe & Wheaton, 2013). This paradoxical scenario raises questions about the kind of people who practice these sports, and if their personality profiles somehow correspond to that rebellious image of the sport pioneers. This study tries to answer these questions in a

particular outdoor sport: mountain ultrarunning.

Studies of personality traits in athletes have yielded inconclusive results as to which traits predominate in ultra-distance mountain runners, or in endurance athletes, or even in athletes in general, or which traits are associated with sporting success (Piedmont et al., 1999; Doppelmayr et al., 2004; Hanson et al., 2015; Waśkiewicz et al., 2018; Goddard et al., 2019; Piepiora, 2021). The relevance of addressing mountain runners, and specifically, ultrarunners (i.e., those who regularly run distances over the 42 km of the marathon), lies in the fact that ultra-distance races are one of the endurance sports with the greatest growth in recent times, with numerous elite athletes who have broken records and a massification of the sport, with 611,098 participations in races and 329,584 participants in 2018, along with a progressive increase in female participation, although still lower than male participation (23% of the total number of participants in races up to 50 miles and 16%, in races over this distance) (International Association of Ultrarunners (IAU), 2020). Meanwhile, there has been a 1,000% increase in competitive events in the last decade (Finn, 2018).

Given this background, the aim of this study is to contribute to the study of personality in endurance athletes, particularly, in the discipline of mountain running (including ultrarunning), to further elucidate whether it is possible to establish patterns in terms of personality traits present in this type of athletes, and to discuss the practical uses of this information. Specifically, we aim to identify if there is a particular personality profile in terms of the five major personality traits described by Costa and McCrae (1992)[1], that differentiates the study population from the normal population and athletes in general, as described in the literature; and to identify if there are differences among mountain runners according to the distance they ran (in a race they participated in October, 2019), their declared motivations for running (to participate, complete the distance, improve their time, or place well), and their sex. Finally, analyses are performed to establish distinct groups among the runners, using their personality profiles and performance in the race.

In the Chilean and Latin American context, furthering the knowledge about the sport of ultrarunning is of great relevance, since it is a growing sport, with enormous potential given the mountainous terrain of our countries and the consolidation of running events that attract international runners and tourism (Madriñán, 2019). The opportunities our landscape offers to promote physical activity in the population is another fact that should not be ignored, in a context where only 18,7% of the population over 5 years old follows the World Health Organization physical activity weekly recommendations (150 minutes of moderate activity or 75 minutes of intense activity), and where an important gender gap appears, with 45,3% of men practicing some activity and only 25.8% of women (Ministerio del Deporte, 2021).

The rest of the article is organized as follows: First, a review of the literature is carried out focusing on the study of personality traits in athletes, and specifically, on ultrarunners. Then, the methodology of the study is described, including the conceptual framework, main hypotheses, inclusion criteria, measurement instruments and data analysis techniques. Thirdly, the results obtained after executing the methodology are reported and described, highlighting the most significant results. Afterwards, the results are discussed, contrasting them with previous studies, and considering the limitations of the study. Finally, the main conclusions obtained from the study and future directions of this line of research are established.

Literature Review

Costa and McCrae's (1992) Big Five model, a standard in Psychology, describes five core personality traits: Neuroticism (emotional stability, stress management), Extraversion (sociability, assertiveness, tendency to converse and enjoy social events), Openness to Experience (appreciation of the arts, adventure, flexibility, imagination and creativity), Conscientiousness (self-discipline, conformity, control, achievement orientation and sense of duty) and Agreeableness (compassion, tolerance and cooperation). In this model, Openness to Experience and Extraversion would be related to risk taking (Self & Findley, in Booth & Thorpe, 2007).

Piedmont et al. (1999) point out that the Big Five model has been able to predict achievement in different life domains, such as work and academics, and it is also related with sporting success, since low Neuroticism would allow for high self-confidence and low anxiety in athletes, and high Conscientiousness would allow for goal orientation and competitiveness. According to Piepiora (2021), the general profile of athletes in terms of the Big Five involves: low Neuroticism; high Extraversion and Conscientiousness; and average Agreeableness and Openness to Experience.

Traits of the Big 5 Model in Athletes

Extraversion

Researchers have identified higher Extraversion in athletes than in non-athletes, a trait that could be related to Mental Toughness, which refers to the ability to cope with anxiety, show self-confidence in sport contexts and achieve success (Hughes et al., 2003; Goddard et al., 2019).

Taylor & Doria (1981) found that Extraversion predicted good sports performance, especially in team sports, however, other authors such as Coleman (1980) have proposed that low Extraversion would be a characteristic in extremely superior athletes. Piedmont et al. (1999) found that in athletes belonging to teams, Extraversion

[1] These factors assess whether a person "is chronically predisposed to emotional distress versus emotionally stable (Neuroticism); energetic and thrill-seeking versus sober and solitary (Extraversion); curious and unconventional versus traditional and pragmatic (Openness to Experience); kind and trusting versus competitive and arrogant (Agreeableness); disciplined and fastidious versus laidback and careless (Conscientiousness)" (Costa & McCrae, 2008, p. 226).

tends to be higher. A more recent review of studies on extraversion in sport by Allen et al. (2020) found that the most convincing evidence regarding this trait was that athletes are more extraverted than non-athletes.

According to Barnett (2006), there would be a strong influence of personality on the choice of leisure activities, the individual's ability to experience fun and pleasure in leisure activities or become absorbed in the activity; consistently, it has been found that more extraverted individuals tend to choose social leisure activities, including sports, and are more motivated by competition.

Openness to Experience

This trait reflects the ability to seek new experiences, a general preference for active imagination (fantasy), aesthetic sensitivity, attention to inner feelings, preference for variety and intellectual curiosity (Costa & McRae, 2008). High levels could be related to participation in non-traditional sports, due to the level of receptivity to ideas and opportunity for new experiences (Wilson & Dishman, 2015). However, Steca et al. (2018) found in 881 successful male athletes that they consistently showed higher scores than the normal population on all personality traits except Openness to Experience. Other researchers (Aidman & Schofield, 2004; Singh & Manoj, 2012) have not found a significant relationship between Openness to Experience and high athletic performance.

