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ORIGINAL ARTICLE

Exercise Addiction in Competitive Amateur Runners

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Abstract
Running has gained many devotees over recent decades, thanks to its capacity to maintain and improve health, however, the accessibility and certain characteristics of this pursuit can facilitate the appearance of some negative health consequences. Nowadays, running is one of the most popular amateur sports, but it is thought that excessive running encourages the appearance of addictive behaviours and other health problems. The aim of this study was to analyse the risk of exercise addiction amongst runners, investigating the influence of variables like age, sex, distance, and performance. The Spanish version of the *Running Addiction Scale* (RAS-8) was administrated to a sample composed of 513 Spanish amateur long-distance runners, between the ages of 18 and 64. Overall, results showed that competitive amateur runners in our sample had a low risk of addiction, although age, level of performance, and training variables such as the average number of kilometres run per week, length of training sessions, and number of training days per week were statistically significant risk factors. It is hoped that this research will help the development of more efficient strategies to prevent and control addictive behaviours amongst amateur runners.

Keywords Long-distance runners · Sport · Age · Sex · Addiction

Engagement in regular physical activity at a moderate intensity has undeniable health benefits in terms of physical, mental, and social wellbeing. The study of these benefits has been the focus of several specialists in an attempt to understand the dose-response relationship, that is to say the frequency, intensity and duration of activity required to obtain the maximum possible benefit (Nogueira et al., 2017).

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Exercise addiction refers to physical activity undertaken to an excessive and uncontrolled degree such that it becomes the sole focus of life and causes definitive adverse effects on the physical and mental health of affected people (Goodman, 1990, 2008; Kovacsik et al., 2018).

The term *addiction* entered into the scientific literature in association with physical exercise and sport through Glasser's research (1976) which referred to a *positive addiction* as the aforementioned positive dose-response relationship between exercise and health (Berczik et al., 2012; Márquez & de la Vega, 2015). A short time later, Morgan (1979) suggested *negative addiction*, in reference to the practice of excessive physical exercise and its multiple negative effects including physiological (increased risk of injuries), psychological (significant alterations in personal behaviour), and social (problems with family, human interactions, employment) (Berczik et al., 2014; Landolfi, 2013). Hausenblas and Downs (2002a, 2002b) referred to this behaviour as a multidimensional, maladaptive pattern that leads to a disability or illness of clinical significance manifested in the presence of at least three of the seven diagnostic criteria listed in the Diagnostic and Statistical Manual of Mental Disorders DSM-IV (American Psychiatric Association, 1994).

As with other addictive behaviours, people who may be at risk of exercise addiction are likely to suffer from frequent episodes where they are unable to control their behaviour. This could be because of the pleasure that they obtain from engaging in that activity regardless of the negative consequences (Berczik et al., 2012; Sellman, 2016), or because this behaviour helps them cope with daily life stress, even if it does not bring them any other pleasure (Baumeister & Nadal, 2017).

Exercise addiction is possibly unique in the spectrum of behavioural and chemical addictions (Szabo et al., 2018). Frequently it entails undertaking strenuous physical effort (work) to achieve gratification (not immediate) that can often put at risk an individual's heath (Rendi et al., 2007).

The relationship between addiction and sports context has been studied in a variety of sports, including football, fitness, martial arts and endurance sports (Grima et al., 2021; Lichtenstein et al., 2014; Sachs & Pargman, 1984; Orhan et al., 2019; Sicilia & González-Cutre, 2011; Sancho et al., 2019; Szabo & Griffiths, 2007; Valenzuela & Arriba-Palomero, 2017). However, endurance sports have generated the most interest recently, largely motivated by the growing popularity of amateur running (Grima et al., 2019; Nogueira et al., 2018; Nogueira et al., 2019).

The first explicit reference to running addiction comes from Sachs and Pargman (1984). These authors described a set of withdrawal symptoms suffered by runners during periods of abstinence (understood as the phases of time in which behaviour likely to become addictive did not manifest itself). Amongst the variables studied in relation to levels of addiction risk were age (Berczik et al., 2012; Cabrita et al., 2018; Grima et al., 2019; Lichtenstein, et al., 2014), sex (Cunningham et al., 2016; Kovacsik et al., 2018; Magee et al., 2016) and parameters related to a training program, (kilometres run, weekly training sessions, running pace and personal bests). Over the years, it has become apparent that one of the major problems in this field has been the lack of knowledge about individual differences in the symptoms of exercise addiction and how to assess them (Magee et al., 2016). Szabo et al. (2016) proposed a progressive quantification involving a ten-point *Likert* scale to make it easier to understandaddiction levels, due to the evolving nature of exercise addiction. However, the most of the studies, using different scales, categorise the risk of exercise addiction in three levels (low, moderate and high) to analyse individual differences according to a

symptomology of exercise addiction (Cook et al., 2013a; McNamara & McCabe, 2012; Youngman & Simpson, 2014).

