ORIGINAL

TRAINING EXPERIENCE AS A LIMITING FACTOR IN MASTER LONG DISTANCE RUNNERS

AÑOS DE EXPERIENCIA COMO FACTOR LIMITANTE EN CORREDORES VETERANOS DE LARGAS DISTANCIAS

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ABSTRACT

In the last decades, the number of recreational master runners in long-distance running events has increased. This study, which included 103 runners, aimed to analyse the influence of age and training experience on master runners' performance over long distances. An *ad hoc* questionnaire was used. Training

experience analysis showed significant correlations (p<0.05) in all distances in the 35-39 years category, and in the distance of 21.1 km in the 40-44 years category. Furthermore, in the comparison between categories related to the total time, significant differences were found in 21.1 km distance for age groups of 35-39 / 45-49 (p=0.014) and 35-39 / 50-54 (p= 0.014) as well as in 42.2 km distance for the age groups of 35-39 / 45-49 (p=0.022) and 45-49 / 50-54 (p=0.050). Training experience appears to be a limiting factor for performance in recreational master runners.

KEYWORDS: recreational runners, performance,years of training, marathon

RESUMEN

En las últimas décadas ha aumentado el número de atletas veteranos en carreras populares de resistencia. El estudio, que incluyó 103 atletas, tuvo el objetivo de analizar cómo influye la edad y los años de experiencia en el rendimiento de corredores veteranos en largas distancias. Para ello se elaboró un cuestionario ad hoc. El análisis de los años de experiencia muestra correlaciones significativas (p<0,05) en todas las distancias de la categoría de 35-39 años, así como en la distancia de 21,1 km en categoría 40-44 años. Por otro lado, en la comparación entre categorías relacionados con el tiempo total, se encontraron diferencias significativas en la distancia de 21,1 km para los grupos de edad de 35-39/45-49 (p=0,014) y 35-39/50-54 (p=0,014) así como en la distancia de 42,2 km para los grupos de edad de 35-39/45-49 (p=0,022) y 45-49/50-54 (p=0,050). Los años de experiencia parecen ser un factor limitante del rendimiento.

PABLAS CLAVE: corredores populares, rendimiento, años experiencia, maratón

INTRODUCTION

In the last decades, the number of participants in long-distance running events has increased, especially recreational master runners (≥35 years), according to the "Royal Spanish Athletics Federation, RFEA" standars, so as the number of running events (Salas, Román, Campos & Hermoso, 2014). The amount of recreational runners who participates in some of the most important World marathons as New York, Chigago, London or Berlin, has increased dramatically in the last few years (Barandun et al., 2012). As an example, a recent analysis of the participation trend in the "New York Marathon", from 1980 to 2009, showed that in the aforementioned first three decades, the percentage of under 40 finalists decreased, whereas the percentage of recreational master runners who manage to finish the event increased (Lepers & Cattagni, 2011). In our country, in the XII edition of the Madrid half marathon, the number of recreational master runners was 9.525, versus 6.588 participants in senior category (Salas, Román, Soto, Santos & García, 2013).

The recreational running phenomenon, which started in the 70's in the USA, responds to, as said by Carmack and Martens (1979), the satisfaction of the following fundamental necesities: physical health, psycological health, achievement of goals, tangible rewards, social influencies, availability and other multiple reasons. The availability to practice an individual sport, is a remarkable influencial factor in the great developement of long-distance running events in current societies, in which the lack of time is an important condicionant. Similarly, Llopis and Llopis (2006) and Zmijewski and Howard (2003) reported that the main reason to participate in these popular running events is the satisfaction they produce, which is related in some way, to the social interaction that take place in this kind of events and the search of results. All this generates in the long-distance runner an important attraction (Salas et al. 2013). As said by the same authors, the great part of recreational master runners have a higher education, have a job, are married or in union. They also outline that most of them are not federated, they do not have a coach and have been training for 4-12 years. Men perform around 11 km more than women weekly, the majority of them on the road and train around 4 sesions per week.