Researchers have explored the relationship between the Sensation Seeking construct and Openness to Experience. Sensation Seeking involves a need for intense, new, varied and complex sensations, related to higher physical and social risk activities (Zuckerman, 1971 in Santos Machado et al., 2022). Sensation seekers would have a higher arousal threshold, with a propensity for risk-taking behaviors and extreme sports (Self & Findley, in Booth & Thorpe, 2007). According to Zuckerman (1994), five of the dimensions of Openness to Experience would be related to the search for internal experiences (fantasy, aesthetics, ideas, feelings and values), while the subdimension of Actions would have to do with the search for external experiences, which would be a trait related to Sensation Seeking.

New studies have been able to demonstrate that participating in extreme sports is not necessarily related to impulsive or irresponsible behaviors, but that their participants build competencies through a training process, do not take irrational risks (although sensation and thrill seeking may be an initial motivation), and see their participation linked mainly to psychological well-being, the development of a sport identity, a sense of challenge, and an aesthetic experience of the natural environment (Roberts et al., 2018). Davidson and Stebbins (2011) posit, about challenging activities in nature, that one of their central features is the aesthetic dimension of wonder at the natural environment, which includes the different senses and sensations. Like Roberts et al. (2018), they conclude that participants do not choose the concept of risk as central to characterize their sport motivation, but rather perceive this risk as reasonable according to their level of experience, where excessive risk would decrease the likelihood of experiencing "flow" and fun, making it less attractive.

Following this aesthetic approach, Immonen et al. (2018, in Santos Machado et al., 2022) describe extreme sports as activities “with exquisite possibilities for perception and experience of movement, conducting to an existential reflection and self-realization” (p. 1073).

Neuroticism

Piedmont et al. (1999) describe that a low level of Neuroticism could be related to the ability to perform under pressure, tolerate stress and control impulsivity, positive traits of a successful player. Singh and Manoj (2012) identified that athletes with high levels of Neuroticism exhibited anxiety, depression, aggressiveness, anger and selfishness, presenting low emotional and behavioral stability, and that, in the case of male wrestlers, lower levels were associated with better athletic performance. Piedmont et al. (1999), studied the performance of college-level female soccer players, finding that high Conscientiousness and low Neuroticism were related to sports performance, according to evaluations made by coaches.

Conscientiousness

Singh and Manoj (2012) found in a group of male wrestlers, that athletes with high discipline, responsibility, achievement motivation and goal orientation had better performance. Mirzaei et al. (2013) studied the relationship between personality traits and sport performance in 229 soccer and futsal players, using Costa and McCrae's NEO-FFI questionnaire and a performance scale filled out by coaches, finding that only Conscientiousness had a positive correlation with performance.

Piepiora (2021) found that those who were physically active differed in their levels of Conscientiousness with respect to those who did not train regularly, hypothesizing that, through physical activity, people were able to set goals in their lives and be ambitious. The author points out that there are antecedents on the differences in terms of high Conscientiousness, high Extraversion and low Neuroticism between professional athletes and physically active people, with the former showing greater activity, energy, and ability to experience positive emotions, as well as greater organization, persistence, and goal orientation. In the case of team sports champions, they were distinguished from the rest of the players by a lower level of Neuroticism and a higher level of Extraversion and Openness to Experience.

Agreeableness

Aidman and Schofield (2004) found no relationship between Agreeableness and sports performance in amateur soccer and futsal players. Meanwhile, Kajtna et al. (2014) found no differences in Agreeableness in practitioners of high-risk (skydiving, skiing, rafting) and low-risk (swim-

ming, athletics, karate) sports. No significant relationships were found between Agreeableness and sedentary behavior (Sutin et al., 2016).

Personality Traits in Ultrarunners

Although studies focused on mountain runners and especially on those who participate in ultra-distances, are scarce, there is some background in the field of personality traits, motivations for participation and perceived benefits of participation. Waśkiewicz et al. (2018) studied 1,539 Polish runners and found that ultra-distance runners differed from those running shorter distances, with the former placing more importance on Life Meaning and Affiliation, and less on Self-Esteem and Goal Orientation. Another study, on Marathon des Sables (230 km) runners, showed that they had lower scores on the Competence dimension and higher scores on Meaning of Nature and Meaning of Life than marathon runners (Doppelmayr et al., 2004). Hanson et al. (2015) replicated these results, adding that ultra-distance runners placed less importance on body weight and health concerns. Goddard et al. (2019) took a sample of British runners from the Marathon des Sables and applied the NEO PI-R questionnaire, comparing the results with the normal population, finding higher levels of Extraversion and Openness to Experience.

These studies allow assuming that Openness to Experience (which would be related to Meaning of Life and Nature) could appear higher in the case of runners practicing longer distances in this study.

Groslambert et al. (2021) studied the motivations of 17 mountain runners, identifying three types of runners: 1) Hedonists, who enjoyed the scenery, the feeling of well-being and sociability while running, 2) Resilient, who experienced pleasure in overcoming adverse life events, and who saw the physical and mental challenge of competition as a way of coping with those difficulties and improving their self-esteem, and 3) Competitive, who enjoyed measuring themselves against others, placing great importance on their speed and ranking. No significant differences were observed in speed or heart rate; however, perceived effort and perceived affective valence/pleasure were lower in the case of the Resilient, compared to the Hedonists and Competitive. The authors hypothesize that, for the Resilient, running is seen as an instance to find oneself, which allows to decrease the perception of effort through a dissociation of the sensations of discomfort and pain; on the other hand, their perceived pleasure is also lower. In Hedonists, the perceived pleasure was high, especially because of the proximity to nature and the feeling of being able to escape from routine, with a predominance of intrinsic motivation. Competitive runners, who showed a high level of perceived effort and perceived pleasure, signified hard effort as the way to obtain a good result.

Gender Differences in Personality Traits in Athletes

Regarding gender differences in athletes, Gyombert et al. (2015) found that there was a different personality profile in male and female athletes, with the latter showing higher scores on Extraversion, Agreeableness, and Conscientiousness. They also found that female athletes presented higher anxiety and lower self-confidence than male athletes. The meta-analysis by Costa et al. (2001) found that, in the general population, women had higher levels of Neuroticism than men.

