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Research article

Constituent Year Effect in Masters Sports: An Empirical View on the Historical Development in US Masters Swimming

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Abstract
A participation-related constituent year effect, has been found to exist in masters sports in that relatively younger masters athletes (i.e., those in the first or second year of a 5-year age category) participate in competitions significantly more often than relatively older masters athletes (i.e., those in the fourth or fifth year of a 5-year age category). The main purpose of this study was to examine if the participation-related constituent year effect in US masters swimming always existed or if it has developed over time at different historical time periods. Using archived data, participation in the US Masters national short course swimming championships at each of the historical time periods in years 1972, 1982, 1992, 2002, 2012 and 2016 were examined as a function of an individual's constituent year within any 5-year age category and across gender and age. The results indicated the existence of a participation-related constituent year effect for each of the six time periods. In particular, a participation-related constituent year effect seemed to have existed from the inception of organized masters swimming competitions in the US but has developed more strongly over the years especially for males and older-aged masters swimmers. Generally, the tendency to participate at National swimming competitions during the first year of an age category was significantly more pronounced, whereas the tendency of participating during the fifth year of an age category was lower. Findings suggest that the 5-year age categories may not provide an equal competitive opportunity especially for relatively older athletes as for those who are relatively younger, but may encourage more strategic periodized training and participation.

Key words: Constituent year effect, masters athletes, aging, relative age, sport motivation.

Introduction

Masters sport has its roots in the 1970's where it became an alternative to mainstream sports (i.e., youth and elite sports). Prior to this, elderly people were excluded from organized sport, mainly due to two social norms. Firstly, sport used to be a form to build the character of a person and was therefore addressed to young people. Secondly, sport was considered to cause serious harm to the body of elderly (Coakley, 2017). The increasing popularity of masters sports over the past 40 years has been reflected by increases in participation rates at major masters competitions throughout the world (Knechtle et al., 2016; 2017; Nikolaidis et al., 2017; Unterweger et al., 2016).

Masters athletes have a variety of motives to participate in sports throughout their lifetime, such as health and fitness reasons, enjoyment of physical activity, opportunities to test their own physical capabilities, social inclusion, as well as extrinsic reasons, like awards (Hodge et al., 2008; Larson et al., 2019; Medic, 2009). In most masters competitions, sport governing organizations arrange 5-year competitive age categories (e.g., athletics, swimming) to provide equal chances for aging athletes and organize competitions which cater to their needs to increase the participation of middle-aged and elderly in sports (Medic et al., 2009a). However, recent studies have suggested that there may be potential problems with the current age categorization, indicating that a constituent year effect may be influencing the motivation, participation, and performance of athletes in masters swimming and track and field (Medic et al., 2009a).

The constituent year effect in masters sport refers to the participation- and performance–related advantage of being relatively younger within a standard 5-year age category bracket (Medic et al., 2007). Medic et al. (2007) examined athletes from US masters track-and-field and swimming and found that there was a higher percentage of athletes participating in the National championships when they were in the first and second year of an age group, and significantly fewer if they were in the fourth or fifth year. Medic et al. (2009a) provided further evidence of a participation-related constituent year effect in both male and female masters athletes and in athletes in the fourth decade of life and beyond, however the effect was stronger in males than females and that it increased with age. Participation-related constituent year effect was also found in a sample of US marathon runners (Connick et al., 2015) and Australian masters track and field athletes (Medic et al., 2018). Medic et al. (2009b) also found participation-related constituent year effect in masters swimming and track and field; however the effect was not significant in masters weightlifting and rowing potentially because those sports are grouped based on both age and weight class and/or due to the lower popularity and cultural importance of these sports. Utilizing a retrospective longitudinal study design where athletes were followed over a period of 5 years, Medic et al. (2011) reported that the odds of a masters swimmer participating in the first year of any 5-year age category was more than two times greater than the odds of that athlete participating during the fifth year.

