Competitive Systematization in Age-group Swimming: An Evaluation of Performances, Maturational Considerations, and International Paradigms

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The most appropriate method for grouping youth swimmers to assure fair competition has been debated for decades with little progress being made. The present study evaluates the age classification utilized at the 2nd FINA World Youth Swimming Championships and those used by swimming federations around the world. Our results illustrate a greater proportion of older participants and older finalists at the international event. No universal age-grouping system is evident among the various swimming federations. We conclude that most age-grouping systems, particularly those using a multi-age group paradigm, unduly influence participation and bias competition outcomes. More effective age-groupings are hypothesized. From these research findings, continued international discussion on this topic appears to be warranted.

Key words: youth swimming, age classification, growth and maturation, fairness in competition

INTRODUCTION

Competitive youth swimmers are commonly separated by sex and then stratified into competitive groups based on chronological age (CA). This is done regardless of the differences in maturational timing and tempo or physical size among the swimmers that may exist within a given CA (Malina et al., 2004). Implementing maturation- or size-based assessments for a more fair grouping system is not logistically practicable. Such assessments are complex, costly, invasive, potentially unsafe, and at times, unreliable. However, given the variation in maturity status within a single CA, collapsing CAs into multi-age categories does not assure competitive fairness and equity. Kojima et al. (2009) demonstrated the age-related differences in swim performance of the top 100 U.S. swimmers and confirmed the hypothesis that younger swimmers within the standard multi-age-groups used by USA Swimming are competitively disadvantaged. Whether or not this is true at the international level of competition remains to be determined.

With the intention of providing future World and Olympic level athletes with greater competitive and more intercultural experiences, the Fédération Internationale de Natation (FINA) hosted the second edition of the FINA World Youth Swimming Championships in July, 2008. Only one age-group was provided for each sex, combining 14-17 year-old girls and 15-18 year-old boys at the Youth Championships. However, considering the magnitude of our recent findings (Kojima et al., 2009), it was hypothesized that older swimmers within the multi-age-groups might represent the majority (or at least a greater proportion) of the finalists at this event. Furthermore, the age-grouping system that combined four CAs into a single group is likely to have resulted in age-related (also potentially maturation-based) competitive outcomes which might differ in the girls as compared to the boys. The goals of this study were 1) to evaluate the appropriateness of the age-groups at the 2nd FINA World Youth Swimming Championships and 2) to discuss age-grouping systems used by countries in the world as a means of gaining a better insight into the most appropriate age-group stratification paradigm.

METHODS

The 2nd FINA World Youth Swimming Championships

All data (i.e., meet results) were acquired from the official website of FINA (http://www.fina.org). The single age-grouping for each sex was composed of four CAs (ages 14-17 years for girls and ages 15-18 for boys). The Championships included 17 individual events for both sexes: 50-, 100-, 200-, 400-, 800-, and 1500-m freestyle, 50-, 100-, and 200-m backstroke, breaststroke, and butterfly, and 200- and 400-m individual medley. In addition, there were three relays: 400- and 800-m freestyle relays and 400-m medley relay. To investigate the influence of the age-groupings on the swimmers qualifying for preliminaries and finals, a frequency distribution of all competitors and the top 8 finishers in the 17 events was examined for each of the four CAs. A relative frequency distribution of all competitors and finalists was calculated and averaged over the 17 events. To examine the influence of the age-groupings on 'chance of participation' in the Youth Championships and selection at the trials of each country, the relative frequency distribution of relay members of the top 8 countries was examined. All data were analyzed using PASW Statistics 17.0 (SPSS inc., Chicago, Illinois). Chi-square tests were performed to determine whether or not there was a significant difference between the expected frequencies (a quarter of the total frequency for age) and the observed frequencies within the age-groups. One-way analysis of variance (ANOVA) with Tukey's post-hoc test and Pearson product moment correlation coefficients were also used to test the research hypotheses. The level of significance was set at $p < 0.05$.

International age-grouping systems

Information regarding age-grouping systems of FINA swimming federations was collected from the website of each national federation. The following countries were selected for this study due to the lack of a common language: Australia, Britain, Canada, China (Hong Kong & Macau), Germany, Japan, New Zealand, Spain, Taiwan, and the USA. Phone correspondence was also made to obtain more details of each federation's rationale and intent in their age-grouping systems.

RESULTS

The 2nd FINA World Youth Swimming Championships

The total number of swims in the 17 individual events was 754 for the girls and 943 for the boys. When expressed by age categories, in girls there were 66 swims (8.8%) by fourteen year olds, 148 (19.6%) by fifteen year olds, 218 (28.9%) by sixteen year olds, and 322 (42.7%) by seventeen year olds. In boys, there were 46 swims (4.9%) by fifteen year olds, 152 (16.1%) by sixteen year olds, 259 (27.5%) by seventeen year olds, and 486 (51.5%) by eighteen year olds. A significant difference was found between the observed and expected values in both sexes, indicating an uneven distribution of swims across age categories.