However, in spite of all publised data related to long-distance runners, to our knowledge, there are not studies that describe how performance evolves in these recreational master runners at different long-distances running events. The data analysis is essential to determine when the biggest fall in perfomance is produced in these athletes and its causes. Different investigations have been made, as the one carried out by Celie, Faes, Hopman, Stalenhoef, and Rikkert (2010) whose main goal was to determine the changes produced in race performance due to de age with a total of 194.560 participants (professionals and recreationals) in a 15 km event from 1995 to 2007. They found that, when aging, the average time decreased 0.2% per year. In another study by March, Vanderburgh, Titlebaum and Hoops (2011) the fact that older recreational master runners tend to mark better rate in marathon events could be due to the experiences more than the cronological age. To our knowlodge, there are not studies that have compared how recreational master runners perform on different distances neither.

Therefore, the main goal of this study was to analyse the influence of age and training experience on master runners' performance over long distances (42.2km, 21.1 km and 10 km). Based on previous literature, two hypotheses were proposed. The first one was that with agging, the athletes would perform worse in long distances. The second one was that as long as training experience and participation in running events increase; the athletes would perform better.

METHOD

Participants

This research included 103 men and women Spanish Caucasian runners aged between 35 and 55 years old. The subjects characteristics are detailed in Table 1. Some participants have been included in two different categories given that data were obtained from different seasons and may have changed category:

Table 1. Participant characteristics

Category (RFEA)	Age (Years)	N	Experience (Years)	Training (h/week)	Training (km/week)
M35	35 – 39	54	7.52 ± 4.91	6.65 ± 7.49	11.90 ± 5.35
M40	40 – 44	38	7.15 ± 6.50	6.30 ± 2.73	12.31 ± 9.44
M45	45 – 49	22	6.82 ± 4.78	6.08 ± 2.81	13.66 ± 7.11
M50	50 - 54	17	9.88 ± 7.57	6.64 ± 3.99	28.78 ± 35.10

The inclusion criteria included: belong to master category M35, M40, M45 o M50, according to the Royal Spanish Athletics Federation (RFEA, 2014) rules and have completed at least a 10 km, 21.1 km or 42.2 km event of the RFEA official calendar (www.rfea.es). Professional athletes were excluded from this study, that is,, those who voluntary engage in this sport and receive remuneration by a club.

All participants took part voluntarily in this study and they were previously informed about the goals of it. In turn, all of them signed the written informed consent. The data collected were subjetcted to the Organic Law 15/1999 about protection of personal data. This study followed the ethical standars recognised by the Declaration of Helsinki (revised in Seoul, Republic of Korea in October 2008).

Procedure

Figure 1 shows in detail the procedure of the data collection. In early November 2014 we proceed to the development of the formulary. Then it was sent to a random group of people to see if the formulary was readable and reliable. In mid-November the formulary was emailed to all participants who voluntarily chose to participate. The doubts were treated and the anonymity and confidentiality of these was respected. Once all the participants answered, we proceeded to collect and organise all the data, and then started the statistical treatment of the data.
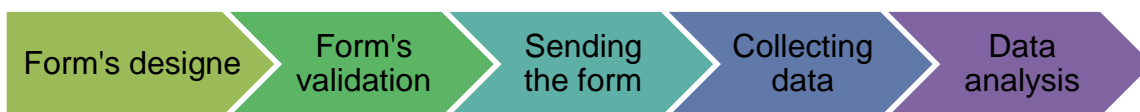
Figure 1. Timeline of the procedure carried out in research

Tools and measures

To carry out this study, the tool Google Forms (http://docs.google.com) was used to build an *ad hoc* form the same as De la Fuente-Valentín, Pardo and Kloos (2009). This tool is useful as long as it allows the data collection from the participants by using a personalised totally online questionnaire. So, this tool was subjeted to a validation process based on expert judgement, this is the common process used for this kind of actions (Barroso & Cabero, 2010). The distance between the researcher and the experts forced us to use the e-mail as the most appropiate way to communicate in order to validate the process. Then, the questionnaire was sent to each expert requesting the return of their evaluations by the same means.