Other studies such as that of Monasterio et al. (2018) in base jumping athletes, found no significant differences between men and women (except for the Cooperation trait, which was higher in women). Williams (1980) also put forward the thesis that, in athletic populations, women tend to show personality traits more similar to men. Regarding the Sensation Seeking trait (related to Openness to Experience within the Big Five model), Frick (2021) found no significant differences between male and female divers. Given that women tend to be more risk-averse than males, results could be explained by the fact that those who self-select to participate in this discipline, whether male or female, are Sensation Seekers (scoring much higher than those who practice lower-risk sports).

Quantitative Analysis of Personality Traits in Previous Studies

In general, the quantitative analysis in previous studies can be divided into two main phases: first, a phase of design and application of instruments for measuring personality traits, commonly in questionnaire format; and then, a second phase of statistical analysis of the data. The five-factor model (Costa & McCrae, 1992) and NEO-FFI questionnaire were the most frequently used approaches in the quantitative studies revised (Mirzaei et al., 2013; Sutin et al., 2016; Goddard et al., 2019; Piepiora, 2021). In the study by Allen et al. (2020), a meta-analysis of other studies that examined personality traits in athletes, showed that 38% of the 151 studies analyzed used the five-factor model.

Regarding the statistical analysis, some studies focus on looking for relationships between traits and sports performance, while others focus on studying the differences in the mean values of traits between groups. In the studies by Mirzaei et al. (2013) and Sutin et al. (2016), traits are related to sports performance through statistical regression models, estimating the weight that each trait contributes to sports performance, and its statistical significance. There are mixed cases, such as the study by Goddard et al. (2019), where they used statistical regression to relate traits to the mental resilience in athletes, and then measure differences between groups through t-tests and Pearson correlations. Another approach to measuring these differences is through analysis of variance (Piepiora, 2021), a common test that, like the t-test, assumes that the studied variables follow a normal distribution.

The present study introduces a novelty in that, besides identifying a personality profile in mountain runners and

comparing them to the general population, it attempts to establish differences within the runners, according to the distance they run (ultra-distances or shorter), their stated motivations for running, and their sex. It also introduces a cluster analysis of the runners using different variables, to explore how theoretical categories proposed by the literature are reflected in the quantitative data.

Methodology

This study is conducted from a quantitative paradigm, which uses data collection and analysis to answer research questions and test previously elaborated hypothesis, using statistics to establish patterns of behavior in a given population (Hernández, Fernández & Baptista, 2014). A cross-sectional observational analytical study was conducted with the participants of a well-established trail and ultra-trail race in Santiago de Chile in 2019 (The North Face Endurance Challenge). The race offered distances of 10, 21, 50, 80 and 160 kilometers. For the purposes of this study, "Ultras" will be understood as runners who ran distances of 50 km, 80 km or 160 km in the race, while "Trail" will be understood as those who ran distances of 10 km or 21 km (these being, usually, entry categories to the practice of this sport).

Instruments

An online questionnaire with 50 questions, developed specifically for this study, was used, which included demographic data (sex, age, studies, job, borough, civil status, kids) and other closed and open questions to characterize the sports practice of the participants and their main motivation to participate (frequency of running, years running, distance that they will run in the race, favorite distance to run, if they belong to a running team, reasons to choose a race, their main motivation to start running, their main goal when participating in a race, changes they have experimented through running, products and services they consume related to running, role compatibility, difficulties they have found for running, what they enjoy the most about running in nature, among other questions). Additionally, the 60 questions NEO-FFI questionnaire for measuring personality traits (Costa & McCrae, 1992), with six facet scales for Neuroticism (N), Extraversion (E), Openness to Experience (O), Agreeableness (A) and Conscientiousness (C) domains, was administered online, being presented as optional for those answering the first questionnaire. Finally, the participants' results in the competition were recorded, using their relative position in the division to which they belonged.

The NEO Personality Inventory-Revised and its variations are questionnaire measures of a comprehensive model of general personality traits, the Five-Factor Model or Big Five. The validity of the scales is attested by over 2,000 articles, chapters, and books, and they have been correlated with scales from the Minnesota Multiphasic Personality Inventory, the Millon Clinical Multiaxial Inventory, the Personality Assessment Inventory, and the Basic Personality Inventory, with the Five-Factor Model having become the dominant model in personality psychology. When first published in 1985, the NEO Personality Inventory consisted of 180 items, with six facet scales for each of the domains, and four years later a short version, the NEO-FFI, with 60 items, was introduced, with a Spanish translation published in 1994 (Costa & McCrae, 2008). While there are no reported uses of the scale with Chilean population, the NEO-FFI has been validated in other latinamerican populations, such as Mexican (Meda Lara et al., 2015) and Peruvian (Martínez Uribe & Cassaretto Bardales, 2011). The test has been applied in sport participants, such as women who practice fitness activities where personality was not found to be a relevant variable for sport selection (Saraiva de Sousa et al., 2022), and gym users, where Conscientiousness was found to be related to a positive self-concept (Zagalaz et al., 2017).

Sample

A convenience sample was used, obtained from an open invitation sent via e-mail to runners registered in the competition. A total of 114 people responded to the personality questionnaire (corresponding to a response rate of 11%), 86 of them (60 men and 26 women) doing so completely, which are the cases used for the analyses reported below. The percentage of women in this sample, while inferior to men, overrepresents them in relation to the usual percentage of women in ultrarunning races (10-15%) (IAU, 2020).

A 42% of the runners participated in ultra-distances, and a 58% in shorter distances, in the race used to access them. Their average age was 36.8, they had started running an average of 5.5 years ago, 98% of them had a college or postgraduate degree. 54% of them lived in the north-east boroughs of Santiago, representing a high socioeconomic status. 70% of them ran 5 or more times a week, and 43% of them belonged to a running team.

This sample size would provide results with 95% of statistical significance and at least 75% of statistical power for all comparisons with an effect size over 0.21 according to Cohen's statistical power test (Cohen, 1988).