Figures 1 and 2 illustrate the relative frequency distributions (%) of the top 8 swimmers over the 17 events and relay members of the top 8 countries. Significant differences in the mean relative frequency among CAs were found in both sexes (Table 1). The oldest CA in both sexes (age 17 for girls and age 18 for boys) had a significantly greater proportion compared with all other age categories. The younger CAs had fewer swims in the finals and represented a smaller proportion of the total distribution. The age-related differences were more evident in boys. There was only one 15-year-old finalist (100-m butterfly) in boys, and he was the only swimmer under the age of 17 who competed in a relay final.

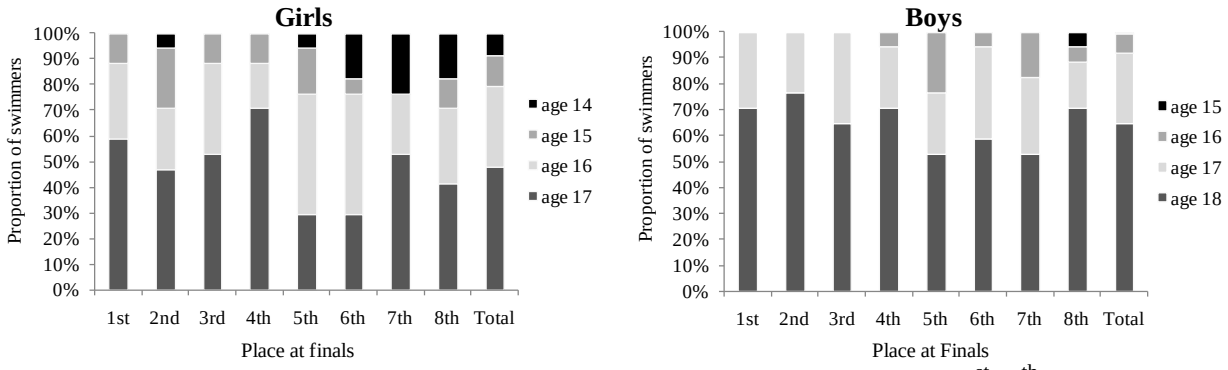

Figure 1. The relative frequency distributions (%) of the top 8 swimmers (1^{st}–8^{th}) and the total swims in finals (Total, N = 136) over 17 events for the four age categories.

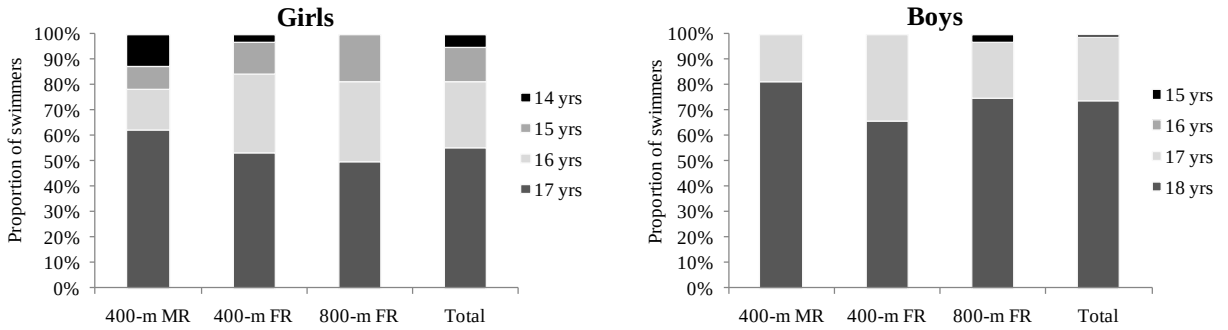

Figure 2. The relative frequency distributions (%) of the top 8 relay members and the total finalists of three relays (Total, N = 96) for the four age categories.
MR, medley relay; FR, freestyle relay

Table 1. Mean relative frequency distributions (%) of the top 8 swimmers and the top 8 relay members over all events for the four age categories.

Girls			Boys		
Age (yrs)	IE finalists	Relay members	Age (yrs)	IE finalists	Relay members
17	47.8 ± 14.2 ‡	55.2 ± 6.5 ‡	18	64.7 ± 8.9 ‡	74.0 ± 7.9 ‡
16	31.6 ± 10.9 ‡	26.0 ± 9.0 ¶	17	27.2 ± 6.2 ‡	25.0 ± 8.3 ‡
15	11.8 ± 7.0 †	13.5 ± 4.8 *	16	7.4 ± 8.8 †	0 ± 0 †
14	8.8 ± 19.0 †	5.2 ± 6.5 †	15	0.7 ± 2.1 †	1.0 ± 1.8 †

IE, individual event
‡ Significantly different from all other age categories ($p < 0.05$).
† Significantly different from two oldest age categories ($p < 0.05$).
¶ Significantly different from the youngest and oldest age categories ($p < 0.05$).
* Significantly different from the oldest age category ($p < 0.05$).

