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Original research

Transient Relative Age Effects across annual age groups in National level Australian Swimming

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ABSTRACT

Objectives: To determine the prevalence, magnitude and transient patterning of Relative Age Effects (RAEs) according to sex and stroke event across all age-groups at the Australian National age swimming Championships.
Design: Repeated years of cross-sectional participation data were examined.
Methods: Participants were 6014 unique male (3185) and female (2829) swimmers (aged 12–18 years) who participated in Freestyle (50, 400 m) and/or Breaststroke (100, 200 m) at the National age swimming Championships between 2000–2014 (inclusive). RAE prevalence, magnitude and transience were determined using Chi-square tests and Cramer's *V* estimates for effect size. Odds Ratios (OR) and 95% Confidence Intervals (CI) examined relative age quartile discrepancies. These steps were applied across age-groups and according to sex and each stroke event.
Results: Consistent RAEs with large-medium effect sizes were evident for males at 12–15 years of age respectively, and with large-medium effects for females at 12–14 respectively across all four swimming strokes. RAE magnitude then consistently reduced with age across strokes (e.g., Q1 vs. Q4 OR range 16 year old males = 0.94–1.20; females = 0.68–1.41). With few exceptions, by 15–16 years RAEs had typically dissipated; and by 17–18 years, descriptive and significant inverse RAEs emerged, reflecting overrepresentation of relatively younger swimmers.
Conclusions: Performance advantages associated with relative age (and thereby likely growth and maturation) are transient. Greater consideration of transient performance and participation in athlete development systems is necessary. This may include revising the emphasis of sport programmes according to developmental stages and delaying forms of athlete selection to improve validity.

1. Introduction

Across many youth sports contexts, the procedure of (bi-)annual age-grouping is implemented for logical organisation purposes and to reduce developmental differences between competitors on the basis of safety and equity.[1,2] However in athlete development terms, annual age-grouping still permits the potential for up to 12 months of chronological age difference and potentially greater biological age difference during years associated with maturation.[3] As a consequence, Relative Age Effects (RAEs[4]) can emerge; reflecting outcomes from an interaction between participants' birth dates and the dates used for chronological age grouping.[5] Being relatively older within an age grouping is associated with consistent attainment and selection advantages across junior and representative stages of sport, including an increased likelihood of selection to access further resources within athlete development systems, such as coaching expertise; skill development programmes; and, physical conditioning support.[1,3,6]

RAEs are most prevalent and with the highest effect sizes in male team sports contexts. By comparison, sport and age-matched female contexts have shown either lower RAE effect sizes or have been less prevalent; though fewer samples have been examined.[1,7] At various male junior and youth tiers (i.e., school, local community, representative and international) of soccer,[8,9] baseball,[10]

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handball,[11] rugby[6] and Australian rules football,[12] participation ratios between the relatively oldest and youngest quartiles have varied from small (e.g., 1.5–1), moderate (3-5–1) and in some cases large (≥5–1). Higher magnitude RAEs are associated with selective representative contexts at ages associated with puberty and maturation.[13] More recently, studies have identified that individual but still physically demanding sports are also associated with RAEs, notably including athletic sprinting,[5] tennis,[14] ski-jumping, cross-country and alpine skiing.[15,16] By comparison, sports with less dependence on physical characteristics and which have a technical skill emphasis have not been associated with RAEs (e.g., golf & shooting).[17]

Several hypotheses have been proposed to account for RAEs,[3,18] though most supported by evidence is the 'maturation-selection hypothesis'.[1,19,20] The hypothesis states that greater chronological age is equated with an increased likelihood of enhanced anthropometric characteristics from normative growth. Greater height and lean body mass (to a degree) are predictive of better physical capacities such as aerobic power, muscular strength, endurance and speed.[21] In turn, these provide physical performance advantages in specific tasks.[22] Also, during puberty, the timing and tempo of physical development generate further anthropometric and physical variation between individuals until its cessation.[23] Unfortunately for the relatively younger or later maturing, these processes lead to shorter-term disadvantages where they are more likely to be overlooked and excluded[24] at various stages of junior and youth sport, at least until the end of growth and maturation.