Chapman and De Castro (1990) developed a running-specific tool to assess the risk of addiction, The Running Addiction Scale (RAS). In a sample of marathon runners, Rudy and Estok (1990) used this scale to analyse the effect of addictive behaviours on daily responsibilities, stating [concluding?] that running consumes time and energy. Aidman and Woollard (2003) examined the association between a day's deprivation of training and competitive runners' perception of exercise addiction level, as well as with their emotional and physiological responses. The study found that the exercise-deprivation group showed significant symptoms of withdrawal, depressed mood, reduced vigour, and increased tension, anger, fatigue, and confusion. Smith et al. (2010) analysed the differences in exercise addiction levels and [physical social anxiety*] between competitive and noncompetitive runners. They found that the competitive runners scored significantly higher on risk of exercise addiction. Sancho and Ruiz-Juan (2011) developed a Spanish version of the scale to determine addiction levels displayed by marathon runners, proposing four addiction risk levels (minimal, low, high, and maximum). One year later, Ruiz-Juan and Zarauz (2012), using this scale, found that men with higher scores ran more kilometres and spent more days and hours training per week.

Different studies developed other scales to assess runners' behaviours, such as the *Exercise Dependency Scale* (Hausenblas & Downs, 2002b). Those studies found that withdrawal* or increase in the amount of exercise in amateur runners may be due to the relevance of the context in which the exercise is performed and to other variables, such as loneliness and anxiety (Cook et al., 2013a; Lukács et al., 2019; Zandonai et al., 2020). The focus of our study is on the risk of exercise addiction in Spanish competitive amateur runners. More specifically, it investigates the influence of variables such as age, sex, distance run and performance level on risk of addiction. Hence, the overarching hypothesis is that competitive amateur runners who show a greater dedication to running (more days of training, more hours of training, etc.) and who had better times, will have a higher risk of addiction.

Method

Participants

The sample consisted of 514 competitive amateur Spanish runners between 18 and 64 years old (M= 38; SD = 8.759), of whom 107 (20.8%) were female and 407 (79.2%) were male (Table 1). Amateur runners were considered those engaged in running as a recreational activity and who did not receive material benefits for participating in nonprofessional sports. The inclusion criteria were that participants should be 18 years or older, Spanish, training at least three days a week and participating regularly in long distance competitions (10 km, 21 km and 42 km) (Table 2).

Measures

An *ad hoc* questionnaire of 23 items was developed to collect personal and sporting data about participants, along with additional information such as details about training habits and performance. The sociodemographic variables were age, sex, educational level, employment situation, club-membership, civil status, parenthood and the most important reason to start

Table 1 Main characteristics of the sample (frequency, percentage, mean and standard deviation)

		Min		Low		High		Max		Total			
		N	%	N	%	N	%	N	%	N	%	Mean	SD
Sex	Men	149	76.8	134	78.8	84	82.4	40	83.3	407	79.2		
	Women	45	23.2	36	21.2	18	17.6	8	16.7	107	20.8		
Age	≤ 36	86	44.3	55	32.4	30	29.4	14	29.2	185	36.0	38.29	8.75
	36-55	98	50.5	109	64.1	68	66.7	32	66.7	307	59.7		
	≥ 56	10	5.2	6	3.5	4	3.9	2	4.2	22	4.3		
Club-membership	Yes	85	43.8	90	52.9	50	49.0	34	70.8	259	50.4		
	No	109	56.2	80	47.1	52	51.0	14	29.2	255	49.6		
Civil Status	Single	88	45.4	67	39.4	33	32.4	17	35.4	205	39.9		
	Married	84	43.3	83	48.8	51	50.0	23	47.9	241	46.9		
	Divorced	8	4.1	4	2.4	6	5.9	3	6.3	21	4.1		
	Common Law Partner	14	7.2	16	9.4	12	11.8	5	10.4	47	9.1		
Parenthood	Yes	84	43.3	85	50	54	52.9	23	47.9	246	47.9		
	No	110	56.7	85	50	48	47.1	25	52.1	268	52.1		
Employment Situation	Study	25	12.9	17	10	5	4.9	3	6.3	50	9.7		
	Employed	153	78.9	146	85.9	91	89.2	39	81.3	429	83.5		
	Unemployed	12	6.2	5	2.9	4	3.9	5	10.4	26	5.1		
	Retired	4	2.1	2	1.2	2	2.0	1	2.1	9	1.8		
Reasons to start running	Healthy	134	69.1	134	78.8	77	75.7	37	77.1	382	74.3		
	Cheap Sport	37	19.1	23	13.5	12	11.8	6	12.5	78	15.2		
	Social	3	1.5	1	0.6	1	1.0			5	1.0		
	Personal Goals	3	1.5	1	0.6	3	2.9	4	8.3	11	7.4		
	Others	17	8.8	11	6.5	9	8.8	1	2.1	38	2.1		
Running expertise years	< 5 years	92	47.4	59	34.7	45	44.1	13	27.1	209	40.7		
	Between 5-10 years	40	20.6	56	32.9	27	26.5	19	39.6	142	27.6		
	More 10 years	62	32.0	55	32.4	30	29.4	16	33.3	163	31.7		
Duration of training session	< 60’	73	37.6	72	42.4	18	17.6	10	20.8	135	26.3		
	60-90’	116	59.8	64	37.6	79	77.5	32	66.7	356	69.3		
	>90’	5	2.6	34	20.0	5	4.9	6	12.5	23	4.5		
Km/week	≤ 55	160	82.5	118	69.4	66	64.7	26	54.2	370	73.0	43.31	22.26
	56-85	31	16.0	48	28.2	29	28.4	15	31.3	123	23.9		