Hypotheses

As previous studies highlight mountain runners' appreciation for the meaning of life and natural landscapes as part of their motivations for engaging in the sport (Roberts et al., 2018; Wilson & Dishman, 2015; Davidson and Stebbins, 2011), it is expected that,

Mountain runners will show significantly higher scores than the general population on the trait of Openness to Experience (H1)

In addition, it is expected that, in line with the profiles of successful athletes in general according to the literature (Piepiora, 2021; Piedmont et al., 1999), that they will present high scores in Conscientiousness and low scores in Neuroticism, in relationship to the general population.

Mountain runners will show significantly higher scores than the general population on the trait of Conscientiousness (H2)

Mountain runners will show significantly lower scores than the general population on the trait of Neuroticism (H3)

Following what the existing literature shows about gender differences in personality traits in the general population and in athletes, with women having higher levels of Agreeableness and Neuroticism (Monasterio et al., 2018; Gyombert et al., 2015; Costa et al., 2001), it is expected that,

There will be significant differences between males and female runners in their personality profiles (H4)

Considering previous studies showing distinct profiles in ultrarunners compared to shorter distances runners (Goddard et al., 2019; Waśkiewicz et al., 2018; Hanson et al., 2015; Doppelmayr et al., 2004), it is expected that,

There will be significant differences between ultrarunners and runners of shorter distances in their personality profiles (H5)

These differences are projected to be intensified in the trait of Openness to Experience, which is expected to be higher in ultrarunners, for whom training and races involve more time alone in nature.

It is also expected that runners will present significant differences in their personality profiles according to their stated motivation for running, making it able to identify profiles for recreational and competitive runners (Groslambert et al., 2021).

There will be significant differences between runners declaring different motivations for running, in their personality profiles (H6)

Statistical Analysis

The data analysis is divided into three main sections. First, a descriptive statistical analysis is performed for the personality variables, as well as for race performance and demographic variables such as age, experience, and distance. For this analysis, the mean, standard deviation, as well as the maximum and minimum value reported in the total sample are calculated. Second, a test of means for independent samples is performed (Goddard et al 2019), comparing the mean values of different subsets of the population. Since the data is not normally distributed according to the Kolmogorov–Smirnov test (Goddard et al 2019), a Wilcoxon-Mann-Whitney test for mean ranks is performed instead of a t-test, because the former does not require the data to be normally distributed. As a result of this test, statistical significance is obtained for each comparison performed. Comparisons of the mean values obtained in the 5 personality traits are made between 1) the competitors of each distance in contrast with the general population; 2) the competitors who declare different motivations to participate in the event in contrast with the general population; 3) comparisons between different groups according to distances, sex and motivations. In the case of comparisons between motivations, in addition to personality traits, the means of absolute and relative performances obtained in the event are contrasted. Third and finally, a cluster analysis is performed to identify groups within the participants. For this analysis, personality variables, declared motivation to compete and relative performances are used, and following the observations of Groslambert et al. (2021) three groups are identified within the participants. For the clustering process, Gaussian mixed models are performed using the Kullback-Leibler similarity, as proposed by Van der Maaten and Hinton (2008) for dealing with codependent variables. As a result, three groups are obtained, where each subject belongs exclusively to one of them. For these groups, descriptive statistics are presented, in the same way as in the first section of the statistical analysis, and then the means of the personality and performance variables are contrasted between clusters, as described in the second section of the statistical analysis. Finally, a graphical analysis of the personality and performance variables by clusters is performed through box-and-whisker plots, which allow visualizing the data distributions for each variable and cluster combination. All statistical analysis are performed using the R statistical computing language.

Ethical Approval

This study was conducted as independent researchers at the time, and all subjects signed an Informed Consent online before accessing the questionnaire, as well as being provided contact information in case of any questions.

Transparency and Openness

We report how we determined our sample size, all data exclusions and all measures in the study, and we follow Journal Article Reporting standards.

All data analysis procedures were implemented using R programming language version 4.0.0 (R Core Team, 2020). This study's design and its analysis were not preregistered.

Results

Table 1 shows descriptive statistics of the sample, revealing the mean values of the five personality traits in the runners. Neuroticism, Agreeableness and Conscientiousness, are on average 14 points away from the mean of the population, defined by the NEO-FFI questionnaire at 50. It can be observed that, in all the personality variables, the range of scores covers most of the spectrum, with the maximum being close to 100 and the minimum close to 0. For all the personality variables, it can also be observed that the standard deviations are around 25 points, which reinforces the wide variability present in the sample.

Table 2 shows the differences between the means of each personality variable and the mean of the general population, which, by definition, is 50, as indicated above. In those cases where the value displayed is negative, it means that the value present in the sample of runners is lower than the general population. This analysis is performed for Trail runners, Ultras, and for the sum of both. It reveals

that, in the case of Neuroticism, Agreeableness and Conscientiousness, the differences are statistically significant for the three groups analyzed. In the case of Openness to Experience, differences are not significant for any group and, in the case of Extraversion, they are significant for Trail and total, obtaining values 10.1 and 7.9 points above the general population, respectively. The only difference between Trail and Ultra distances is evident in the case of the Extraversion dimension, where only in the case of shorter distances, is higher than in the general population.

Table 1.
Descriptive statistics of the sample

	Mean	Standard Deviation	Maximum	Minimum	Normality test p-value
Neuroticism	35,9	22,0	96,0	1,0	0,01 ***
Extraversion	57,9	27,6	99,0	2,0	0,00 ***
Openness	53,7	25,7	99,0	3,0	0,03 *
Agreeableness	35,9	23,6	98,0	1,0	0,00 ***
Conscientiousness	64,3	22,9	96,0	2,0	0,00 ***
Place in race %	46,5	25,3	95,8	4,2	0,04 **
Place in race	74,5	59,2	235,0	3,0	0,00 ***
Distance	46,3	46,2	160,0	10,0	0,00 ***
Age	37,3	9,0	61,0	18,0	0,08 *
Years of Experience	5,5	2,7	8,5	1,0	0,01 ***

Statistical significance: *** 99% - ** 95%- * 90%

Descriptive statistics of the variables used in the study. For all the numerical variables, the mean, standard deviation, maximum and minimum were calculated, considering the entire population with complete data. Also, a normality test was performed and all variables show a normal distribution with at least a 90% of statistical significance.