Further research is necessary to better understand constituent year effect in masters sports as this might help to create an environment in which aging athletes have better opportunities to participate successfully in sports. So far, no studies have reported whether there are changes or significant points in history regarding the constituent year

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effect throughout the 40+ years of masters sports (Rubin & Rahe, 2010). For example, studies by Medic et al. (2007, 2009a) were cross sectional in nature in that participation entries that were collected between 1998 and 2006 were grouped and converged into one database. Thus, it remains unknown whether there has always been a participation-related constituent year effect in masters sports or if there has been a change, development or peak in the strength of the effect. Therefore, the main research questions examined in this study were: Has the participation-related constituent year effect always existed in US masters swimming? Has the strength or direction of the effect changed over time? Has the effect been influenced by gender and age over time?

Methods

Participants

The present study tracked the existence of the constituent year effect in masters athletes participating in the US Masters national short course swimming championships at each of the historical time periods in years 1972, 1982, 1992, 2002, 2012 and 2016. A time span of ten years in between the examined competitions was used in order to examine representative data on the development of constituent year effect, with the year 2016 representing the most recent year (i.e., essential data from 2017, 2018, and 2019 competitions were unavailable). Archived data were retrieved from the official homepage of the US Masters Swimming (i.e., http://www.usms.org). Data were considered reliable since they were posted as the 'final and official' meet roster by the overriding national body for the sport of swimming (i.e., US Masters Swimming). Even though athletes 18 years of age or older are eligible to participate in masters swimming, the data taken into consideration for analyses only included swimmers of the age 35 and older. The approach was chosen since it is in line with previous studies on constituent year effect in masters sports (Medic et al., 2007) and thus allows for congruency and comparability. The sport of masters swimming was chosen since it is one of the sports in which the participation-related constituent year effect had been documented. Data on participating athletes for each of the six selected historical periods were recorded from the result lists along with the name, age and gender of each athlete with the total sample consisting of 5232 masters athletes (3220 males and 2012 females; age range 35 to 95 years).

Data collection

Since the establishment of US masters swimming in 1970, National Short Course Masters Swimming Championships have been held on an annual basis with competitions divided into age groups with five-year cohorts (e.g., 35-39, 40-44, 45-49, etc.). Therefore, consistent with previous studies, masters athletes in their first year of a 5-year age category were identified as "year 1" participants (i.e., 35, 40, 45, 50, etc.). Similarly, "year 2" masters athletes consisted of competitors in the second year of any 5-year age category (i.e., 36, 41, 46, etc.) and likewise "year 3", "year 4" and "year 5" for participants, who were in their third fourth and fifth year of any age category at the time of championships. To determine whether a participation-related constituent year effect is influenced by age, participants were divided into three age groups: younger (35-49yrs), middle (50-64yrs), and older (65yrs and above) aged athletes.

Statistical analysis

The data were analyzed using a software program (i.e., SPSS). Observed counts were calculated for each year of the 5-year cohort. Expected counts were assumed to be equal throughout each age category and therefore set at 20%. Differences between the observed and expected participation of the athletes were calculated with the chi-square tests. The final step involved calculating the effect sizes to evaluate the magnitude of a possible unequal participation distribution for each constituent year within the 5-year age category. To measure the effect size, we followed the guidelines provided by Vincent (2005). Therefore, the effect size was calculated as the ratio between observed and expected frequency counts and the standard deviation. The level of significance was set at $p < 0.05$ for each statistical analysis.

Results

Table 1 presents frequency counts distributions for participation entries in each constituent year of the 5-year age category for the total sample and across five different historical time periods. For the total sample, the results showed that the participation-related constituent year effect was evident ($\chi^2_4 = 196.83$, $p < 0.0001$). Specifically, results indicated that significantly more masters swimmers who were within the first and second year and significantly fewer who were within the fourth and fifth year of an age category participated at National competitions. The effect sizes were largest during the first and last year of an age category. The results for time indicated the existence of a participation-related constituent year effect for each of the six time periods, specifically during 1972 ($\chi^2_4 = 15.56$, $p < 0.01$), 1982 ($\chi^2_4 = 33.74$, $p < 0.0001$), 1992 ($\chi^2_4 = 69.39$, $p < 0.0001$), 2002 ($\chi^2_4 = 45.50$, $p < 0.0001$), 2012 ($\chi^2_4 = 19.59$, $p < 0.001$), and 2016 ($\chi^2_4 = 64.77$, $p < 0.0001$). As can be seen from Figure 1, a participation-related constituent year effect seemed to have existed from the inception of organized masters swimming competitions in the US. Generally, the tendency to participate at National competitions during the first year of an age category was significantly more pronounced, whereas the tendency of participating during the fifth year of an age category was lower. Across time, the effect sizes were largest during the first and last year of an age category.