In this questionnaire the following data was collected:

1. Personal data of each participant, as birth date and gender.
2. Training data like years of experience and hours of training.
3. Information of each event in which the date, the distance and the final time were included.

Statistical Analysis

The data of this study was analysed by the statistical software SPSS, v22.0 for Macintosh. (SPSS Inc. Chicago, USA). The results are shown as percentages, average and standard deviation (average ± SD). The normality of each data variable was checked by W of Shapiro-Wilk test, being n=103, and the variance homogeneity by Levene´s test. Although almost all the studied variable met the normality and homocedasticity criteria, due to the small sample size (category M35=54, category M40=36, category M45=22, category M50=17), the non-parametric U of Mann-Whitnney test was used to see if there were significant differences or not between groups.

The magnitude of differences (effect size,"ES") was calculated by the Cohen's *d* and were interpreted as "small" (<0.2) "moderate" (≥0.2 y <0.5) "large" (≥0.5 and <0.8) or "very large" (>0.8). Spearman's rank correlation coefficient was used to valorate the posible associations between the variables in the different age groups. Significance was set for $p<0.05$.

RESULTS

Table 2 depicts the values resulting from the comparison between the total time associated with distances of 10 km, 21.1 km and 42.2 km. Significant differences were found in 21.1 km distances for the age group of 35-39/45-49 (p=0.014) and 35-39/50-54 (p=0.014) with a large and a very large effect size, respectively. Also, significant differences were found in 42.2 km distances for the age group of 35-39/45-49 (p=0.022) and 45-49/50-54 (p=0.050) with a large and a very large effect size, respectively. On the oher hand, no significant differences were observed for 10 km distances.

Table 2. Time comparison between age groups

| Distance	Category	Cohen' *d*	E.S.	p
10 km	35-39 / 40-44	0.53	Large	0.950
	35-39 / 45-49	0.58	Large	0.960
	35-39 / 50-54	0.36	Moderate	0.236
	40-44/ 45-49	0.12	Small	0.674
	40-44 / 50-54	0.20	Moderate	0.460
	45-49 / 50-54	0.23	Moderate	0.970
21.1 km	35-39 / 40-44	0.53	Large	0.081
	35-39 / 45-49	0.78	Large	0.014
	35-39 / 50-54	0.98	Very Large	0.014
	40-44/ 45-49	0.29	Very Large	0.452
	40-44 / 50-54	0.48	Moderate	0.238
	45-49 / 50-54	0.16	Small	0.660
42.2 km	35-39 / 40-44	0.43	Moderate	0.119
	35-39 / 45-49	0.78	Large	0.022
	35-39 / 50-54	0.17	Small	0.854
	40-44/ 45-49	0.24	Moderate	0.279
	40-44 / 50-54	0.57	Large	0.400
	45-49 / 50-54	1.24	Very Large	0.050

E.S.: Effect Size

Figure 2, figure 3, figure 4 and figure 5 show how the results achieved in 10 km, 21.1 km and 42.2 km distances according the years of experince of the participants in each age group evolve. In the 35-39 years category significant correlations were found (p<0.05) for 10.0 km (p=0.001) and 21.1 km (p<0.001)

distances (see Table 3. In the 40-44 years category significant correlations were found for 21.1km (p=0.034) distances (see Table 3). On the other hand, in 45-49 years and 50-54 years categories no significant correlations were found (see Table 3).