Table 1 (continued)

		Min		Low		High		Max		Total			
		N	%	N	%	N	%	N	%	N	%	Mean	SD
	≥86	3	1.5	4	2.4	7	6.9	7	14.6	21	4.1		
Training frequency/week	≤ 3	117	60.3	67	39.4	27	26.5	8	16.7	219	42.6	3.89	1.28
	4-5	65	33.5	81	47.6	58	56.9	24	50.0	228	44.4		
	6-7	12	6.2	22	12.9	17	16.7	16	33.3	67	13.0		
Date of first race	< 5 years	106	54.7	81	47.7	51	50.0	19	39.6	257	50.0		
	Between 5-10 years	40	20.6	43	25.3	27	26.5	18	37.5	128	24.9		
	More 10 years	48	24.7	46	27.1	24	23.5	11	22.9	129	25.1		
Distance of first race	10km	162	83.5	151	88.9	87	85.3	37	77.1	437	85.0		
	21km	29	14.9	18	10.6	13	12.7	10	20.8	70	13.6		
	42km	3	1.5	1	.6	2	2.0	1	2.1	7	1.4		
Usual Distance	10km	122	62.9	92	54.1	50	49.0	21	43.8	285	55.5		
	21km	53	27.3	59	34.7	38	37.3	11	22.9	161	31.3		
	42km	19	9.8	19	11.2	14	13.7	16	33.3	68	13.2		
Best 10km	No answer	12	6.2	10	5.9	3	2.9	1	2.1	20	3.9		
	< 35’	13	6.7	6	3.5	6	5.9	6	12.5	31	6.0		
	35’- 39’59”	27	13.9	46	27.1	30	29.4	10	20.8	113	22.0		
	> 40’	142	73.2	114	67.1	63	61.8	31	64.6	350	68.1		
Best 21km	No answer	38	19.6	24	14.1	12	11.8	5	10.4	79	15.4		
	< 1h20’	8	4.1	7	4.1	9	8.8	8	16.7	32	6.2		
	1h20’- 1h29’59”	31	16.0	38	22.4	25	24.5	9	18.8	103	20.0		
	> 1h30’	117	60.3	101	59.4	56	54.9	26	54.2	300	58.4		
Best 42km	No answer	95	49.0	71	41.8	35	34.3	14	29.2	215	41.8		
	< 2h45’	2	1.0	4	2.4	4	3.9	5	10.4	15	2,9		
	2h45’- 3h14’59”	20	10.3	28	16.5	18	17.6	6	12.5	72	14.0		
	> 3h15’	77	39.7	67	39.4	45	44.1	23	47.9	212	41.2		
Additional Gym Attendance	Yes	142	73.2	129	75.9	66	64.7	40	83.3	377	73.3		
	No	52	26.8	41	24.1	36	35.3	8	16.7	137	36.7		

Table 2 Mean rank (Md) and Kruskal-Wallis' H and significant levels of the main characteristics of the sample

		Md	H	p
Age	≤ 36	232.92	9.89	.007**
	36-55	273.52		
	> 56	240.68		
Club-membership	Yes	273.72	6.91	.009**
	No	241.02		
Running expertise years	< 5 years	241.79	7.01	.030*
	Between 5-10 years	282.32		
	More 10 years	256.02		
Duration of training session	< 60'	214.85	20.06	.000***
	60-90'	269.34		
	>90'	324.54		
Km/week	<= 55	238.38	26.05	.000***
	56-85	289.20		
	>= 86	376.17		
Training frequency/week	<= 3	206.74	55.28	.000***
	4-5	284.42		
	6-7	331.80		
Usual Distance	10km	232.94	10.98	.004**
	21km	253.92		
	42km	292.91		
Best 10km	< 35'	257.95	7.74	.021*
	35'- 39'59"	277.29		
	> 40'	236.96		
Best 21km	< 1h20'	271.06	8.97	.011*
	1h20'- 1h 29'59"	228.82		
	> 1h30'	208.63		
Best 42km	< 2h45'	202.43	6.88	.032*
	2h45'- 3h 14'59"	153.38		
	> 3h15'	145.14		

running. Training and performance variables included the average of kilometres run per week, duration of training sessions, number of training days per week, running expertise years, date of first race, distance of first race , usual distance, personal bests, and additional gym attendance.