In the longer-term, recent studies suggest RAE and maturation inequalities may be transient on athlete development. Based on examining Candian ice-hockey players entering the professional NHL draft (aged 18–20), Deaner et al.,[25] initially identified a typical RAE with 36% and 14.5% being relatively older and younger respectively. However, the relatively younger actually went on to play in 20% of all NHL games played by the sample and were twice as likely to attain career benchmarks (i.e., 400–600+ games played). The relatively older were less likely to play a single NHL game and underperformed given their draft overrepresentation. Similarly, in UK Rugby League, the likelihood of attaining a professional contract at 18+ years old was associated with being relatively younger and later maturing. In their longitudinally data, it was identified that by 15–16+ years old later maturing players 'caught-up' with their early maturing counterparts on performance measures[26–28] illustrating transient patterns. That said, evidence of these transient patterns is still limited and explanatory mechanisms remain speculative. Thus, identifying RAE transiency is significant with important implications for sport systems, their practitioners and athletes.

As an individual sport context with high physiological demands, competitive swimming has received limited RAE examination,[29,30] yet RAE prevalence can be hypothesised. Relative age and maturation relate to physical (e.g., VO_2max; upper and lower body strength) and anthropometric (e.g., height, lean mass) development and these characteristics predict performance.[23,31] The influence of relative age and maturation on performance can also be isolated as other extraneous or confounding inter-athlete factors are not present (e.g., coach selection, team interaction).[12,25] Further at many swimming events, there are often sex-specific age-groups spanning junior and youth ages (e.g. 12–18 years old), divided according to stroke (e.g., freestyle; breaststroke) and distances (50 m & 400 m). Therefore, whilst recognising performance requirements in these events, an examination of transient RAE participation patterns is feasible.

In Australia, swimming is culturally iconic and one of the most popular individual sporting and leisure activities. Twenty-eight–thirty percent of all children and 14–16% of all adults are estimated to participate at some level.[32] Swimming Australia (the National sporting organisation) contains nearly 1000 swimming clubs and 90,000 registered members[33] reflecting participation from grassroots community to the elite National team. Connecting participation to competition, Swimming Australia has a junior and youth competition structure spanning states and territories reflecting regional or state level competition. The culmination and pinnacle of junior competition are the National age Championships. It is in this latter context that the current study resides. Based on a substantial data-set tracking 14 years of participation at the National age Championships, the purpose of this study was to determine the prevalence, magnitude and transient patterning of RAEs according to sex and four stroke events (i.e., Freestyle — 50 m & 400 m; Breastroke — 100 m & 200 m) within and across Australian Swimming age-group competition. If RAE patterns were identified, we rationalised findings held potentially significant and wide-ranging implications for Swimming Australia and their athlete development system.

2. Methods

Following institutional ethical approval, participants were N = 6014 unique male (n = 3185) and female (n = 2829) male and female swimmers (aged 12–18 years). These swimmers had competed in either specific or multiple swimming stroke events at the Australian National age Championships between 2000–2014 (inclusive). Multiple years of cross-sectional data were examined to increase participant numbers in the sampling frame and to capture an accurate representative account of participation trends over time. To participate at the championships, swimmers have to be 12–18 years old, and whether competing in 'heats' only or 'finals' for a given stroke and distance, participation reflected the fastest qualification times in Australia for a given year. Respective age-groups were determined by the swimmer's age on the first day of the annual championship event, with cut-off dates marginally changing each year (often early April). For example, in the year 2000 the cut-off date was 10th April while in 2014 it was 14th April.

In this study, data pertaining to Freestyle (50 m & 400 m) and Breaststroke (100 m & 200 m) were examined to reflect a sampling frame acknowledging between stroke and within stroke factors. Freestyle was sampled as it is considered to be the fastest of the four strokes, while Breaststroke is regarded as the slowest.[34,35] Due to mechanical and drag differences associated with these strokes,[36] they are also associated with different energetic requirements[37] and which interact with distance. Thus, two different distances for each stroke were examined. However, as we wanted to examine RAE trends across males and female and across multiple years of annual Championships, constraints related to stroke distances sampled were apparent. As the National Age Championships mimics the Olympic event schedule, the 50 m and 400 m Freestyle reflected the shortest and longest distances where both sexes participated and permitted an assessment as to whether physiological factors attenuated RAE trends. However, equivalent distances in Breaststroke were not available, and the 100 m and 200 m were the only events available. That said, these sampled stroke events did reflect the most competitive (i.e., higher participation numbers) in the Championship schedule and were considered informative for athlete evaluation and selection purposes.

In collaboration with Swimming Australia, participation data associated with the National age Championships was retrieved from two secure databases (i.e., 'Team Manager' and 'Event Manager') by two employees. Data was then systematically screened for data entry errors, with multiple identified and corrected. Data entry accuracy was also randomly checked with coaches and former participating athletes. Screening checked that only one participant