Table 2.
Comparison of runners against the parameters of the general population

	Trail	Ultras	All
Neuroticism	-15.2 ***	-12.3 **	-14.1 ***
Extraversion	10.1 **	4.6	7.9 **
Openness	3.9	3.3	3.7
Agreeableness	-16.1 ***	-11.2 **	-14.1 ***
Conscientiousness	16.2 ***	11.4 **	14.3 ***

Statistical significance: *** 99% - ** 95% - * 90%

Comparison of runners against the parameters of the general population. Trail corresponds to runners of distances 10 and 21 km; Ultra, are runners of 50, 80 and 160 km; and in All, both populations are grouped together. The values reflect the difference between the measurement of that group and the general population for the corresponding variable.

Table 3 shows the differences in personality variables of runners, according to their motivations to compete, compared to the general population. Those runners who seek to "Complete the distance" present statistically significant differences with the general population in almost all variables, except for Extraversion, with a notable difference of 15.9 points less than the general population in Neuroticism, and 17.1 points higher in Conscientiousness. On the other hand, those who only seek to "Participate in the event" do not present significant differences in any of the dimensions. In the case of those who seek to "Improve their time", differences are in line with those who seek to "Complete the distance", but are stronger in the Agreeableness dimension, with 17.5 points less than the general population, being the greatest difference for this group, followed by Neuroticism, with 13.7 points less than the general population. Regarding those who seek to "Place well", they present a different pattern, where the significant differences are in Agreeableness, with 26.1 points less than the general population; Extraversion, with 17.2 points more; and Conscientiousness, with 18 points more.

Table 3.
Comparison of personality traits between runners, separated by their main motivations when racing, and the general population

	Motivation			
	Participate	Complete the distance	Improve time	Place well
Neuroticism	-16.4	-15.9 ***	-13.7 ***	-6.7
Extraversion	15.3	5.2	6.2	17.2 *
Openness	6.3	8.3 *	2	-10.2
Agreeableness	-13.1	-8.4 **	-17.5 ***	-26.1 **
Conscientiousness	13.1	17.1 ***	9.7 **	18 *

Statistical significance: *** 99% -** 95%-* 90%

The values reflect the difference between the measurement of that group and the general population for the corresponding variable.

Table 4 shows comparisons between different groups of the sample defined by sex, distances, and motivations for participation. The values reflect the difference between the first group and the second, so if the values are negative, then the first group would have a lower mean than the second. It is noteworthy that, in the differences between sexes, women exhibit lower values for all personality variables, although only Agreeableness shows a statistically significant difference. Regarding the differences according to the distances they ran, it can be observed that there are no statistically significant differences in any of the personality variables. In the comparisons of the profiles defined by motivation, in addition to comparing personality variables, performance variables are compared. Few statistically significant differences can be seen at first glance, where the only difference between personality variables is between those who seek to "Complete the distance" and those who seek to "Place well", where the first group presents values 18.5 points higher in Openness and 17.7 points higher in Agreeableness. This comparison also shows that there are significant differences in absolute performance in the event, with the first group finishing on average 45 places behind the second. A significant difference in Agreeableness is also seen between those seeking to Complete the distance and improve their time, and a difference in performance between those seeking to "Improve their time" and those seeking to "Place well". In the latter group, the good results obtained in the race were aligned with their motivation, revealing an accurate self-perception.

Although significant differences appear in some crosses between motivations and personality traits, these do not allow to construct two clear profiles, if we group the motivations to "Participate" and "Complete the distance" as a more recreational category, and those of "Improve their time" and "Place well", as a more competitive category.

Table 4.
Comparison of personality traits between runners in different groups, contrasting separately for different distances, different sexes, and motivations

Group 1	Group 2	Neuroticism	Extraversion	Openness	Agreeableness	Conscientiousness	Place %	Place
Women	Men	-5.5	-7.6	-2.8	-11.8 **	-7.8	-	-
Trail	Ultra	-2.9	5.5	0.6	-4.9	4.8	-	-
Complete the distance	Improve time	-2.2	-1	6.3	9.2 *	7.5	-3.4	9
Complete the distance	Place well	-9.2	-12.1	18.5 *	17.7 **	-0.9	8.1	45.3 ***
Complete the distance	Participate	0.5	-10.1	2	4.8	4	6.3	2.4
Improve time	Place well	-7	-11.1	12.2	8.6	-8.3	11.5	36.3 *
Improve time	Participate	2.8	-9.1	-4.3	-4.4	-3.5	9.7	-6.5
Place well	Participate	9.8	1.9	-16.5	-13	4.9	-1.8	-42.9

Values reflect the difference between Group 1 and Group 2 measurements for the corresponding variable. Since running performances differ by distance and sex, only comparisons of these variables across motivations are included.

Table 5 shows the descriptive statistics of the groups obtained from the cluster analysis. The means of each variable are presented, together with their standard deviation. Cluster 2 obtains the best relative and absolute performances, followed by cluster 3 and then cluster 1. Regarding personality variables, clusters 1 and 2 are similar in Neuroticism and Conscientiousness, but there are large differences in Agreeableness and noticeable differences in Extraversion and Openness. Cluster 3 has means quite far from the values presented by the other clusters, being the highest group in Neuroticism, the lowest in Conscientiousness, Extraversion and Openness, and the lowest in Agreeableness together with cluster 1.

Table 5.
Descriptive statistics of the clusters obtained from the clustering analysis

	Cluster		
	1	2	3
# Participants	23	26	26
Place in race %	61.48	29.46 **	50.22 *
	(18.73)	(25.87)	(19.71)
Place in race	96.13 *	53 **	76.92 ***
	(61.05)	(53.27)	(57.67)
Neuroticism	30.65	30.19	46.38
	(16.8)	(17.05)	(26.78)
Extraversion	78.04 **	64.04	33.92 *
	(17.15)	(23.54)	(20.72)
Openness	60.61	65.42	35.81
	(27.13)	(21.85)	(17.64)
Agreeableness	26.52 **	55.62 ***	24.42
	(11.12)	(22.09)	(20.67)
Conscientiousness	76.91 *	73.12	44.23 *
	(15.46)	(16.49)	(20.75)
Statistical significance: *** 99% -** 95% -* 90%			

Each value represents the mean, and the standard deviation of this variable is reported in parentheses. Except for "Place in race", all other variables have a range between 1 and 100. A normality test was performed and the statistical significance is reported next to the mean values.