The Running Addiction Scale (RAS-8)

The Running Addiction Scale (RAS) was designed by Chapman and De Castro (1990) and was composed of 11 items aimed at assessing addiction to exercise and running. Using a Likert scale from 1 (*strongly disagree*) to 5 (*strongly agree*), participants registered their responses to statements such as: "*I wouldn't change arrangements with friends in order to run*"; or "*I feel I have to run at least once a day*". Responses to the 11 items were summed, creating an RAS with values ranging from 11 to 55. The RAS had a Cronbach α=.82 indicating adequate internal consistency (Chapman & De Castro, 1990).

The Spanish version of the scale RAS-8 was developed by Sancho and Ruiz-Juan (2011). The number of items was reduced to eight and scoring was done on a seven-pointed Likert scale, with values ranging from 1: (*strongly disagree*) to 7: (*strongly agree*). In order to combine the scores from all items, it was necessary to invert the response values for items 1, 2, 3, and 4. For the score's interpretation, the scale items mean must be used. The psychometric

properties of the scale adapted by Ruiz-Juan and Sancho (2012) were acceptable, showing an internal consistency (Cronbach α = .84) and goodness of fit values obtained similar to the original version once confirmatory factor analysis was completed (χ^2/df = 4.07; GFI = .88; IFI = .9; CFI = .9; TLI = .88; SRMR = .05; RM- SEA = .07).

Procedure

Data collection was carried out between March and October 2017 during several running events of distances from 10 km to 42 km held in Spain and involving the participation of competitive amateur runners. Questionnaires were presented in paper format to the participants during the collection of bib numbers, which takes place between two days and two hours before the competition. Prior to administering questionnaires, all participants were asked to give informed consent in observance of data confidentiality (Law 15/1999, of 13th December, concerning the protection of personal data), and advised that data would be published in an online open access format. This research was developed according to the Ethical Guidelines of the University of León (Spain) and the Declaration of Helsinki (World Medical Association, 2014).

Statistical Analyses

An observational descriptive study was carried out in order to find differences between those runners with the highest and lowest scores on the RAS-8. Descriptive analyses (mean and standard deviation) were performed to characterise the sample. Kolmogorov-Smirnov tests for skewness and kurtosis confirmed the non-normality of the sample distribution, so that an inter-group comparative analysis was completed using *Krushkal Wallis test* as appropriate for each of the different independent variables. Level of statistical significance was $p<.05$. A *Cohen's d* (Cohen, 1988; Fritz et al., 2012) effect size was then calculated where, a value of *d* that was lower than .2 indicated no effect; *d* from .2 to .4 equated to a small effect size; *d* from .5 to .7 equated to a medium or moderate effect size; and values from .8 corresponded to a large or high effect size. Finally, crosstab analyses and *Pearson chi-square test* were performed to evaluate the relationships between levels of addiction risk and other variables of interest. The software used to perform the analyses was the SPSS 26.0 (Statistical Package for Social Sciences; IBM, Armonk, NY, USA).

Table 3 Effect Size (d de Cohen) to significance variables

	Eta squared (n^2)	d de Cohen	Effect size
Age	.015	.251	Small effect
Club-membership	.012	.216	Small effect
Running expertise years	.010	.199	No effect
Duration of training session	.035	.383	Small effect
Km/week	.047	.444	Medium effect
Training frequency/week	.104	.682	Medium effect
Usual Distance	.018	.268	Small effect
Best 10km	.011	.213	Small effect
Best 21km	.014	.235	Small effect
Best 42km	.010	.196	No effect

Results

To study the differences in levels of addiction risk amongst runners as measured by their scores on the RAS-8, we performed a quartile-based categorisation similar to the approach used by by Ruiz-Juan and Zarauz (2012): *minimum addiction risk* (≤4.37), *low* (4.37-4.99), *high* (5.00-5.62) and *maximum addiction risk* (≥5.62).

The total sample mean of the RAS-8 score was 4.57 (SD=.84), with males having a mean of 4.60 (SD=.84) and females a mean of 4.43 (SD=.84). That difference is not significant. showing no significant differences ($p \geq .05$).

Our sample consisted of competitive amateur runners most of whom were middle-aged males who run between 3 and 5 days a week for 60 to 90 minutes per day. Their weekly distances were around 50 km. These runners considered this activity as a good way to take care of their health. The data indicated that participants preferred 10 km as the running distance for training and competition.

According to RAS-8 categorization, the sample showed minimal levels of risk of addiction, with 70% of the participants showing either minimum (37%) or low (33%) risk levels. Only 9% of the runners showed a maximum risk of addiction. Differences between runners at minimum and maximum risk were mainly observed for the variables club-membership, number of training days per week, and additional gym attendance. Runners with a minimum addiction risk generally do not belong to a club, run fewer than three days per week, and don't have extra practice at the gym. Participants with maximum addiction risk normally belong to a club, train between 4and 5 days per week, and regularly go to a gym.

