



Centenarian athletes: Examples of ultimate human performance?

Romuald Lepers, Paul J. Stapley, Thomas Cattagni

► To cite this version:

Romuald Lepers, Paul J. Stapley, Thomas Cattagni. Centenarian athletes: Examples of ultimate human performance?. *Age and Ageing*, 2016, 45 (5), pp.729 - 733. 10.1093/ageing/afw111 . hal-01413071

HAL Id: hal-01413071

<https://u-bourgogne.hal.science/hal-01413071>

Submitted on 30 May 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Centenarian athletes: Examples of ultimate human performance?

ROMUALD LEPERS¹, PAUL J. STAPLEY², THOMAS CATTAGNI³

¹CAPS UMRI 093, INSERM, Univ. Bourgogne Franche-Comté, F-21000 Dijon, France

²Neural Control of Movement Laboratory, School of Medicine, Faculty of Science, Medicine and Health, University of Wollongong, Australia

³Laboratory Movement, Interactions, Performance EA 4334, University of Nantes, UFR STAPS, Nantes, France

Address correspondence to: T. Cattagni, UFR STAPS, Université de Nantes, Laboratoire 'Motricité, Interactions, Performance' EA 4334, 25 bis Boulevard Guy Mollet - BP 72206 44 322 Nantes cedex 3, France. Tel: +(33) (0) 2 51 83 72 32; Fax: +(33) (0) 2 51 83 72 10. Email: thomas.cattagni@univ-nantes.fr

Abstract

Background: some centenarians are engaged in regular physical activity and sometimes in sporting events.

Objective: we aimed to identify world records of centenarian athletes in several sports and determine which represented the best performance when compared to all-age world records, all disciplines taken together.

Methods: all of the best performances achieved by centenarians were identified and compared in three disciplines: athletics, swimming and cycling. The performances were considered as an average of the respective speeds, except for jumping and throwing events for which the maximum distances performed were considered. Within each discipline, the decline in performance of centenarian athletes was expressed as a percentage of the world record for that discipline. In total, 60 performances of centenarian athletes were found. These performances belong to 19 individuals: 10 in athletics, 8 in swimming and 1 in cycling.

Results: the centenarian world record performed by Robert Marchand in one hour track cycling appears to be the best performance (–50.6% compared with the all-age world record in this discipline) achieved by a centenarian.

Conclusions: although the physiological characteristics of Robert Marchand are certainly exceptional, his remarkable performance could also be due to the lower age-related decline for cycling performances compared with running and swimming. Our observations offer new perspectives on how the human body can resist the deleterious effects of ageing.

Keywords: centenarian, sporting performance, master athletes, ageing, health

Introduction

Centenarians that were themselves Olympians will get to see the 25th Olympics this year, some 80 years or so after they competed. The continuous increase in life expectancy over the last decades has contributed to the growth in the number of centenarians in the world's population [1, 2]. For example, in 2015 the Queen of England sent some 9,736 wishes of congratulations to centenarians, compared to just 3,000 in 1952 when she came to the throne [3]. Even if the total number of centenarians in the world remains uncertain, in 2013 the United Nations' *World Population Ageing 2013* estimated that there were around 4,41,000 living centenarians worldwide (i.e. 6.2 centenarians per 1,00,000

people) [2]. In 2010, more than 80% of US centenarians were female [4]. Centenarians are the fastest growing demographic in much of the developed world [5]. By 2050, it is expected that there will be around 3.4 million centenarians worldwide [2]. Centenarians are often considered as models of successful healthy ageing [6]. Some of them reach this age milestone while maintaining notable health indices. They preserve a high level of physical activity and therefore achieve remarkable sporting performances considering their age.

In recent times centenarians have even begun to participate in sporting competitions worldwide, becoming icons of healthy ageing and provide evidence that it is never too late to start exercising and reap the benefits of regular exercise [7].

Fauja Singh, one of the most famous centenarian athletes, was *a priori* the first to finish a marathon despite his performance not having yet been approved by the *World Master Athletics Association* (i.e. the association that validates master athlete performances in athletics). In 2014, the French cyclist Robert Marchand (102 years) set the hour record in track cycling in the 100–104-year age group. In the same year, the Japanese swimmer Mieko Nagaoka set several swimming world records (distances from 50 m to 1500 m) in the 100–104-year age group.

Even though we may associate the above mentioned (and other) performances of centenarian athletes with an outstanding human capacity, the age-related decline in performance of these centenarian athletes is not actually known. Moreover, it would be interesting to know who, of the centenarian athletes across different disciplines, attained the best performance in comparison to the respective world records of their disciplines.