To investigate the chance to advance to the finals and therefore to score, i.e., chance of success, for swimmers in each CA category, the ratio of the number of top 8 swimmers to total competitors in each event was examined (Table 2). No significant difference in the mean ratio for the 17 individual events among CAs was found in girls, while the mean ratio in boys was significantly different ($p < 0.01$) and related to age ($r = 0.59$, $p < 0.01$).

Table 2. The mean ratio of the number of finalists to the total competitors over 17 events by age category.

Girls		Boys	
Age (yrs)	Mean ratio	Age (yrs)	Mean ratio
17	0.21 ± 0.10	18	0.20 ± 0.06 ‡
16	0.21 ± 0.14	17	0.16 ± 0.07 †
15	0.11 ± 0.11	16	0.08 ± 0.11
14	0.16 ± 0.18	15	0.03 ± 0.12

‡ Significantly different from the two youngest age categories ($p < 0.05$)
† Significantly different from the youngest age category ($p < 0.05$)

DISCUSSION

The hypothesis that older swimmers within the designated age-groups represent the majority of swims in the finals and that of competition at large was supported by the analyses. There were a greater number of older participants and finalists in both sexes. Furthermore, the odds of advancing to the finals for boys were significantly greater for the oldest swimmers at the Championships. By combining four ages into a single competitive cohort, participation was influenced and thus performance outcomes at the FINA Youth Championships were nearly predetermined. Although "fairness" was not a goal at this international event, the age-grouping system employed did not provide the younger swimmers within age-groups with an equal chance of experiencing a higher level of competition or any competitive success.

Age-related variations in physiological parameters related to sports performance during adolescence are well documented (Malina et al., 2004). These variations are attributable mainly to maturity status and size differences (e.g., limb length, height, and muscle mass) and become more apparent during and after the growth spurt, especially in boys. One marker of maturation is the age at peak height velocity (PHV: on average, age 12 in girls and age 14 in boys). Regarding swim performance data, Pelayo et al. (1997) reported age-related differences in the performance of non-skilled students aged 11 to 17 years. Also, Kojima et al. (2009) recently demonstrated age-related differences in the swim times of the top 100 U.S. swimmers from age 5 to 20 years. Both studies found significant differences in swim performance between 14- and 17-year-old girls, while swim performance of boys in 15 to 17 year-old categories was significantly different from each other. In each case, younger swimmers were slower than older swimmers. Girls reach a point where age (and maturity) is less of an issue about two years earlier than boys.

In the present study, younger swimmers typically placed lower than older swimmers (Figure 1). Nine 14 and 15 year-old girls (out of 51, 17%) finished within the top 3 in any of the 17 events. In the boys, no 15 or 16-year-olds finished in the top 3, and only ten 16-year-olds finished in the 4-8th places. There was only one 15-year-old finalist, and he finished 8th in his event. This might lead to the conclusion that age (and thus maturation) might be more important among boys than among girls, at least in this age range.

Within the relays, the majority of the finalists (81.2% in girls and 99.0% and in boys) were swimmers in the two oldest age categories (Figure 2 and Table 1). Moreover, the mean ratio of chance to advance to the finals over 17 events is presented by age categories in Table 2 (note that the ratio does not reflect the absolute number of swimmers, rather, swims). Significant differences in the ratios among CAs were revealed in the boys, while there was no significant difference in girls. This indicated that the age-grouping systems combining plural ages together would clearly influence competition and the chance of success, especially in boys due in part to

their greatly varied maturational nature among these CAs. The data pertaining to the girls (similar ratios) imply that the difference in the number of finalists among CAs might possibly be reduced if the number of participants at each CA was equal.

International age-grouping systems

According to FINA, each national federation is allowed to adopt their own competitive age-groupings. Thus, there are a wide variety of age-grouping systems in swimming currently in use around the world (Table 3). Each of the ten countries examined in this study uses a different system to classify swimmers, from as few as four to as many as eight age-groups. Some federations adopt sex-specific age-groups where CAs in the girls are pooled in a different manner from the boys. Others provide the same age-groups for both sexes. Britain and Japan use single-age-based qualification times for national youth championships, although some age categories are combined into competitive groups for the actual competition. China and USA entrust age-grouping systems and rules to each provincial swimming association or local swimming committee, so there may not be a common age-grouping system across these countries.

Table 3. Age-grouping systems in representative swimming countries (federations).