Comparative analysis of the differences between groups using the Kruskal-Wallis test for the independent variables showed significant differences for age (H=9.89, p=.007), club-membership (H=6.91, p=.006), running expertise years (H=7.01, p=.030), length of training sessions (H=20.06, p=.000), usual distance (H=10.98, p=.004), kilometres run per week (H=26.05, p=.000), number of training days per week (H=55.28, p=.000), and personal best

Table 4 Crosstab analysis from combining usual distance and levels of addiction risk (chi squared, X^2, and significance level)

	10 km		21 km		42 km		Total	
	X^2	p	X^2	p	X^2	p	X^2	p
Sex	2.12	.546	1.89	.594	1.63	.652	1.80	.614
Age	8.27	.218	5.44	.488	3.26	.352	11.33	.078
Club-membership	8.40	.038*	.314	.957	3.39	.335	11.89	.008**
Civil Status	7.73	.562	7.47	.588	1.93	.993	8.30	.503
Parenthood	3.05	.384	3.25	.355	3.88	.274	2.98	.394
Employment Situation	10.40	.319	6.87	.650	5.74	.765	11.54	.240
Running expertise years	9.81	.133	7.50	.277	3.15	.789	14.09	.029*
Duration of training session	19.81	.003*	16.56	.011**	4.28	.638	28.68	.000***
Km/week	29.93	.008**	14.72	.099	9.43	.396	41.77	.000***
Training frequency/week	28.02	.000***	17.61	.007**	13.65	.034*	61.18	.000***
Date of first race	6.25	.181	8.29	.218	4.47	.613	6.69	.350
Distance of first race	7.07	.314	1.60	.657	5.38	.496	11.74	.228
Best 10km	9.59	.384	7.55	.272	7.45	.589	21.31	.011*
Best 21km	17.46	.042*	2.46	.982	8.43	.491	19.76	.019*
Best 42km	11.56	.239	10.52	.309	12.56	.183	22.38	.008**
Additional Gym Attendance	11.23	.011*	2.82	.419	4.52	.210	6.90	.075

Table 5 Crosstab analysis (%) combining usual running distance and levels of addiction risk (sociodemographic and performance variables)

		10 km					21 km					42 km				
		Min	Low	High	Max	Tot	Min	Low	High	Max	Tot	Min	Low	High	Max	Tot
Sex	Men	29.3	26.3	15.8	6.0	72.9	28.6	31.1	18.0	5.6	83.2	25.0	26.5	20.6	22.1	94.1
	Women	12.4	9.4	3.4	1.9	27.1	4.3	5.6	5.6	1.2	16.8	2.9	1.5	0.0	1.5	5.9
Age	≤36	20.3	12.0	5.6	2.6	40.6	12.4	8.1	5.6	2.5	28.6	4.4	10.3	7.4	4.4	26.5
	36-55	18.4	19.5	11.3	4.9	54.1	19.9	26.7	16.8	3.7	67.1	23.5	17.6	13.2	19.1	73.5
	> 56	3.0	1.1	0.8	0.4	5.3	0.6	1.9	1.2	0.6	4.3	2.9	1.5	4.4	4.4	13.3
Club-membership	Yes	17.3	17.3	7.1	5.6	47.4	16.8	20.5	13.0	3.7	54.0	14.7	16.2	13.2	19.1	63.2
	No	24.4	15.4	10.5	2.3	52.6	16.1	16.1	10.6	3.1	46.0	13.2	11.8	7.4	4.4	36.8
Civil Status	Single	19.9	13.2	5.6	3.0	41.7	11.8	15.5	6.2	2.5	36.0	10.3	5.9	7.4	7.4	30.9
	Married	17.3	15.4	9.0	4.1	45.9	18.0	18.6	12.4	3.1	52.2	16.3	16.1	9.9	4.5	48.5
	Divorced	1.5	0.4	1.1	0.0	3.0	0.6	0.6	1.2	0.6	3.1	1.6	0.8	1.2	0.6	10.3
	Common Law Partner	3.0	3.8	1.9	0.8	9.4	2.5	1.9	3.7	0.6	8.7	2.7	3.1	2.3	1.0	10.3
Parenthood	Yes	17.7	15.0	10.2	3.8	46.6	16.1	18.6	13.7	1.9	50.3	14.7	19.1	7.4	14.7	55.9
	No	24.1	17.7	7.5	4.1	53.4	16.8	18.0	9.9	5.0	49.7	13.2	8.8	13.2	8.8	44.1
Employment Situation	Study	5.3	4.9	0.8	1.1	12.0	3.7	1.9	0.6	0.0	6.2	1.5	0.0	1.5	0.0	2.9
	Employed	33.1	26.3	16.2	5.3	80.8	26.7	33.5	20.5	6.2	87.0	23.5	26.5	19.1	22.1	91.2
	Unemployed	2.6	1.1	0.4	1.1	5.3	1.9	0.6	1.9	0.6	5.0	1.5	1.5	0.0	1.5	4.4
	Retired	0.8	0.4	0.4	0.4	1.9	0.6	0.6	0.6	0.0	1.9	1.5	0.0	0.0	0.0	1.5
Reasons to start running	Healthy	27.8	24.8	12.4	5.3	70.3	24.8	31.7	18.6	5.0	80.1	14.7	19.1	17.6	22.1	73.5
	Cheap Sport	8.6	6.0	2.3	1.1	18.0	6.8	0.6	3.7	1.9	13.0	4.4	7.4	0.0	0.0	11.8
	Social	0.8	0.4	0.0	0.0	7.1	0.0	0.0	0.6	0.0	0.6	1.5	0.0	0.0	0.0	1.5
	Personal Goals	1.1	0.0	0.8	1.5	3.4	0.0	0.6	0.0	0.0	1.2					
	Others	3.4	1.5	2.3	0.0	7.1	1.2	3.7	0.0	0.0	5.0	7.4	1.5	2.9	1.5	13.2
Running expertise years	< 5 years	22.9	14.7	8.3	3.0	48.9	12.4	8.1	10.6	1.9	32.9	8.8	7.4	5.9	2.9	25.0
	Between 5-10 years	6.4	8.6	2.6	3.0	20.7	9.3	14.9	8.1	2.5	34.8	7.4	11.8	8.8	10.3	38.2
	More 10 years	12.4	9.4	6.8	1.9	30.5	11.2	13.7	5.0	2.5	32.3	11.8	8.8	5.9	10.3	36.8
Duration of training session	< 60’	18.8	9.8	5.3	2.3	36.1	8.1	3.1	1.9	1.9	14.9	2.9	2.9	0.0	1.5	7.4
	60-90’	22.9	21.8	12.0	4.5	61.3	22.4	32.9	21.1	3.7	80.1	23.5	20.6	16.2	20.6	80.9
	>90’	0.0	1.1	0.4	1.1	2.6	2.5	0.6	0.6	1.2	5.0	1.5	4.4	4.4	1.5	11.8
Km/week	≤ 55	36.8	27.8	13.2	5.3	83.1	26.1	19.9	17.4	5.0	68.3	13.2	11.8	2.9	5.9	33.8
	56-85	4.5	4.5	3.4	1.5	13.9	6.2	15.5	5.6	1.2	28.6	11.8	14.7	13.2	13.2	52.9
	≥86	0.0	0.4	1.2	1.1	2.7	0.6	1.2	0.6	0.6	3.1	2.9	1.5	4.4	4.4	13.3