Method

In order to investigate these two aspects of centenarian performances, we identified and compared all of the best performances achieved by centenarians in three disciplines: athletics, swimming and cycling. Data were collected from the following websites of the international association or federations: <http://www.world-masters-athletics.org> for athletics; <http://www.fina.org/content/masters-records> for swimming and <http://www.uci.ch/track/about> for cycling. Each record performance (centenarians or non-centenarians) measured in time was expressed as an average speed over each distance (i.e. for 60 m running, 50 m swimming or 1 h track cycling, etc.). For jumping and throwing events, the performance was defined using the maximum distance obtained. In total, 60 performances of centenarian athletes were found (20 in athletics, 39 in swimming and 1 in cycling). These performances belong to 19 individuals: 10 athletes in athletics (9 males and 1 female), 8 athletes in swimming (5 males and 3 females) and 1 male athlete in cycling.

Within each discipline, the decline in performance of centenarian athletes was expressed as a percentage of the world record for that discipline, as follows:

Decline in performance (%) =

$$\frac{\text{Performance at 100 yrs or more} - \text{World Record}}{\text{World record}} \times 100$$

Results

The results are presented in Table 1. In athletics, the best centenarian performance (i.e. the lowest percentage decrease between the world record and the centenarian record) among men was found in the high jump (−63.3%) and in the shotput (−81.9%) for women. For running, only male performances were found and the lowest decrease for a centenarian in comparison to the world record was observed in the 100 m (−64.5%). In swimming, the lowest

decrease for a centenarian was observed in the 50 m backstroke for males (−73.0%) and females (−71.2%). The centenarian world record performed by Robert Marchand in track cycling appears to be the best performance (−50.6% compared with the hour world record) achieved by a centenarian, all disciplines taken together.

Discussion

Previous studies have shown that athletic performance is maintained until 35 years of age, followed by linear decreases to 70–80 years of age ranging from 7 to 14% per decade, depending on the discipline. After this threshold of age, the performances in running tend to plummet, whereas the performances, for example, in throwing decline much more gently [8]. We found that the average decline in performance of centenarian athletes was 78% in comparison with the initial world record. Our methods of comparing records of each centenarian with the corresponding world record of that discipline provide a powerful means of assessing their performance using robust criteria. Ideally however, further information could be gained by comparing their centenarian record with each athletes' own record. This, however, is impossible as we did not have access to that information.

Several performances completed by Fauja Singh in athletics were not considered in the present report because they are unofficial. His best performance in comparison with the respective world record was achieved in the 100 m (−59.1%, 23.4s) while, for instance, the decrease in his marathon performance was 75.7%.

The performance of the centenarian cyclist Robert Marchand is outstanding and corresponds to an age-related decline in performance of less than 8% per decade for more than 6 decades. This lower age-related decline for a cycling event is consistent with previous work showing that the age-related decline in cycling performances was less compared with running and swimming [9, 10]. Irrespective of the specificity of the locomotion type, Robert Marchand has certainly shown exceptional physiological characteristics (e.g. muscular and cardiorespiratory functions) for his age [7]. This is in agreement with previous observations showing that centenarians have significant limitations to gas exchange across the lungs during exercise but this limited oxygen transport is tempered by improved skeletal muscle cycling efficiency [6].

Given the increased number of centenarians worldwide, the increased participation rate of master athletes in competitions [10] and the development of specific competitions for master athletes, it is very likely that the number of centenarian athletes will increase in the coming years leading to progress in their performances. Only two performances of centenarian athletes were found in the 105–109-year age group while a performance of a supercentenarian (age > 110 years) athlete has never been observed so far. We expect in the near future however, to observe the first sporting performance for a supercentenarian athlete.

Table 1. Overview of the centenarian athlete performances compared with the respective world records in athletics, swimming and running