Table 6 shows the comparisons between means of the variables in each cluster contrasted with the other clusters. Between cluster 2 and cluster 3, all variables present statistically significant differences, where the largest differences are in Extraversion, Openness and Agreeableness, in line with what was observed in Table 6. The analysis shows that between clusters 1 and 3, despite having significant differences in almost all personality variables, except for Agreeableness, they do not present significant differences in sport performance. Finally, between clusters 1 and 2, differences can be seen in performance and in personality, particularly in the variables of Agreeableness and Extraversion.

Table 6.
Comparison of personality traits between runners from different clusters

Group 1	Cluster 1	Cluster 1	Cluster 2
Group 2	Cluster 2	Cluster 3	Cluster 3
Place in race %	32 ***	11.3	-20.8 ***
Place in race	43.1 ***	19.2	-23.9 *
Neuroticism	0.5	-15.7 **	-16.2 **
Extraversion	14 **	44.1 ***	30.1 ***
Openness	-4.8	24.8 ***	29.6 ***
Agreeableness	-29.1 ***	2.1	31.2 ***
Conscientiousness	3.8	32.7 ***	28.9 ***
Statistical significance: *** 99% - ** 95% - * 90%			

Values reflect the difference between the measurement of Cluster 1 and Cluster 2 for the corresponding variable. Since the absolute and relative measurements of running performances could vary by cluster, they are included in the analysis.

In Figure 1, the distributions of the personality and relative performance variables can be observed for each cluster. Distributions are consistent with the analysis of means, where those variables that were different in the analyses of Tables 6 and 7, show differences in the whole range of the distribution, and not only in the value of the means. Despite grouping the subjects in clusters, outliers can be observed in clusters 2 and 3, represented by dots in Figure 1, in all variables except Neuroticism.

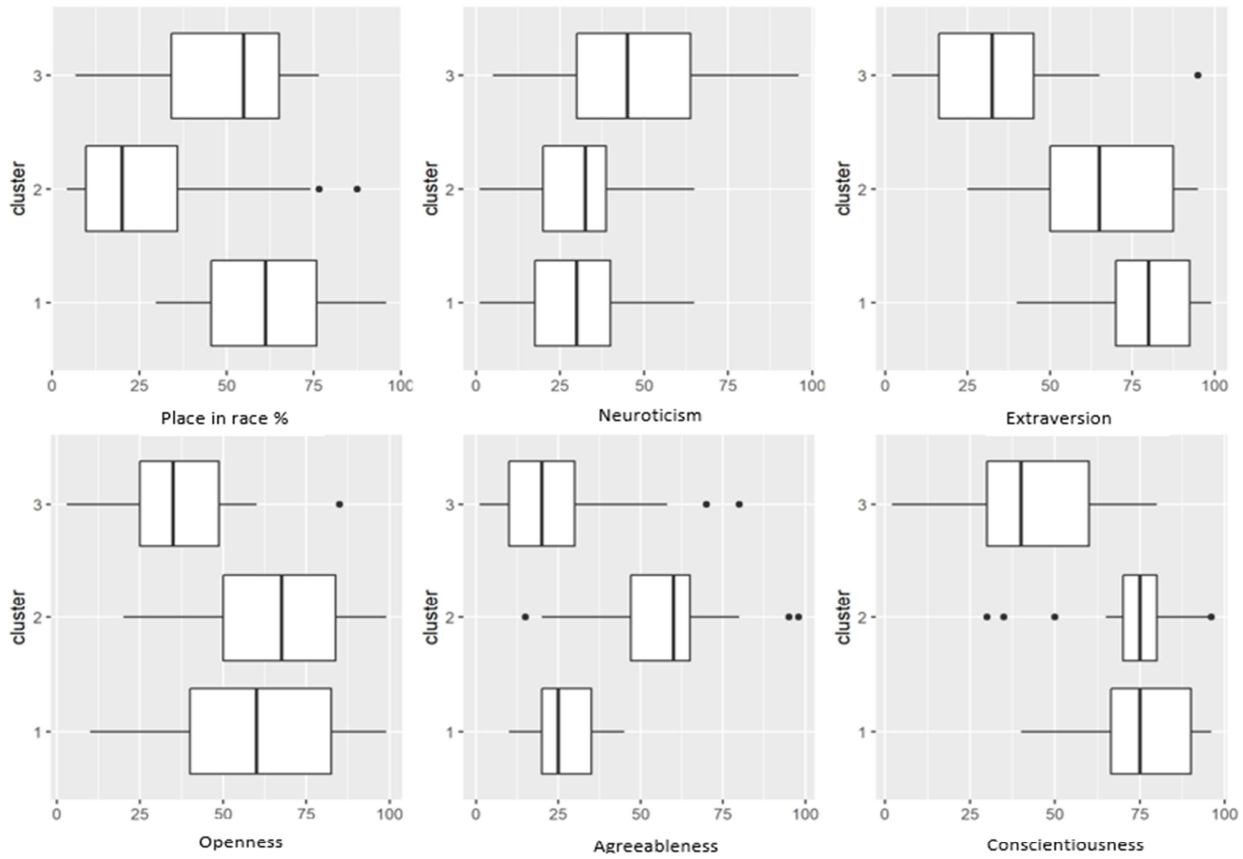

Figure 1. Distribution of personality variables and place in race (percentile) among the 3 clusters. The vertical axis represents clusters 1, 2 and 3 in ascending order, and the horizontal axis represents the indicated variable. The box plot represents the distribution of each variable in the corresponding cluster, where the box represents the range between the 25th and 75th percentile, the middle line represents the median and the whiskers on the graph represent up to 1.5 times the interquartile range. Points outside the whiskers are represented as dots and correspond to outliers.