Country	Sex	< 8	9	10	11	12	13	14	15	16	17	18	19 <	20	Σ
Australia	unisex	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	5
Britain	Girls				◆	◆	◆	◆	◆	◆	◆				5
	Boys				◆	◆	◆	◆	◆	◆	◆	◆			6
	QT				◆	◆	◆	◆	◆	◆	◆	◆			8
Canada	Girls		◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	5
	Boys		◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	5
China*	unisex			◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	5
Hong Kong	unisex		◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	4
Macau	unisex	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	6
Germany	Girls				◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	6
	Boys				◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	6
Japan	unisex		◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	4
	QT		◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	10
New Zealand	unisex		◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	8
Spain	Girls		◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	6
	Boys		◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	5
Taiwan	unisex		◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	4
USA*	unisex		◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	4

Unisex, the same age-groups are adopted for girls and boys; QT, qualification time for national or state youth (age-group) championships; Σ, total age-groups; *Age-grouping systems differ among local swimming committees or provincial swimming associations.

The fact that FINA does not stipulate particular rules for age-grouping provides notable characteristics of age-grouping systems among federations, such as 1) the number of age-groups, 2) sex-dependent or independent groups, 3) single-age-based qualification times regardless of age-groups, and 4) local/provincial organization-determined systems. These are conceivably derived as a means of reinforcement and enlivenment of youth swimmers. For instance, combining multi-ages into groups appears to be an attempt to provide a higher competitive field for swimmers although the multi-age-grouping reduces the chance of success for younger swimmers within age-groups. Moreover, since girls, on average, reach maturity sooner than

boys, and therefore potentially have less variation in sports performance among older individuals (Malina et al., 2004), they could be classified into a multi-age-group at an earlier age than boys.

Using multi-age classification addresses the issue of younger swimmers being discouraged until they "age up." It is not uncommon for young swimmers to terminate their competitive swimming careers when they move up to older multi-age-groups: thus being at the "bottom of their age-group," where they feel they can no longer compete successfully. This coincides with a greater time demand for academics and schoolwork. Lack of success at higher levels of competition causes swimmers to reevaluate their interests. In light of these logistic and maturational factors, Kojima et al. (2009) have suggested an alternative age-grouping system: 1) using single CA category (at least, up to age 14 years in girls and 16 years in boys), 2) sex-dependent groupings, and 3) a single unisex group for girls and boys aged 7 years and under. These ideas may not address all inherent issues of grouping adolescent swimmers by CA, but may better ensure fairness and equality in competition than the current paradigms in use today.

Lastly, that FINA does not control worldwide age-grouping rules may be logically appropriate. From the point of view of documented ethnic variation in timing of growth and maturation (Eveleth & Tanner, 1990; Malina et al., 2004), it would be unreasonable to adopt a universal age-grouping paradigm. Data have shown that maturational events occur at early ages in Asian and Black-American children when compared with European and American Caucasian children. There seems to be approximately a 1-year difference in the age at PHV between these ethnic groups. To compare the mean age of Asian vs. European/North American swimmers, we used data from the present study and found a mean age of 15.8 ± 1.1 years for Asians girls vs. 16.2 ± 0.9 years for Caucasians ($p > 0.05$). In boys, the Asian swimmers were younger (16.9 ± 1.0 vs. 17.6 ± 0.6, $p < 0.05$). Due to maturation-related competitive advantages in early maturers over late and/or average maturers (Malina et al., 2004), the ethnic differences may be an interesting consideration in predicting performance outcomes at international competitive events.

CONCLUSION

Age classification systems clearly influence participation and competition outcomes in competitive youth swimming. The number of swimmers qualifying for competitive events and then qualifying for finals at international events is significantly greater for swimmers who are the oldest in their age-groups. Grouping swimmers by the use of broad CAs is not the optimal way to encourage younger competitors. With today's computing power and software sophistication, novel strategies are available to group swimmers without affecting the meet timeline or expense. These new innovative strategies may act to enhance competition and encourage participation.

REFERENCES

1. Eveleth, P. B. & Tanner, J. M. (1990). *Worldwide Variation in Human Growth*. 2nd Edition. Cambridge: University Press.
2. Fédération Internationale de Natation: http://www.fina.org
3. Kojima, K., Jamison, P. L., Brammer, C. L., & Stager, J. M. (2009). Age classification in USA Swimming: are current competitive age-groups appropriate? *Medicine & Science in Sports & Exercise, 41(5)*, 148.
4. Malina, R. M., Bouchard, C., & Bar-Or, O. (2004). *Growth, Maturation, and Physical Activity*. 2nd Edition. Champaign, IL: Human Kinetics.
5. Pelayo, P., Wille, F., Sidney, M., Berthoin, S., & Lavoie, J. M. (1997). Swimming performances and stroking parameters in non skilled grammar school pupils: relation with age, gender and some anthropometric characteristics. *Journal of Sports Medicine and Physical Fitness, 37*, 187-93.