

A Movement–Analysis Comparison in Two Models of Junior Sport

Timothy B. Hartwig and Geraldine Naughton

Despite widespread encouragement for children to participate in sport, the efficacy of early sporting pathways remains underexplored. We compared a rotational junior-sport model combining skills from rugby, cricket, and netball with a modified games model. Motion analysis was used to quantify movement. Results revealed no differences between sporting models in relative percent time spent stationary ($p = .32$), walking ($p = .89$), jogging ($p = .45$), and fast running ($p = .06$). The rotational model had a greater number of skill-development opportunities per minute (median = 3.4) compared with the modified games model (median = 1.1, $p = .001$). Promising results from varied and rotational skill exposure warrant further elucidation.

Key Words: physical activity, movement quantity, movement opportunity, children's participation

Junior sports offer opportunities to be active, expend energy, develop motor skills, and nurture growth through positive psychosocial experiences (17). Despite well-established benefits of being active through sport in childhood and the risks associated with habitual sedentary behavior (12,14,20), junior-sport participation is declining. In Australia, the number of children participating in sport outside of school has dropped from 86% in 1985 to 62% in 2003 (1). Notable increases in obesity are correlated with declines in physical activity (14). Emerging evidence implicates inactivity as a major contributing factor to obesity (7). A challenge in addressing problems of childhood obesity, then, is to develop strategies to increase physical activity.

Factors linked to decreasing participation rates in junior sports include socioeconomic, family, and workplace changes (2,6,8,13,16,24). The integrity of junior-sport models, including the quality of participant experiences, however, is rarely explored as a contributing factor of decreased participation. Subsequently, improvements in junior-sport delivery and design since the evolution of modified junior sports more than 2 decades ago have been slow. The extent to which current junior-sport pathways attract and adequately provide children with experiences that maximize potential benefits to cardiovascular and musculoskeletal health, skill development, and positive socialization into sport remains equivocal. Using

Hartwig and Naughton are with the School of Exercise Science, Australian Catholic University, Sydney, Australia.

time–motion analysis, this study aimed to quantify opportunities to develop skills and be physically active in two models of junior sport. Specifically, a recently developed junior-sport model called “Ready Set Play,” which combines basic skills from rugby, cricket, and netball, was compared with opportunities presented in each sport’s established modified game.

Methods

Participants

After ethical approval from the university’s human research ethics committee was obtained, 23 children between the ages of 5 and 9 years who had enrolled in the Ready Set Play program were invited to participate in this study. Participation was encouraged via promotion on the Ready Set Play program’s Web site, and brochures were available for parents on the first evening of the program. Parents who allowed their children to participate provided written consent.

Research Design

The research design was an observational, randomized cross-over study of time–motion analysis in children participating in traditional modified games and the Ready Set Play program once a week for 6 weeks for approximately 1 hr each session. Children in the Ready Set Play program rotated between six stations of small-group activity. Tasks at each station resembled the introductory skills of rugby, netball, and cricket. Modified junior-sports games of Netta Netball, Walla Rugby, and Kanga Cricket provided the comparison model. Participants were randomly assigned to one of two groups. For the first 3 weeks Group 1 participated in the Ready Set Play program while Group 2 participated in traditional modified games. For the next 3 weeks Group 1 participated in traditional modified games and Group 2 participated in the Ready Set Play program.

Procedures

Anthropometric Data. Anthropometric measures were taken in the presence of parents and two researchers. Sensitive measures such as body mass were recorded behind a screen out of view of other participants. Each participant’s body mass was measured using a digital scale (Wedderburn, UWBW150) accurate to 0.01 kg, and standing stretch height was measured using a stadiometer. Body-mass and height data were used to calculate each child’s body-mass index (kg/m^2).

Time–Motion Analysis. Time–motion-analysis software (Trak Performance, Sports Tec Pty. Ltd.) was applied to video footage collected from each session. Video footage required spatial references such as field markings to improve analysis accuracy. An elevated viewing platform was selected to adequately record playing fields and participants. Two digital video cameras recorded two separate playing fields that were 15 by 30 m in dimension. Timing gates were used in Week 1 to measure walking, jogging, and sprinting speeds of the participants across 20 m.