Table 3. Years of experience of each distance by categories

Category	Years Exp.	Distance	R (Spearman)	p
35-39	7.52 ± 4.91	10.0 km	0.623	0.001
		21.1 km	0.465	<0.001
		42.2 km	0.270	0.063
40-44	7.15 ± 6.50	10.0 km	0.520	0.500
		21.1 km	0.400	0.034
		42.2 km	0.260	0.350
45-49	6.82 ± 4.78	10.0 km	0.297	0.700
		21.1 km	0.059	0.800
		42.2 km	0.140	0.390
50-54	9.88 ± 7.57	10.0 km	0.131	0.520
		21.1 km	0.200	0.620
		42.2 km	0.493	0.230

Figure 2. Results' evolution of 35-39 years age group according to their years of experience
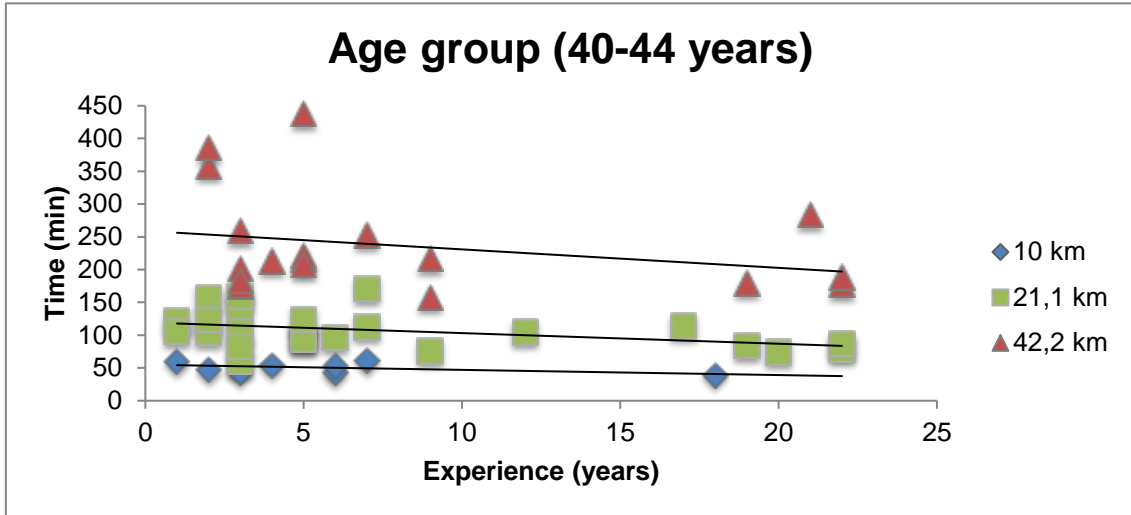