Table 5 (continued)

		10 km					21 km					42 km				
		Min	Low	High	Max	Tot	Min	Low	High	Max	Tot	Min	Low	High	Max	Tot
Training frequency/week	≤3	27.4	18.4	5.3	1.9	53.0	17.4	8.7	6.2	1.2	33.5	8.8	4.4	1.5	1.5	16.2
	4-5	12.0	12.0	9.8	4.1	38.0	13.0	21.1	16.1	4.3	54.7	16.2	17.6	8.8	8.8	51.5
	6-7	2.3	2.3	2.6	1.9	9.0	2.5	6.8	1.2	1.2	11.8	2.9	5.9	10.3	13.2	32.4
Date of race date	< 5 years	24.8	19.2	9.8	3.8	57.5	13.0	11.2	11.2	1.9	37.3	11.8	11.8	5.9	8.8	38.2
	Between 5-10 years	6.8	6.4	2.3	3.0	18.4	11.2	13.0	8.1	2.5	34.8	5.9	5.9	11.8	8.8	32.4
	More 10 years	10.2	7.1	5.6	1.1	24.1	8.7	12.4	4.3	2.5	28.0	10.3	10.3	2.9	5.9	29.4
Distance of first race	10km	38.0	32.0	16.9	7.1	94.0	23.0	28.6	18.6	5.6	75.8	19.1	22.1	13.2	13.2	67.6
	21km	2.6	0.8	0.8	0.8	4.9	9.9	8.1	5.0	1.2	24.2	8.8	4.4	4.4	8.8	26.5
	42km	1.1	0.0	0.0	0.0	1.1						0.0	1.5	2.9	1.5	5.9
Best 10km	< 35’	2.6	1.5	1.1	1.1	6.4	3.1	0.6	1.2	0.6	5.6	1.5	1.5	1.5	2.9	7.4
	35’- 39’59”	6.0	7.5	5.3	1.1	19.9	5.0	10.6	6.8	0.6	23.0	4.4	11.8	7.4	8.8	32.4
	> 40’	32.7	23.7	11.3	5.6	73.3	24.8	25.5	15.5	5.6	71.4	22.1	13.2	11.8	10.3	57.4
Best 21km	< 1h20’	9.4	7.1	3.4	1.5	21.4	2.5	1.9	1.2	0.6	6.2	1.5	2.9	2.9	4.4	11.8
	1h20’- 1h 29’59”	1.1	0.8	1.9	1.5	5.3	8.1	8.1	5.6	1.2	23.0	4.4	10.3	10.3	8.8	33.8
	> 1h30’	25.6	18.0	9.0	4.5	57.1	22.4	26.1	16.8	5.0	70.2	19.1	13.2	7.4	8.8	48.5
Best 42km	< 2h45’	0.4	0.8	0.8	0.4	2.3	0.6	1.2	0.0	0.6	2.5	0.0	0.0	2.9	4.4	7.4
	2h45’- 3h 14’59”	2.6	3.0	2.6	0.4	8.6	6.2	7.5	3.1	0.0	16.8	4.4	10.3	8.8	7.4	30.9
	> 3h15’	13.5	7.5	6.8	3.0	30.8	16.8	21.7	13.7	5.6	57.8	20.6	16.2	7.4	8.8	52.9
Additional Gym Attendance	Yes	31.2	25.9	9.8	6.8	73.7	23.6	24.8	18.0	6.2	72.7	20.6	25.0	11.8	17.6	75.0
	No	10.5	6.8	7.9	1.1	26.3	9.3	11.8	5.6	0.6	27.3	7.4	2.9	8.8	5.9	25.0