Time results were entered into the Trak Performance program to set population-specific speed zones for walking, jogging, and fast running. Although the use of Trak Performance video-analysis techniques has not yet been validated with children, direct observation as a means of quantifying duration, intensity, and frequency of specific events is well-accepted, valid, and precise (3,22).

Trak Performance software permits the analysis of each participant's movements. The software allows researchers to simulate real-time movements of the participants by observing video footage and "tracking" children's locomotive movements. Tracking occurs on a scaled version of the playing field that is superimposed on a drawing tablet attached to a computer. Selected movement statistics are recorded by entering a corresponding computer keystroke when a movement occurs (e.g., the "k" key when a kick is observed). A 6% coefficient of variation for inter- and intrarater tracking reliability was achieved on repeated measures of the same videotape by the three researchers who analyzed the video footage.

For the purpose of this study, movements analyzed using Trak Performance were classified as either movement quantities or movement opportunities. Movement quantity is defined as the relative percentage of time spent stationary (0–1 km/hr), walking (1–3 km/hr), jogging (3–6 km/hr), and fast running (> 6 km/hr). Movement opportunity refers to the number of "events" performed. An event is the observation of a skill or movement, other than horizontal locomotion, that generally requires motor coordination. Seven key events were selected: catching, kicking, throwing, hitting, skills, fitness, and jumping. The fitness category incorporated skills such as skipping, sit-ups, and push-ups. A miscellaneous category called skills was included to capture a wide variety of frequently occurring, more complex actions and otherwise noncategorized events, such as balancing, bouncing balls, and somersaults.

Parent Surveys. Parents of participants completed a survey that provided sociodemographic data ($n = 21$). To ensure that there was no bias among research participants, surveys were also completed by a convenient sample of parents ($n = 18$) whose children were enrolled in Ready Set Play but did not partake in the research component.

Statistical Analysis

After tests for normality, descriptive data were presented as means and standard deviations. Independent two-sample t tests were used to compare means of descriptive characteristics (e.g., height, weight, age, body-mass index) between the two groups of children in the research project. Nonnormally distributed, categorical demographic data from parents of children in the research and nonresearch components of the Ready Set Play program were coded into three percentiles and treated with chi-square analyses. Time and speed differences between the two junior-sporting models represented by movement quantities were analyzed again using independent two-sample t tests. The inability to consistently identify individual children from videotapes prohibited the use of repeated-measures analyses to compare intraindividual differences in the two models of junior sport over time. Poorly distributed movement-opportunity variables of the number of events and events per

minute were recoded into two categorical groups for values above and below the median and treated using chi-square analyses. Sample size of the research group was restricted to 23, based on the availability of equipment and staff to analyze videotapes and provide weekly reports to program organizers.

Results

Descriptive Data

Three of the 23 participants who had volunteered to participate were female. Participants averaged 97 min of organized physical activity per week, according to weekly activity diaries completed by parents. Age, body mass, height, and body-mass-index data are presented in Table 1. Independent *t* tests revealed no differences ($p < .05$) between the two research groups for all variables measured with the exception of height ($p = .032$). The two groups were considered similar with regard to descriptive data.

Sociodemographic Data

Results of the analyses revealed no sociodemographic differences between the research and nonresearch families (Table 2). Subsequently, it was assumed that the

Table 1 Descriptive Data of Research Participants ($M \pm SD$) and *t* Test Scores for Group 1 and Group 2

	Participants (<i>N</i> = 23)	Group 1 (<i>n</i> = 12)	Group 2 (<i>n</i> = 11)	<i>p</i>
Age	6.6 $\pm$ 0.9	6.8 $\pm$ 1.1	6.4 $\pm$ 0.8	.363
Body mass	27.7 $\pm$ 8.1	28.8 $\pm$ 8.6	26.5 $\pm$ 7.8	.504
Height*	122.6 $\pm$ 9.6	126.4 $\pm$ 9.6	118.5 $\pm$ 6.5	.032
Body-mass index	18.2 $\pm$ 3.6	17.7 $\pm$ 2.7	18.7 $\pm$ 4.4	.524