While there is not a perfect fit of the identified groups with categories described by the literature, such as Hedonistic, Resilient and Competitive runners (Groslambert et al., 2021), it is possible to find some of these traits in the clusters obtained from the analysis: it is observed that the percentile in race performance is lower (a better result) in cluster 2, which would coincide with the fact that they show a typical profile of the successful athlete (lower Neuroticism and higher Conscientiousness), thus being close to the Competitive or result-oriented profile. However, their high Agreeableness with respect to clusters 1 and 3, does not fit with the typical profile of the competitive athlete, who tends to be less cooperative. Cluster 3, which shows higher rates of Neuroticism and low Extraversion and Openness, could be assimilated with the Resilient group of Groslambert et al. (2021), where the approach to sport would be less focused on pleasure, and signified as a way to overcome adverse events. Meanwhile, cluster 1, with low performance and high Extraversion and Openness, could coincide with a Hedonistic profile, open to trying different types of sports or competitions, since they would not be so focused on results, but on the social aspect and the pleasure of being in nature, present in the sport.

Discussion

Contrary to previous research on outdoor and extreme sports[2] and the popular discourse of mountain ultrarunners, the trait of Openness to Experience, linked to the aesthetic experience and ability to enjoy natural environments, an aspect that seems to be fundamental to this sport, did not show significant differences with respect to the general population. Thus, the first hypothesis (*Mountain runners will show significantly higher scores than the general population on the trait of Openness to Experience*) was not confirmed.

An explanation to this phenomenon could be that participants are only focused on the risk taking and sensation seeking aspect of Openness to Experience, rather than on the aesthetic experience of nature, thus not obtaining higher scores in this trait. Mountain running, while not involving such high level of risk as other extreme sports, involves exposure to the elements, requires some knowledge of how to act in the mountains, and subjects the body to levels of fatigue that constitute important tests of endurance. This orientation has been reported in elite downhill cyclists studied by Hagen (2013), who found that

[2] Davidson & Stebbins, 2011; Wilson & Dishman, 2015; Roberts et al., 2018

they did not declare benefits related to in the natural environments, but felt connected to certain trails or obstacles. When analyzing the dimension of Openness to Experience in relation to the motivation for practicing the sport, some patterns emerged, where those who practice the sport seeking to Complete the distance presented higher levels of Openness with respect to the general population, far above those motivated by Placing well. Thus, it could also be possible that there are mountain runners who are more attracted by the competitive aspect or the physical challenge, than by the connection with nature involved in the practice of this sport, which would align with the profiles proposed by Groslambert et al (2021).

Another possible explanation for this finding, stems from the transformation of outdoor sports through the cooptation of these disciplines by the market, which has made the practice more common and sheltered, expanding the type of population that engage in it. While the history of outdoor disciplines, including that of ultrarunning, is linked to counterculture and a rebellious attitude towards traditional imperatives (which would be expected to be related to a greater Openness to Experience), nowadays, as Poulson (2016) states,

The expansion of adventure sport is probably less about resistance to corporate sport— as some participants claim it is—and more of a continuing expansion of the disciplinary power identified by Foucault into more areas of our lives. (…) In effect, many people once entered the wilderness to get lost, to ramble, to be overwhelmed by the extraordinary sights they encountered. Currently, adventure sport often seems less about experiencing awe than imposing people's will upon an outdoor landscape. (p. 20)

Coinciding with the literature (Piedmont et al.,1999; Piepiora, 2021), where the aspect that has been most related to good sport performance is Conscientiousness, the runners in the sample were significantly above the general population in this trait, both in the case of Trail and Ultra distances; on the other hand, the low levels of Neuroticism in both the Trail and Ultra populations also coincide with previous studies showing that athletes in general tend to present lower levels in this dimension, a trait that has been correlated with good sports results. With these results, hypothesis number two (*Mountain runners will show significantly higher scores than the general population on the trait of Conscientiousness*) and three (*Mountain runners will show significantly lower scores than the general population on the trait of Neuroticism*) were confirmed.

Agreeableness presented significant differences with the normal population, being lower both in the case of Trail and Ultra distances, which could be reflecting a more direct style, which coincides with the image of toughness that characterizes the sport. The fact that it is an individual sport, could make it more attractive to those who are not interested in cooperation, which is part of this dimension of personality. These results contradict previous findings (Sutin et al., 2016; Kajtna et al., 2014), that found no significant differences with the general population in this dimension.

Regarding Extraversion, although the runners of short distances are above the general population in this trait, this does not include the runners of ultra-distances. This allows postulating that for those who choose to run longer distances, which usually involve spending more time alone during training and competitions (and who often report enjoying the solitude and silence of the mountain), the social aspect of the sport is not as relevant as the performance or challenge orientation (being the social aspect something that is usually highlighted by those who are just starting to run, as part of their motivations). Given that this is the only difference identified between runners of shorter and ultra-distances, hypothesis number five (*There will be significant differences between ultrarunners and runners of shorter distances in their personality profiles*) cannot be confirmed, because when directly comparing both groups, they do not show significant differences in any of the personality traits.

The fact that there were few significant gender differences among the runners contravenes the stereotypes that exist regarding the characteristics that would differentiate men and women, where it has been reported that men would be more competitive or take more risks in the sporting arena (Frick, 2011; 2021).

Counterintuitively, the only personality trait with significant differences between male and female runners was Agreeableness, where women exhibited lower values than men, even though in the normal population this trait is usually higher in women (Gyombert et al., 2015). This could be explained in terms of self-selection, where women who decide to practice a sport where most of the participants are men and where athletes are characterized by their toughness, would be more similar to men in terms of this trait. Although this study focuses on personality traits, which are more permanent and genetically determined characteristics, it opens research possibilities regarding gender differences in sport, and how sport environments could drive women to exacerbate traits that are related to competitiveness, as a way to prove their toughness in a sport where they are assumed to be weaker.

Consequently, hypothesis number four (*There will be significant differences between males and female runners in their personality profiles*) was only partially confirmed.

Regarding hypothesis number six (*There will be significant differences between runners declaring different motivations for running, in their personality profiles*), it was only partially confirmed: while some significant differences appeared between some of the competitive (Place well) and recreational categories (Complete the distance), with the latter being higher in Openness to Experience and Agreeableness —which allow characterizing this group as more focused on enjoying the experience than on performance (which is also shown in their lower performance in the race) —, it did not allow identifying clear profiles between both of the recreational categories (Participate/Complete the dis-

tance) and both of the competitive categories (Improve time/Place well).