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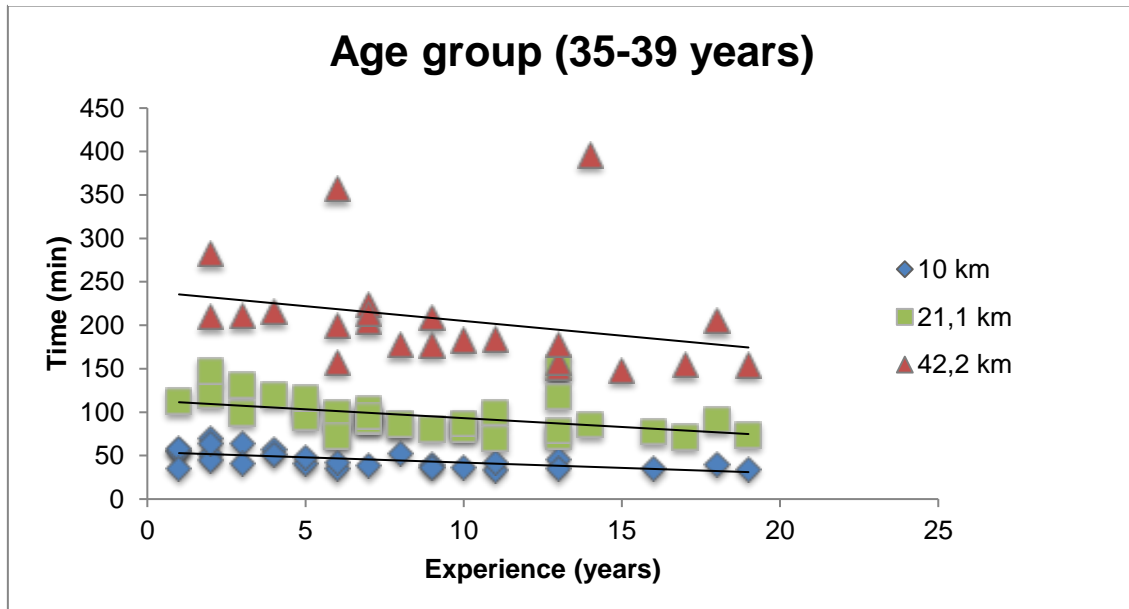
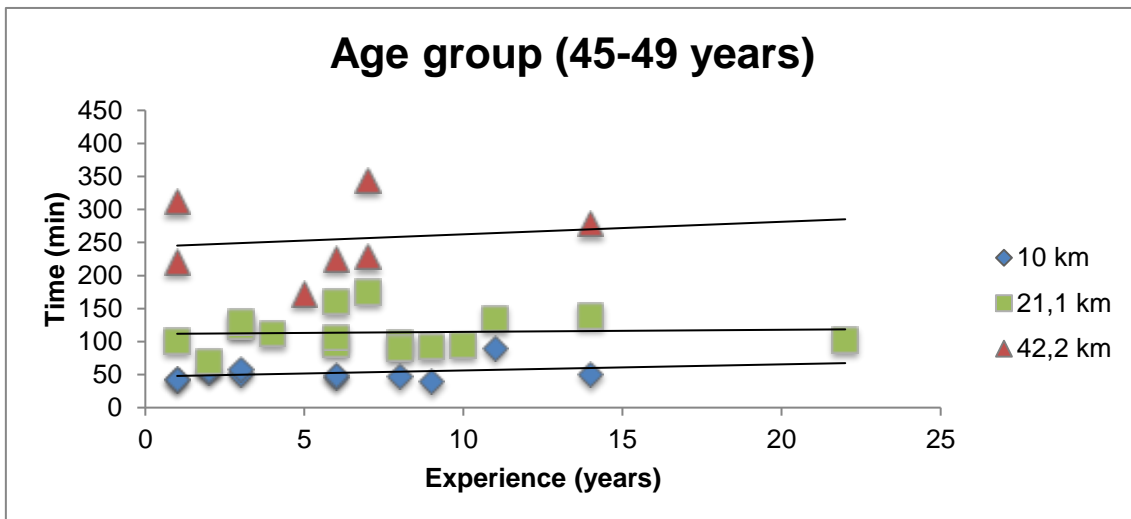**Figure 3.** Results' evolution of 40-44 years age group according to their years of experience