The results for gender indicated the participation-related constituent year effect was evident for both males ($\chi^2_4 = 154.00$, $p < 0.0001$) and females ($\chi^2_4 = 49.93$, $p < 0.0001$). However, as can be seen from Figure 2, the effect was stronger in males and was strongest during the first and last year of an age category. Furthermore, for males the effect was significant ($p < 0.05$ in year 2012 and $p < 0.0001$ for all other years) in each of the years, whereas for females it was significant in year 1992, 2002, and 2016 (see Table 2).

Table 1. Participation rate distributions within constituent years among masters swimmers across historical periods

		Observed Frequency	Expected Frequency	χ^2	d.f.	*p*	Effect size
Total	Year 1	1385	1046	109.57	1	< .0001	1.49
	Year 2	1143	1046	8.92	1	< .01	0.43
	Year 3	996	1046	2.43	1	N.S.	-
	Year 4	906	1046	18.84	1	< .001	0.62
	Year 5	802	1046	57.08	1	< .0001	1.08
1972	Year 1	33	36	.25	1	N.S.	-
	Year 2	57	36	12.25	1	< .001	1.77
	Year 3	30	36	1.00	1	N.S.	-
	Year 4	31	36	.69	1	N.S.	-
	Year 5	29	36	1.36	1	N.S.	-
1982	Year 1	151	103.6	21.69	1	< .0001	1.60
	Year 2	106	103.6	.06	1	N.S.	-
	Year 3	83	103.6	4.1	1	< .05	.70
	Year 4	103	103.6	.01	1	N.S.	-
	Year 5	75	103.6	7.90	1	< .01	.97
1992	Year 1	276	184.8	45.01	1	< .0001	1.61
	Year 2	196	184.8	.68	1	N.S.	-
	Year 3	171	184.8	1.03	1	N.S.	-
	Year 4	152	184.8	5.82	1	< .05	.58
	Year 5	129	184.8	16.85	1	< .0001	.99
2002	Year 1	234	167.6	26.31	1	< .0001	1.52
	Year 2	190	167.6	2.99	1	N.S.	-
	Year 3	145	167.6	3.05	1	N.S.	-
	Year 4	132	167.6	7.56	1	< .01	.82
	Year 5	137	167.6	5.59	1	< .05	.70
2012	Year 1	319	281	5.14	1	< .05	1.02
	Year 2	291	281	.36	1	N.S.	-
	Year 3	309	281	2.79	1	N.S.	-
	Year 4	255	281	2.41	1	N.S.	-
	Year 5	231	281	8.90	1	< .01	1.35
2016	Year 1	372	273.4	35.56	1	< .0001	1.48
	Year 2	303	273.4	3.20	1	N.S.	-
	Year 3	258	273.4	0.87	1	N.S.	-
	Year 4	233	273.4	5.97	1	< .05	.61
	Year 5	201	273.4	19.17	1	< .0001	1.09

χ^2 = Chi square; d.f. = Degrees of freedom; *p* = p-value; N.S. = Non-significant.

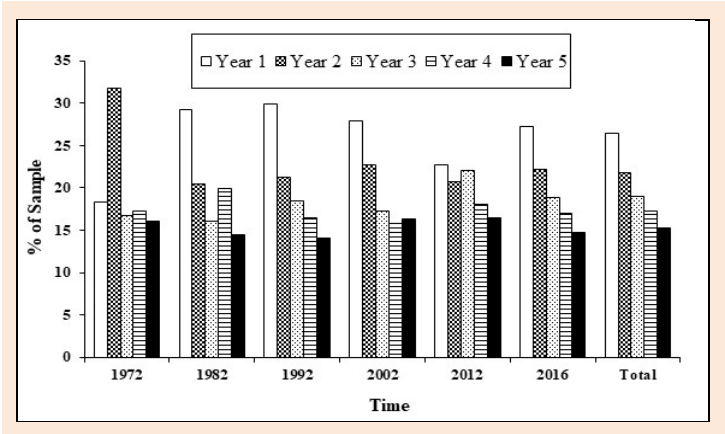

Figure 1. Percentages of masters athletes who participated in USA National Short Course Swimming Championships within each constituent year of an age category across different historical periods.