* $p < .05$

Table 2 Sociodemographic Data and *p* Values for Research (*n* = 21) and Nonresearch (*n* = 18) Families

	Most frequent percentile	Research families	Nonresearch families	<i>p</i>
Father employed	Full time	95.2%	83.3%	.287
Mother employed	Part time	60.0%	61.1%	.421
Father education	Tertiary	81.0%	77.8%	.970
Mother education	Tertiary	75.0%	55.6%	.327
Marital status	Married	81.0%	83.3%	.954
Socioeconomic status ^a	Highest	81.0%	88.9%	.669
Number of siblings	1	52.4%	55.6%	.183

^aSocioeconomic status determined by postcode data.

research group was a representative sample of all families involved in the Ready Set Play program. Sociodemographic data also indicated that most of the research children in this study had a high socioeconomic status (81%), were from two-parent families (81%), had well-educated parents (78%), and had one sibling (52.5%).

Movement Quantity

Time–motion analysis found no differences between the Ready Set Play and traditional modified sports models for time spent in various movement categories (Figure 1). Results from a series of independent two-sample *t* tests revealed no differences between the Ready Set Play and traditional modified sports groups for time spent stationary, walking, jogging, and fast running ($p < .05$). Results also showed that the children spent most of their time stationary and spent only a small proportion of their total time in more energetic movement categories. Approximately three quarters, or 45 min, of the time in both models was spent stationary.

Movement Opportunity

Movement-opportunity data were standardized to represent 60-min sessions. Median values for the number of events in the Ready Set Play were higher than the traditional modified sport models in all event categories except “hit” (Figure 2). The highest scoring categories were catch, throw, and jump, with kick and hit comparatively infrequent. The total number of events recorded in the two groups was converted to a more general estimate of movement opportunities termed events per minute. The median value for events per minute for Ready Set Play was 3.4 and for traditional modified sports was 1.1.

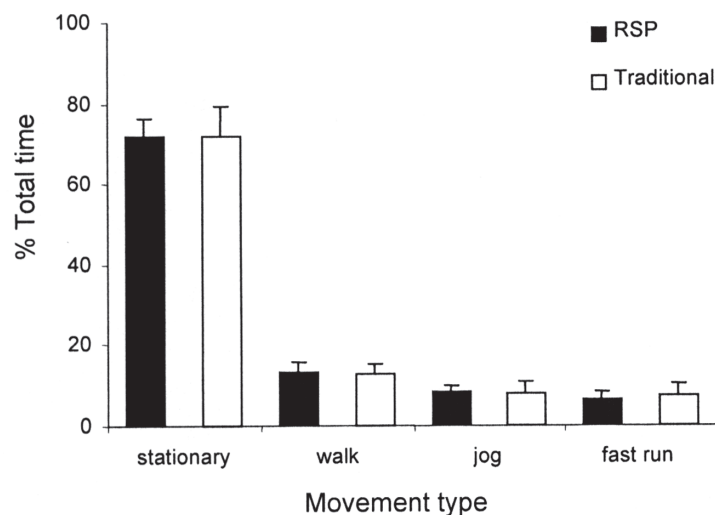


Figure 1 — Mean percentage of time spent in various movement categories. *Note.* RSP = Ready Set Play.

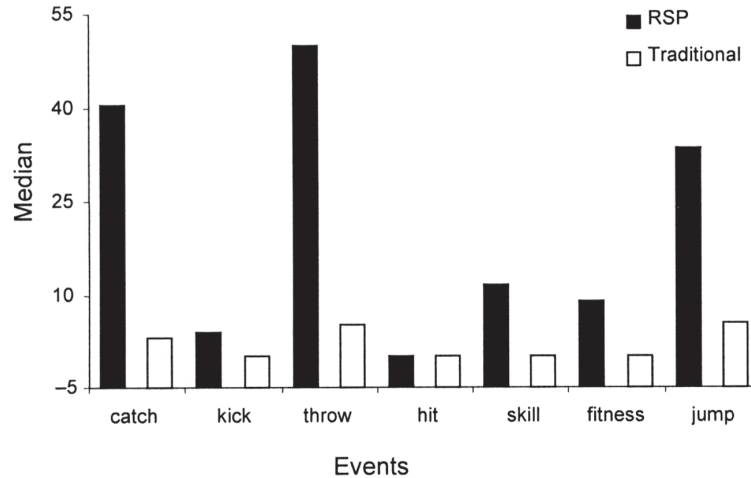


Figure 2 — Median event scores standardized to represent events occurring per 60 min.
Note. RSP = Ready set Play.