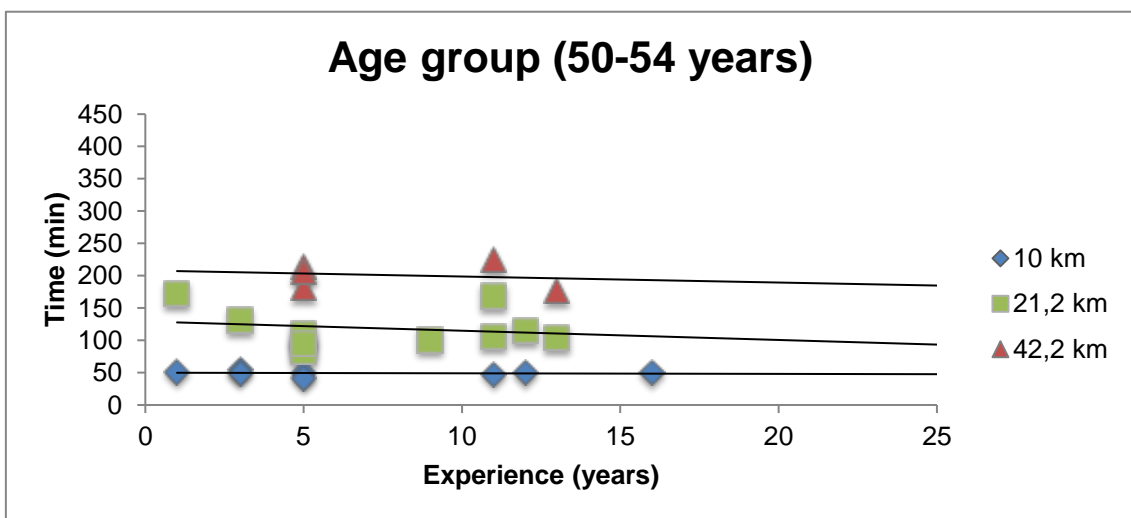**Figure 4.** Results' evolution of 45-49 years age group according to their years of experience

Figure 5. Results evolution of 50-54 years age group according to their years of experience

DISCUSSION

The main goal of this study was to investigate wich one or ones were the performance limiting factors in master long distance runners. Based on previous literature, two hypothesis were proposed. The first one was that with aging, the athletes would show imparied performance in long distances. The second one was that as training experience and participation in running events increase, the athletes would perform better. According to our first hypothesis, the age of the participants of this study is significantly related to the marks achieved at distances of half marathon (21.1 km) and marathon (42.2 km) (Table 2). Also, the results seem to confirm the second hypothesis as years of experience were significantly related to the 40-44 years age group 21.1 km performance. Similarly, significant correlations were obtained in the age group of 35-39 years for the 10 km, 21.1 km and 42.2 km distances (see Table 3).

In general, the best performance in endurance events is maintained until the age of 30 to 35 years, followed by a moderate decrease until the age of 50 years and then progressively decreases regardless of distance and discipline (Leyk et al., 2009). This also agrees with the study of Knechtle, Rüst, Rosemann and Lepers (2012), which concluded that between ages of 30 and 50 years, there are no changes in the anual performance and from age 50, the percentage of change in the anual performance was three times higher than between 30 to 50 years. All this could explain the results observed in our study where in the comparison of 45-49 age group with the 50-54 age group, significant marathon performance differences were found (Table 2).

In master athletes, as age increases, one of the most undesirable consequences seems to be the risk of musculoskeletal injuries. (Osorio, Clavijo, Arango, Patiño & Gallego, 2007). These athletes appear to show an increased risk of injuries than the rest of the population, wich can be determined by internal factors, in relationship with the athlete, or external factors, related to the environment (Osorio et al., 2007). The rearfoot strike, with mild external rotation and slight lateral inclination seems to be the most common type of foot strike in master athletes, independently of the event (Salas et al., 2014). Approximately the 80% of these runners have a rearfoot strike (Hasegawa, Yamauchi & Kraemer, 2007). It is plausible that runners with this kind of foot strike have a higher risk of injury. The modification of the rearfoot strike to a forefoot strike may reduce the risk (Cheung & Davis, 2011).