The results for age indicated the participation-related constituent year effect was significant for younger ($\chi^2_4 = 37.23$, $p < 0.0001$), middle ($\chi^2_4 = 115.80$, $p < 0.0001$) and older-aged ($\chi^2_4 = 89.35$, $p < 0.0001$) masters swimmers. However, as can be seen from Figure 3, the effect has been strongest amongst older-aged masters swimmers since 1992. In addition, for younger-aged group the effect was significant ($p < 0.05$) in each of the years except for 2016; for the middle-aged group the effect was significant ($p < 0.05$) in each of the years except for 1972; whereas for older-aged masters swimmers it was significant in year 1992, 2002, 2012, and 2016 (see Table 2).

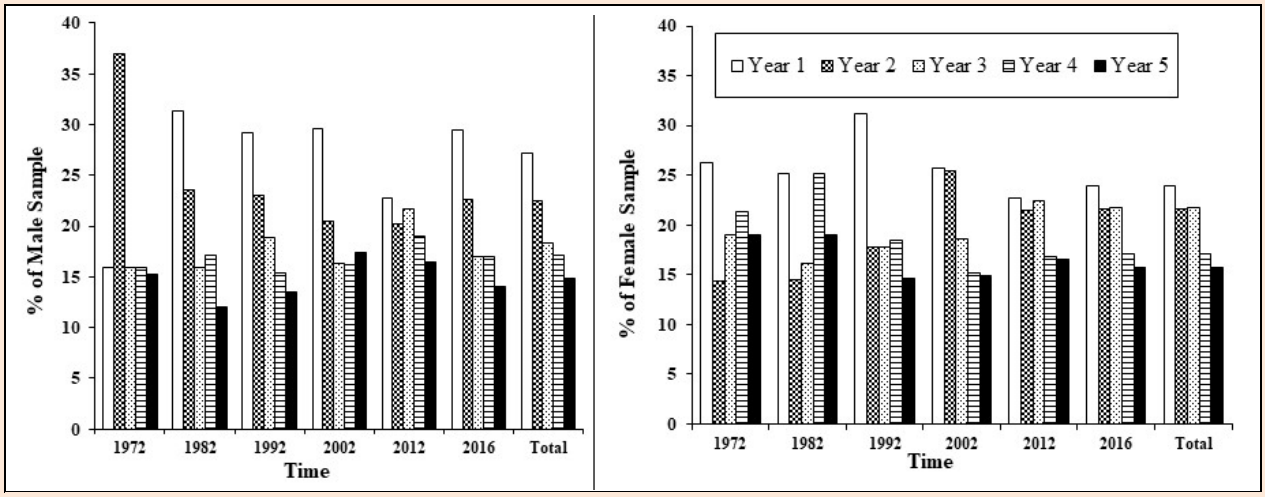

Figure 2. **Percentages of male and female masters athletes who participated in USA National Short Course Swimming Championships within each constituent year of an age category across different historical periods.**