World Record Holders (year)							100 year-old performers (year)						
Athletics-Running							Athletics-Running						
Men							Men						
60 m Indoor	Maurice Green (1998)	Usain Bolt (2009)	Time (s)	Speed (m/s)	Age group	Time (s)	Speed (m/s)	Change (%)	Time (s)	Speed (m/s)	Change (%)		
100 m			6.29	9.54	100-104	27.29	2.20	-77.0					
			9.58	10.44	100-104	26.99	3.71	-64.5					
					100-104	29.83	3.35	-67.9					
					105-109	34.5	2.90	-72.2					
					105-109	42.22	2.37	-77.3					
200 m	Usain Bolt (2009)		19.19	10.42	100-104	77.59	2.58	-75.3					
400 m	Michael Johnson (1999)		43.18	9.26	100-104	221	1.81	-80.5					
1500 m	Hicham El Guerrouj (1998)		206	7.28	100-104	1006.41	1.49	-79.5					
Athletics-Jumping							Athletics-Jumping						
Men							Men						
Long jump	Mike Powell (1991)	Javier Sotomayor (1993)	Distance (m)	Speed (m/s)	Age group	Distance (m)	Speed (m/s)	Change (%)	Distance (m)	Speed (m/s)	Change (%)		
High jump			8.95		100-104	1.78		-80.1					
Shotput			2.45		100-104	0.9		-63.3					
			23.12		100-104	6.56		-71.6					
					105-109	4.27		-81.5					
Athletics-Throwing Men							Athletics-Throwing Men						
Discus throw	Jürgen Schult (1986)	Yuriy Sedykh (1986)	Distance (m)	Speed (m/s)	Age group	Distance (m)	Speed (m/s)	Change (%)	Distance (m)	Speed (m/s)	Change (%)		
Hammer throw			74.08		100-104	14.86		-79.9					
Javelin throw			86.74		105-109	7.5		-89.9					
			98.48		100-104	11.32		-86.9					
					100-104	12.42		-87.4					
Women							Women						
Shotput	Natalya Lisovskaya (1987)	Gabriele Reinsch (1988)	Time (s)	Speed (m/s)	Age group	Time (s)	Speed (m/s)	Change (%)	Time (s)	Speed (m/s)	Change (%)		
Discus throw			22.63		100-104	4.1		-81.9					
Hammer throw			76.8		100-104	9.3		-87.9					
Javelin throw			81.08		100-104	11.3		-86.1					
			72.28		100-104	6.43		-91.1					
Swimming							Swimming						
Men							Men						
Freestyle							Freestyle						
50 m (SC)	Florent Manaudou (2014)	Armaury Leveaux (2008)	Time (s)	Speed (m/s)	Age group	Time (s)	Speed (m/s)	Change (%)	Time (s)	Speed (m/s)	Change (%)		
			20.26	2.47	100-104	76.92	0.65	-73.7					
					100-104	126.66	0.39	-84.0					
100 m (SC)			44.94	2.23	105-109	172.48	0.29	-88.3					
					100-104	182.22	0.55	-75.3					
					100-104	272.29	0.37	-83.5					
50 m (LC)			20.91	2.39	100-104	91.19	0.55	-77.1					
					100-104	100.46	0.50	-79.2					
100 m (LC)			46.91	2.13	100-104	203.1	0.49	-76.9					
					100-104	245.98	0.41	-80.9					
Backstroke							Backstroke						
50 m (SC)	Florent Manaudou (2014)		Time (s)	Speed (m/s)	Age group	Time (s)	Speed (m/s)	Change (%)	Time (s)	Speed (m/s)	Change (%)		
			22.22	2.25	100-104	86.68	0.58	-74.4					
					100-104	89.78	0.56	-75.3					

Continued

Table 1. Continued

		World Record Holders (year)		100 year-old performers (year)			
100 m (SC)	Nicholas Thoman (2009)	48.94	2.04	Jaring Timmerman (2009) Tom Lane (1995)	100–104 100–104	105.59 122.52	0.47 0.41
50 m (LC)	Lian Tancock (2009)	24.04	2.08	Jaring Timmerman (2014) Jean Leemput (2014) John Harrison (2014) Jaring Timmerman (2009) Hans Hahn (2008) Jean Leemput (2014) John Harrison (2014) Tom Lane (1994) Tom Lane (1994) Tom Lane (1994)	105–109 100–104 100–104 100–104 100–104 100–104 100–104 100–104 100–104 100–104	189.55 206.09 219.53 231.54 301.82 89.13 92.2 110.73 253.84 544.31	0.26 0.49 0.46 0.43 0.33 0.56 0.54 0.45 0.39 0.37
100 m (LC)	Aaron Peirsol (2009)	51.94	1.93				
200 m (LC)	Aaron Peirsol (2009)	111.92	1.79				
<i>Women</i>							
<i>Freestyle</i>							
50 m (SC)	Ranomi Kromowidjojo (2013)	23.24	2.15	Mieko Nagaoka (2009)	100–104	94.12	0.53
100 m (SC)	Lisbeth Trickett (2009)	51.01	1.96	Mieko Nagaoka (2009)	100–104	210.49	0.48
50 m (LC)	Britta Stefen (2009)	23.73	2.11	Mieko Nagaoka (2014) Mary Maina (1994)	100–104 100–104	101.88 310.84	0.49 0.16
100 m (LC)	Britta Stefen (2009)	52.07	1.92	Mieko Nagaoka (2014)	100–104	225.85	0.44
200 m (LC)	Federica Pellegrini (2009)	112.98	1.77	Mieko Nagaoka (2014)	100–104	468.76	0.43
400 m (LC)	Katie Ledeccky (2014)	238.37	1.68	Mieko Nagaoka (2014)	100–104	996.8	0.40
800 m (LC)	Katie Ledeccky (2015)	487.39	1.64	Mieko Nagaoka (2014)	100–104	2284.3	0.35
1500 m (LC)	Katie Ledeccky (2015)	925.48	1.62	Mieko Nagaoka (2014)	100–104	4448.73	0.34
<i>Backstroke</i>							
50 m (SC)	Etiene Medeiros (2014)	25.67	1.95	Mieko Nagaoka (2014) Rosa Sellares (2010)	100–104 100–104	98.71 233.6	0.51 0.21
100 m (SC)	Katinka Hosszu (2014)	55.03	1.82	Mieko Nagaoka (2014)	100–104	222.81	0.45
200 m (SC)	Katinka Hosszu (2014)	119.23	1.68	Mieko Nagaoka (2014)	100–104	460.01	0.43
50 m (LC)	Jing Zhao (2009)	27.06	1.85	Mieko Nagaoka (2014)	100–104	93.89	0.53
100 m (LC)	Gemma Spofforth (2009)	58.12	1.72	Mieko Nagaoka (2014)	100–104	219.81	0.45
200 m (LC)	Missy Franklin (2012)	124.06	1.61	Mieko Nagaoka (2014)	100–104	485.64	0.41
<i>Cycling</i>							
<i>Men</i>							
1 h Track	Bradley Wiggins (2015)	54.526	15.15	Robert Marchand (2014)	100–104	26.925	7.48
							–50.6