In this study, Conesa (2010) concluded that the most common injuriy in master runners appears to be tendinitis followed by muscle injuries. The muscle mass of a runner is another important aspect to consider as muscles of the younger runners are composed by longer fast twitch fibres and in greater quantities than those of the master athletes (Coggan et al., 1990). This factor could have a

great influence on the performance of recreational master runners (Evans & Lexell, 1995). This could be reflected in the results of our study where in the comparison of the younger age group (35-39 years) with the two older age groups (45-49 years and 50-54 years) showed significant differences regarding the 21.1 km performance (Table 2). Also, the body temperature of master runners in a 15 km event seems to be a determining factor in the final race time because as age increases ir more likely to suffer hyperthermia (Veltmeijer, Eijsvogels, Thijssen & Hopman, 2015). The hyperthermia can affect the central and peripheral processes involved in the production of strengh and power (Todd, Buttler, Taylor & Gandevia, 2005) and impair performance during sprints (Drust, Rasmussen, Mohr, Nielsen & Nybo, 2005) or endurance events (González-Alonso et al., 1999). The strategies used to minimise the negative impact of the elevated body temperature on the performance are the heat acclimatisation, pre-refrigeration (González-Alonso et al., 1999) and fluid intake at a certain temperature (Hamilton, González-Alonso, Montain & Coyle, 1991).

In addition, the physiological characteristics could greatly influence the results of the events in relation to age, such as maximum oxygen consumption ($VO_{2\ max.}$) or the cardiac output, which seems to decrease with increasing age (Carlsson et al., 2012). Katzel, Sorkin and Fleg (2001) showed that the volume of training had a significant impact on the degree of VO_{2max} loss. Thus, highly trained runners, and therefore, with more experience, lost approximately half of their aerobic capacity per decade in relation to untrained individuals. As we can see in Figure 2, participants with more years of experience seem to be those who have achieved best performances. Current analyzes could indicate that with age there is an increase in the subjects of BMI (Body Mass Index) and waist circumference and it can be reduced by 40% for those who run over 16 km/week compared to those who run less than 8 km/week. To maintain the same waist circumference, a person who runs 16 km/week at the age of 25, needs to increase his weekly running distance to 65.7 km/week by the age of 50 (Román, Salas & Soto, 2012). These data suggest that age and vigorous exercice interact to alter subjetcs adiposity. Therefore, vigorous physical activity should be increased with age to prevent weight gain (Williams y Pate, 2004). Likewise, endurance training may help to increase free-fat mass and lean mass loss (Donnelly et al., 2009). Also, low amounts of body fat (13%-17%) appear to be advantageous for faster times in running events (Rüst et al., 2011). Bale et al. (1986) described a low percentage of body fat in marathon runners and Hetland et al. (1998) showed that total and regional body fat appears to be inversely correlated with performance on an incremental test in long-distance runners. Usually, in runners, the excess of adipose tissue should require more muscular effort to accelerate legs and, theoretically, the energy expenditure at the same speed is greater (Barandunet al., 2012). Training experience (perhaps associated with age) in very long distances could also improve the muscle's ability to oxidise fat (Jones & Carter, 2000).

The most important limitations of this study was the small simple size and the lack of distinction between both genders. There is also a bias of participation for athletes of a particular geographical area; in this case the mayority

corresponded to the region of El Bierzo (province of León, Spain). For future research we should expand the sample size and its representation in the national geographic scope. It would be necessary to explore other factors that may affect the results in tests completed by these master runners including psychological variables, type of training or kinematic aspects of their running technique. Since it is posible a certain generalization, these results could be a reference to carry out larger studies in wich we will reach more concrete conclusions in the performance of popular master runners in different events. Also, the results of this study could be useful for groups of people who, being master runners, start running. This will give them an idea of what would be the evolution of their performances as they age.

CONCLUSION

According to the results of this study we can conclude that training experience seems to be a key factor in determining performance in master athletes in long-distance events. Thus, the most experienced runners of M35 category appears to be benefited in 10 km, 21.1 km and 42.2 km events. The same occurs with the runners in M40 category at the distance of 21.1 km. The reasons to explain this phenomenon are unclear and require new researches to confirm it. Furthermore, the results of this study seem to confirm that with aging, the athletes get worse marks, especially in the change of category from M45 to M50 in 42.2 km distances.

CONFLICTS OF INTEREST

There is no conflict of interest in the present study.

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