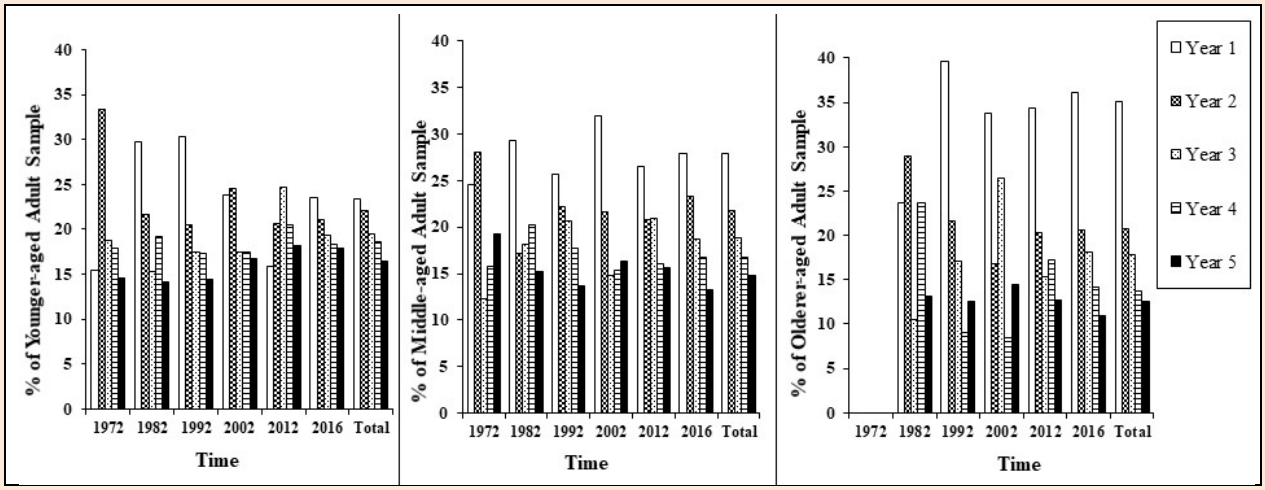

Figure 3. **Percentages of younger, middle and older-aged masters athletes who participated in USA National Short Course Swimming Championships within each constituent year of an age category across different historical periods.**

Discussion

This study was designed to fill the gap in the existing literature by analyzing participation-related constituent year effect in masters swimming over different historical time periods while considering athlete's age and gender. Consistent with the conclusions by Medic et al. (2007; 2009a; 2009b; 2011; 2018), the findings of this study indicated that, for the combined sample over the 40 year period, US masters swimmers attended National competitions most often when they were relatively youngest and least often when they were relatively oldest in comparison to their peers within the same age category. This suggests that the current 5-year age grouping affects masters swimmers unequally depending on birth date, thus resulting in inequitable participation outcomes at yearly National competitions between relatively old and relatively young cohorts. Specifically, a relatively younger cohort of masters swimmers has higher participation rates compared to a relatively older cohort.

The main aim of this study was to analyze whether a participation-related constituent year effect always existed over the past 40 years of masters swimming or if there has been a development of the phenomenon. The results of this study suggest that the participation-related constituent year effect in the US masters sport of swimming existed since its early years of inception and has developed throughout each of the past four decades, especially for males and older-aged masters swimmers. There were statistically unequal distributions of relatively younger and older competitors during the 1980s and subsequent decades (large effect sizes), and similar (but moderate) effects observed in competitions during 1970's. The US Masters Swimming envisions the most important quality of masters swimming is to 'encourage and promote improved physical fitness and health in adults' (U.S. Masters Swimming, 2019). It also acknowledges that a form of competition is needed to achieve the one of the primary goals of a better and prolonged health. On one hand, the competitive character of masters swimming may be associated with declines

Table 2. Participation rate distributions within constituent years among masters swimmers across historical periods for the separate genders and age periods.