(*record 10 km,* H=7.74, *p*=.021; *record 21 km*, H=8.97, *p*=.011; *record 42 km*, H=6.88, *p*=.032).

Concerning the effect size (Table 3), after transforming the Kruskal-Wallis H values of the variables that showed significant results, we found that number of kilometres run per week (*d*=.444) and number of training days per week (*d*=.682), resulted in a medium effect size, while the number of years running (*d*=.199) and personal bests in 42 km (*d*=.196) showed no effect.

Finally, a crosstab analyses were carried using the socio-demographic and performance variables along with the RAS-8 quartile scores controlling for usual distance trained (Tables 4 and 5), according to the usual distance trained by the sample. The analyses found statistically significant relationships for the variables, club-membership (χ^2=11.89, *p*=.008), average number of kilometres run per week (χ^2=41.77, *p*=.000), training sessions duration (χ2=26.68, *p*=.000), number of training days per week (χ2=61.18, *p*=.000), and personal bests according to distance (χ^2_{10km}=21.31; *p*=.011; χ^2_{21km}=19.76; *p*=.019; χ^2_{42km}=22.38; *p*=.008). That suggest that these, variables were related to the risk of addiction. Specifically, the distance of 10 km seemed to show the strongest relationship and therefore, to have the greatest impact on determining the risk of addiction.

Among the variables that showed significant differences, club-membership seemed to increase the risk of addiction for marathon runners, while the risk level was minimal or low for those who did not belong to a club. In terms of training duration frequency, and number of kilometres completed, regardless of distance (10 km, 21 km or 42 km), the greater the dedication, the greater the addiction risk. As to personal bests, those with a better performance and an increased distance covered showed higher addiction risk. Finally, gym attendance appeared to be associated with a lower risk of addiction for all three distances analysed.

Discussion

Exercise addiction is one of the most detrimental behaviours observed amongst amateur athletes in endurance sports, and it is seen more amongst runners than in other sports (Latorre et al., 2016; Lu et al., 2012; Murray et al., 2013). The increasing popularity of competitive amateur running has been seen as increasing the likelihood of finding more cases of addiction risk (around 14.2%) , according to recent research (Di Lodovico et al., 2019).

Addiction risk seems to have a strong relationship with social context and with the modern ways of life, mainly in the Western societies. In these societies, participation in activities such as endurance sports, fitness, and cross-fit, among others, has replaced work as source of feelings of achievement and personal satisfaction (Flores-Allende & Ruiz-Juan, 2010; González-Hernández et al., 2019). As a result, these sports have lost their original function to improve health, and have instead become social and recreational rituals that, for many, seem to be an obligation (Antolín et al., 2009).

Few studies that examine sports addiction have used a sample of amateur runners participating in long-distance competitions. Therefore, the cut-off points and levels established by Ruiz-Juan and Zarauz (2012) were used as a reference in this research. Accordingly, it can be seen that our runners had lower addiction levels than the sample analysed by Ruiz-Juan and Zarauz (2012), although for both samples, the dominant profile was a runner with a low addiction risk. These minor differences could be due to the individual characteristics of the two samples, to the time that has elapsed between the studies, or to changes that have taken place at the societal level since the Ruiz-Juan and Zarauz research was conducted.

Among the most relevant sociodemographic variables explaining exercise addiction in endurance sports, the available scientific literature places age and sex above all others (Lichtenstein et al., 2017). Regarding age, previous studies have reported seemingly inconsistent findings. Some studies found no significant differences based on age (Mayolas-Pi et al., 2016). Others, however, have discovered an inverse relationship between this variable and addiction risk, showing younger athletes with higher risk, perhaps because of the more compulsive tendencies often seen within this age group (Bruno et al., 2014; Cabrita et al., 2018; Grima et al., 2018; Lichtenstein et al., 2014; Reche et al., 2018).