As for the clustering, while it did not yield distinct profiles for each of the groups, it outlined the potential of statistical cluster analyses to identify different types of athletes, including recreational and competitive groups. This could be replicated both in other sports and in larger samples, using a better estimate of their historical performance outcomes (since this study used performance in a single competition), to reach more refined conclusions. Future research could allow for a comprehensive calibration to relate personality traits to the runner profiles described in the literature.

Although further research with these athletes is necessary to have more conclusive results regarding the personality profile of mountain runners in general, as well as to determine if there are significant differences depending on the distances they choose to run or their sex, it is possible to outline that mountain runners present a personality profile that distinguishes them from the general population, where significant differences appear in the traits that the literature has identified as the most influential in sports performance: Neuroticism and Conscientiousness.

This corresponds with what is possible to observe at an informal level in this subculture, where participants describe setting high goals (generally equated to participation in a given sporting event and distance), rigorous planning/fulfillment of training to meet them, and report discipline as one of the main positive changes that running has brought them, accounting for the trait of Conscientiousness.

It is also possible to hypothesize that, in the subjection to difficult and stressful challenges such as races (especially long-distance races, where there is a high probability of something going wrong and having to recover quickly to continue running), low Neuroticism is a necessary trait, since high rates could interfere with sports performance and/or make participation in competitions not enjoyable.

Limitations

Given that the sample corresponds to runners who had registered for a major race in terms of distance, cost, and popularity, and who chose to participate voluntarily by responding to an e-mail, it is possible to assume that their levels of involvement in the sport may be higher than the general population of runners and that, therefore, they may have a personality profile that distinguishes them from the larger group. Because of the use of this sporting event as a way of accessing the runners, there is also a social class and educational level bias involved in the sample (with 98% of the runners having an undergraduate or graduate degree), although international statistics show that the universe of ultra-distance runners is already a privileged group in economic and educational terms.

The parameters for each personality trait have been established for the general population by the NEO-FFI test, but these are not specific to the Chilean population nor the population of runners or ultrarunners, so this assessment has an exploratory character.

Another limitation of the present study is the sample size of n=86, which may limit our ability to generalize our results, but still allowed for statistical analysis with sufficient validity. Despite this limitation, the results obtained in this study provide valuable information on the personality of runners and are a starting point for future studies which can assess larger samples, as well as validate the NEO-FFI test for the general Chilean population. Non-parametric tests were used since they are less sensitive to sample size, compared to parametric tests, so a larger sample size will allow to use more robust statistical tools for data analysis.

Conclusions

In general, it can be concluded, as stated in the title of this study, that ultrarunners, despite their claims of going against the grain and appreciating the poetry of being immersed in nature, are "not so rebel after all", at least when it comes to their personality traits, showing a tendency to be disciplined, competitive, traditional, and pragmatic. The assertion of standing outside the mainstream is in conflict both with the runners' personalities profiles and the cooptation of outdoor sports by the logics of the market and individualism.

This study contributes to the endurance sports field administering a personality questionnaire that has been used in different populations of athletes, in a group about which there is not much information: that of ultradistance mountain runners. This group may be of interest for Sport Psychology, since it is one of the fastest growing endurance sports in recent times, making it possible to establish connections between the predominant traits in these runners and the zeitgeist of self-management that characterizes us today, which involves not only the work environment, but also hobbies and sport, so that it becomes laudable to set difficult goals (easily recognizable in running extremely long distances on difficult mountain routes) and to be highly disciplined in order to achieve them. If being a good athlete is one of the new demands of these times, it is possible to outline that those who have the personality profile described in this study would be more capable of achieving it (or, at least, would be more attracted to this sport and the challenges it involves).

Knowing the personality profile of athletes could have practical applications for organizing the training of runners, as well as preventing negative consequences when these traits can be associated with unhealthy behaviors. For example, knowing that these athletes tend to have high Conscientiousness, should be associated with monitoring of obsessive attitudes and behaviors in runners by those in positions of responsibility, such as Sports Psychologists and Coaches, so that runners can maintain a balance between their sports involvement and other vital areas, without

incurring in disordered eating behaviors, use of steroids or other illegal substances to improve performance, or overtraining and addiction to the sport. This information would also be relevant to include in the initial training of professionals, including Physical Education Teachers, Psychologists, Physical Therapists, Nutritionists, and others, so that they consider how psychological aspects, including personality dispositions, can influence the approach to sport of those who practice it, what sports they choose, what their strengths and weaknesses tend to be, and their sport performance.

For those who work in marketing of sporting events, it may be useful to know that the aspect related to landscapes and natural environment may not be the most important for runners, at least, from their character predisposition. Thus, appealing to aspects such as the difficulty of the challenge, the temperance required to participate in it, or the arduous training it demands, could be more effective strategies.

As for the absence of gender differences in mountain runners, this information may be of relevance for professionals working with male and female athletes, so that they do not establish arbitrary differences based on prejudices and stereotypes and provide equal opportunities for sport development.

Future development of running technology to measure and register performance, together with the use of quantitative tools to characterize the profiles of endurance athletes, can allow systematizing information from running populations for future studies, providing a standard for carrying out this type of analysis, as well as reducing the costs of working with data. This could allow for increasingly larger studies to be undertaken, making it possible to replicate this study with a larger population using running apps such as Strava, which can provide data from training and races performance, to establish a more accurate relationship between performance and personality traits.

Further exploration of possible clusters or profiles within runners could be conducted, to better establish how recreational and competitive runners approach the sport, which could prove useful for coaches working with these different populations.

Given that many of these runners train in groups or with coaches, experimental approaches could be performed with different training conditions or coaching styles, exploring if they work better with certain personality profiles.

The knowledge obtained from this study can act as a valuable input for high performance sport programs and policies, which are still in their infancy in Chile regarding the sport of trail running, with previous attempts to form a Trail Running Federation that have not succeeded. Consolidating a research field around the sport can act as a way of making it more visible, identifying the challenges that it faces and providing suggestions for the trail ahead. Likewise, research that shows the motivations of ultrarunners and the perceived benefits of their practice, can provide clues to develop programs that effectively promote physical activity, addressing the prevailing sedentarism and obesity levels in our population.

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