	Category	Year 1	Year 2	Year 3	Year 4	Year 5	Total	χ^2	p
Gender	**Males**	877	723	590	550	480	3220	154.00	< .0001
	Males 1972	22	51	22	22	21	138	24.83	< .0001
	Males 1982	106	80	54	58	41	339	38.54	< .0001
	Males 1992	176	139	114	93	82	604	47.21	< .0001
	Males 2002	141	98	78	77	83	477	30.20	< .0001
	Males 2012	192	171	184	161	139	847	10.16	< .05
	Males 2016	240	184	138	139	114	815	61.18	< .0001
	Females	508	420	406	356	322	2012	49.93	< .0001
	Females 1972	11	6	8	9	8	42	1.57	-
	Females 1982	45	26	29	45	34	179	8.79	-
	Females 1992	100	57	57	59	47	320	26.69	< .0001
	Females 2002	93	92	67	55	54	361	20.48	< .001
	Females 2012	127	120	125	94	92	558	10.58	-
	Females 2016	132	119	120	94	87	552	13.13	< .05
Age	**Younger Adults**	574	545	479	457	406	2461	37.23	< .0001
	Younger 1972	19	41	23	22	18	123	14.36	< .01
	Younger 1982	84	61	43	54	40	282	21.94	< .001
	Younger 1992	151	102	87	86	72	498	37.68	< .0001
	Younger 2002	104	107	76	76	73	436	12.92	< .05
	Younger 2012	98	128	153	127	113	619	13.43	< .01
	Younger 2016	118	106	97	92	90	503	5.28	-
	Middle Adults	620	485	420	374	328	2227	115.80	< .0001
	Middle 1972	14	16	7	9	11	57	4.67	-
	Middle 1982	58	34	36	40	30	198	12.00	< .05
	Middle 1992	81	70	65	56	43	315	13.11	< .05
	Middle 2002	102	69	47	49	52	319	33.34	< .0001
	Middle 2012	167	131	132	101	98	629	25.05	< .0001
	Middle 2016	198	165	133	119	94	709	46.39	< .0001
	Older Adults	191	113	97	75	68	544	89.35	< .0001
	Older 1972	-	-	-	-	-	-	-	-
	Older 1982	9	11	4	9	5	38	4.63	-
	Older 1992	44	24	19	10	14	111	31.75	< .0001
	Older 2002	28	14	22	7	12	83	16.82	< .01
	Older 2012	54	32	24	27	20	157	22.78	< .001
	Older 2016	56	32	28	22	17	155	29.42	< .0001

χ^2 = Chi square; p = p-value; NS = Non-significant; Younger Adults = 35-49yrs, Middle Adults = 50-64yrs, Older Adults = 65yrs and above.

in participation during later stages of an age category, especially if athletes do not have the perception of an equal chance to succeed compared to their relatively younger competitors (Medic et al., 2013). On the other hand, it is possible that constituent year effect actually confer some benefits, in that it may encourage more strategic, periodized training (similar to an Olympic cycle), thus possibly preventing burnout or overuse injuries. In addition, it may also double as a cost-saving measure for masters swimmers who decide in advance that they will attend National competition every time they move up to a new age category. In spite of this, and consistent with other studies (Unterweger et al., 2016), overall trends also show an increase in the number of masters swimmers in US over each of the past decades since the inception of the sport, indicating positive trends in regards to the overall participation in the sport.

Consistent with previous studies (Medic et al., 2009a; Medic et al., 2018), the participation-related constituent year effect was significant in both male and female swimmers, but seemed to be stronger in males. These findings could be explained by potential motivational differences between male and female athletes. Specifically, males have been found to be more attracted by winning, they derive more meaning from the outcome of the competition, are more ego-oriented, and have less self-determined motivational profile than females (Cheuvront et al., 2005; Medic et al., 2009a) thus, leading to a potential decrease in participation in competitions where the opportunity to perform well was reduced. In line with previous studies (Medic et al., 2009a; 2018), the participation-related constituent year effect was more pronounced with age. Several explanations of why participation-related constituent year effect was strongest amongst older-aged masters swimmers include inevitable declines in athletic performance with age (Tanaka and Seals, 2008), individual's perceptions of physical disadvantage of being relatively older and higher extrinsic motivation (Medic et al., 2009a).

There are several possible explanations for the development of the participation-related constituent year effect in US masters swimming. First, the increased popularity and acceptance of masters swimming may have proliferated the constituent year effect over time, especially through higher competition. For example, significant increases in participation and competition over the years

amongst masters swimmers would have made winning of competitive awards more difficult, especially for relatively older athletes (i.e., those in their last year of an age category). Also, general population growth in the US of approximately 100 million people (U.S. Census Bureau, 2018), which was an increase by a third of the total population, over the forty year period from 1970s through to 2010s (this was also a period of time when baby boomers were reaching masters swimming age eligibility), coupled with increases in media coverage of sport would likely have contributed positively to the observed constituent year effect.