These results differ from those obtained in our study, where we have observed that levels of addiction risk are associated with the middle-aged group. Endurance sports require high maturity levels and strong commitment. In addition, adulthood means that an athlete must manage other responsibilities that are sometimes incompatible with or in conflict with training commitments. That, in turn, may be causing athletes to stop running or to neglect professional or family commitments (Berczik et al., 2012; Cook et al., 2015).

Related to sex, a large number of studies find no differences between male and female long-distance runners (Magee et al., 2016; Ruiz-Juan et al., 2016). That could be explained by the fact that male runners far outnumber female runners, a phenomenon that is similar across the full range of endurance sports practiced. A few studies, however, have found women present a higher addiction risk in triathlon and running. A review of the specialized literature suggests that sex differences can be due to different motivations referred by endurance athletes, such as to lose weight and to improve self-image (Dumitru et al., 2018; Lichtenstein & Jensen, 2016).

In contrast, Cook et al. (2013b), Cunningham et al. (2016), and most recently, Nogueira et al. (2019) observed men to have the greatest addiction risk. Most of these studies have suggested that this phenomenon is related to the current emphasis on how the subjects regarded caring for their bodies or on physical appearance. When the quest for the perfect body is extreme, physical exercise, like running, comes to be seen as the most efficient tool for achieving this goal, which may encourage addictive behaviours (Cook et al., 2018).

According to Smith et al. (2010), a runner's performance level seems to be another predictor of running addiction. The fastest runners showed the higher addiction risk, which was the case in our study too. Those runners who invest the most time and resources in training, along with a set of physical and mental characteristics that favour training, seem to be most susceptible to fall into a motivational spiral of a drive to improve (Cook et al., 2018; Latorre et al., 2016; Salas et al., 2013). Based on the aforementioned, the achievement of improved performance could be driving addiction in these runners. These amateur athletes seem to be unable to control their reward/inhibition behaviour, requiring ever-increasing amounts of exercise to attain the pleasurable effect that they desire (Huang et al., 2019), which the components' model of addiction calls tolerance (Griffiths, 2005). That is to say, competitive amateur runners are most vulnerable to those stimuli related to the appearance of addictive behaviours motivated by the drive and need for external recognition and self-reinforcement. In our study, the 10 km runners (nearly half of participants in our sample) seemed to have the highest addiction risk. Although this is the shortest distance of those analysed, the desire to improve is usually associated with increased training hours. Therefore, a greater dedication may imply enhanced conflict*s* ('components' model of addiction by Griffiths, 2005) with daily obligations.

It is the case that many studies about exercise addiction focus on marathoners and those who run the greatest amount of kilometres per week, who are frequently identified as st the highest risk of addictive behaviour (Grima et al., 2018; Ruiz-Juan & Zarauz, 2012). In order to

understand these findings, we must consider the fact that for long-distance amateur runners, distance may be more important than achieving a good race time. As result, runners participate in ever-longer races. That could put them at in a higher risk of addiction because of the increasing number of kilometres that they must complete in training and, consequently, the greater amount of time invested.

Our study, however, does not support that finding. In our study, the shortest of the analysed distances presented the greatest risk of addiction (excluding the minimal-risk category). Training variables associated with the greatest number of hours, kilometres and training frequency seem to be predictive of addiction risk. Authors such as Buck et al. (2018) recommend that evaluation criteria should be adapted to individual samples to prevent mistakes, as might happen when analysing professional athletes.

Finally, many authors suggest the need to add or assess other variables in order to determine an addiction presence. Such variables might include, the intensity of training or the type of motivation expressed by runners both for taking up running in the first place and for continuing with sport (Poczta & Malchrowicz-Mośko, 2018a, 2018b; Sicilia et al., 2018).

Conclusions

Based on the administration of the RAS-8 (the Spanish version of the Running Addiction Scale) to a sample of competitive amateur runners, and adopting a previous quartile-based categorisation scheme for those runners, we found that the runners in our sample are categorized has having a low addiction risk with 10 km male runners showing the greatest potential risk. Age, performance level and training variables such as, the average number of kilometres run per week, training sessions duration, and training frequency, were the most relevant determinants of behaviours associated with running addiction, which partially confirms the initial hypothesis.

Limitations

Our survey is voluntary and response-based which could be influenciated by other factors such social deseability. The RAS-8 self-report provides a risk score and has no defined or proven categorisation. In addition, the test selection was based on its specialisation in runners study. However, it could have been informative to expand it with other more widely used tools in the study of sport addiction in order to compare with other research with similar samples. Although the number of participants was high, and they came from different parts of Spain, it would advisable to increase the sample, mainly to include more females, in order to generalize the results.

Implications

The present study may be useful in helping to detect those individuals at risk of addiction . We should be mindful that early detection of these sorts of behaviours can be one of the most valuable tools to reduce the number and severity of running addiction cases. Further, we believe that the implementation of programmes to detect and prevent running addiction should take place in a multidisciplinary setting to benefit from the experience of all relevant specialists

from the sports training field (coaches, physiotherapists, doctors, nutritionists, and sports psychologists, amongst others).

Declarations

Conflict of Interest The authors declare no competing interests.

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