The three best centenarian athlete performances in comparison with their respective world records (i.e. the three lowest decreases between a world record and a centenarian athletic performance) are shown in bold text.
SC: short course (25 m); LC: long course (50 m)

The centenarian athletes must be seen not only as exceptional biological examples but also as evidence that it is never too late to be active [7]. We can only hypothesize that, as the number of centenarians grows and attitudes towards exercise changes in these older persons, the exceptional performances detailed here will become more commonplace, and may perhaps open new perspectives on how the human body can resist the deleterious effects of physiological ageing.

Key points

- Some centenarians preserve a high level of physical activity and achieve remarkable sporting performances considering their age.
- The average decline in performance of centenarian athletes was ~78%.
- The world record performed by Robert Marchand in track cycling appears to be the best performance achieved by a centenarian.
- The number of centenarian athletes will increase in the coming years leading to progress in their performances.
- The centenarian athletes must be seen as evidence that it is never too late to be active.

Conflicts of interest

None declared.

Funding

The research was supported in part by grants from the Region des Pays de la Loire, France, for the project 'Longévité, Mobilité, Autonomie' (LMA).

References

1. Vaupel JW. Biodemography of human ageing. *Nature* 2010; 464: 536–42.
2. United Nations. World Population Ageing 2013 [Internet]. New York, USA: Department of Economic and Social Affairs, Population Division; 2013. Report No.: ST/ESA/SER.A/348. Available at <http://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2013.pdf>.
3. Official website of the British Monarchy. Available at <http://www.royal.gov.uk/HMTheQueen/Queenandanniversarymessages/Factsandfigures.aspx>
4. 2010 Census Report Shows More Than 80 Percent of Centenarians are Women U.S. Department of Commerce, United States Census Bureau press release. Published December 10, 2012. (accessed 12 December, 2012).
5. Perls T, Levenson R, Regan M, Puca A. What does it take to live to 100? *Mech Ageing Dev* 2002; 123: 231–42. Review.
6. Venturelli M, Schena F, Scarsini R, Muti E, Richardson RS. Limitations to exercise in female centenarians: evidence that muscular efficiency tempers the impact of failing lungs. *Age (Dordr)* 2013; 35: 861–70.
7. Sanchis-Gomar F, Pareja-Galeano H, Lucía A. 'Olympic' centenarians: are they just biologically exceptional? *Int J Cardiol* 2014; 175: 216–7.
8. Gava P, Kern H, Carraro U. Age-associated power decline from running, jumping, and throwing male masters world records. *Exp Aging Res* 2015; 41: 115–35.
9. Bernard T, Sultana F, Lepers R, Hausswirth C, Brisswalter J. Age-related decline in olympic triathlon performance: effect of locomotion mode. *Exp Aging Res* 2010; 36: 64–78.
10. Lepers R, Sultana F, Bernard T, Hausswirth C, Brisswalter J. Age-related changes in triathlon performances. *Int J Sports Med* 2010; 31: 251–6.
11. Lepers R, Cattagni T. Do older athletes reach limits in their performance during marathon running? *Age (Dordr)* 2012; 34: 773–81.

Received 29 February 2016; accepted in revised form 23 May 2016