In line with previous recommendations by Medic et al. (2009a), a few potential solutions relating to the participation-related constituent year effect in masters sport may be to implement an age-grading system to award prizes at masters competitions, or to use the existing 5-year age categories system in concert with the age-grading system. An age-grading system employs mathematical formulae to derive age corrected times from absolute performance times while adjusting for distance, age and sex. Thus, some of the benefits of this system is its compatibility with the current 5-year age categorization since the absolute results can be calculated with a formula and make them comparable to athletes across the age spectrum, as well as that the athlete's individual result can be comparable to their former performances independent of one's chorological age. Furthermore, an age grading system could be a useful tool for sport psychologists in helping aging athletes in the consideration and development of their sport goals (Medic, 2009). Consequently, this approach could over time potentially further foster the health-enhancing character of masters sports while also taking into account the competitive nature of sport (Geard et al., 2018; McKendry et al., 2018; McPhee et al., 2016). Another potential solution could involve emphasis and encouragement of multiple motives which are unrelated to performance including enjoyment, friendship, health benefits, and personal development (Larson et al., 2019). Future research needs to assess effectiveness of these strategies in reducing or eliminating the participation-related constituent year effects in masters sport. Another solution to increasing participation of relatively older masters swimmers may be to educate coaches and teammates to focus their strategies and approaches that exhibit supportive attitudes and avoid over expectation (Santi et al., 2014).

One of the limitations of this study is that the sample size in the first year of measurement (i.e., 1972) is rather small, which makes this first period less representative statistically in comparison to subsequent periods but could also be an indicator of its popularity or lack of it during its establishment. Also, the statistical analyses were focused on participation entries only and thus the actual sport performances of the athletes over the historical time periods were not considered as part of this study. Future research could consider the achieved performances in competitions of masters athletes in order to highlight the competitive aspect in masters sports as it relates to the constituent year effect. Furthermore, future research needs to examine whether participation at national versus local level competitions and engagement in training activities serves a proxy for healthy engagement in masters sport since it is possible that some masters swimmers who are highly engaged in their sport may choose to avoid certain national competitions due to the expense, travel time, work/family obligations, or lack of interest in competing at that level. The current sample also consisted of masters swimmers only and is limited to US national championships and thus future studies should examine other sports and countries (Medic at al., 2009b; 2018). In future studies, samples from different sports in the same country could also be analyzed simultaneously as this approach might be useful for historical analysis of the constituent year effect in masters sports in shedding light on unique sociological factors. Finally, there is also a possibility that athletes' decisions to competitively participate as a function of constituent year may be influenced by disparities in physical demands (Hunter & Stevens, 2013; Kundert et al., 2018) and the age of peak performance (Allen & Hopkins, 2015; Nikolaidis et al., 2017). Thus, future research needs to explore whether constituent year effects exist across different events and disciplines (e.g., short, middle, long distance).

Conclusion

In conclusion, the results of this study are novel as this is the first study to report on the historical development of a constituent year effect from the inception of masters swimming competitions to recent times. Participation-related constituent year effect in US masters swimmers existed since its inception and developed over decades for both males and females and across the age continuum, however it was strongest for males and older-aged masters swimmers. These findings are derived from the current setting of 5-year age categorizations which was originally established to provide equal participation opportunities for all competitors. Irregular sport participation at masters competitions (i.e., higher absences during later stages of an age category) may sacrifice continuity of involvement but may also promote it through a more strategic periodized training. Given that sport participation is associated with sport performance and functionality in aging athletes (Young et al., 2008), it is crucial that we advance our understanding of the constituent year effect in masters sport as it can likely affect younger, middle and older aged athletes' sport motivation and their ability to maintain overall long term health (Gayman et al., 2017; Tanaka, 2017) through optimal training and competition routine.

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The experiments comply with the current laws of the country in which they were performed. The authors report no conflict of interest.

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Key points

- The aim of this study was to examine the participation-related constituent year effect in US masters swimming over a 40 years period.
- Since the establishment of US masters swimming National competitions, masters athletes have been significantly more likely to participate in competitions when they were relatively youngest and less likely when they were relatively oldest within their 5-year age category.
- Over time, participation-related constituent effect became stronger in males than females and was strongest in older-aged masters athletes.
- Factors such as increased competition and acceptance of sport amongst middle- and older-aged athletes, population growth and increased media coverage of sport may have contributed to the magnitude of the participation-related constituent year effect in masters swimming.

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