A chi-square test categorized participants as above or below the median for each event. A considerable proportion of participants grouped above the median scores in the catch, hit, kick, skill, fitness, jump, throw, and events-per-minute categories were in the Ready Set Play group. Most of the categorization below the median scores for movement opportunities occurred during the traditional modified sports group. Chi-square Pearson's values of asymptomatic significance indicated higher frequencies of opportunities to engage in the categories of catch ($p = .001$), hit ($p = .02$), kick ($p = .001$), skill ($p = .001$), fitness ($p = .001$), jump ($p = .001$), throw ($p = .001$), and events per minute ($p = .001$) during Ready Set Play than in traditional modified groups for all event categories ($p < .05$).

Discussion

This study was the first to investigate the movement effectiveness of a community-based sporting alternative to existing junior-sports models in Australia. Two major findings emerged. Children in the Ready Set Play program were exposed to more frequent movement opportunities than when they participated in traditional modified games. Specifically, there were approximately three times the number of opportunities to perform motor skills and expend energy in addition to horizontal movement in the Ready Set Play program compared with the traditional modified sports model. Children might be deterred from participating in sport and physical activity by a lack of physical competence (19). Junior sport provides one of the earliest occasions to develop physical competencies. When compared with the traditional modified games, the Ready Set Play program offers more opportunities to develop desirable movement competencies.

In addition to this finding, the Ready Set Play program better addresses the goal of allowing children to develop a broad base of movement skills through more varied skill exposure, compared with the traditional modified sports model. The importance of building a strong base of various fundamental movement opportunities and skills at a young age is well supported (9,15). Côté and colleagues (9) propose that participation in sport has four distinct phases: sampling years, specialization years, investment years, and recreational years. The Ready Set Play model complements the notion of offering a variety of activities during the sampling years by exposing children to skills and activities from at least three different sports (rugby, netball, and cricket). An alternative to offering children a variety of sporting experiences is a model called deliberate practice (11). Deliberate practice encourages children to focus on developing the skills associated with a single sport. Although deliberate practice has been shown to effectively develop talented players, more varied experiences during childhood, such as those presented in the Ready Set Play model, might better ensure lifelong participation in sport and physical activity.

Our second major finding from time–motion analysis was that children in both groups accrued equal movement quantities, with approximately 72% of their time spent stationary (with the three modified sports contributing similarly to time spent stationary in the traditional modified group). Not all time spent stationary was unproductive. Stationary time often addressed other equally important goals, such as instruction, feedback, and skill development. Although teaching, organization, and management necessarily compete for time spent moving, our finding suggests that both junior-sport models fail to support the goal of maximizing movement opportunities. Offering approximately 15 min of movement time in a 60-min session might be insufficient to support children's cardiorespiratory and musculoskeletal health. The need for junior sports to offer children maximal opportunities to move is highlighted by an increasing understanding of the links between physical inactivity and undesirable health-related outcomes (14,16). The challenge to improve movement opportunities in both models of junior sport by strategically increasing the number of experiences in energetic-movement categories remains.

Strategies to increase the amount of time spent in locomotor movements during sporting-activity programs, however, are challenging to implement. Children move in stochastic and intermittent bursts of moderately intense physical activity but spend most of their time in low-intensity activity (3). Junior-sports programs designed specifically to increase volumes of movement through an amassed fitness focus might be developmentally inappropriate for young children. Increased movement quantity might be achieved at the expense of the equally important components of gross- and fine-motor-skill development, creativity, and social engagement. The most appropriate ratio of movement quantities to movement opportunities is yet to be determined. Similar objective observation studies have reported time spent in moderate-to-vigorous physical activity in secondary-school physical education classes with 12-year-old boys to be as high as 63% (10). Younger children seeking sampling experiences in community sport, however, are likely to have developmental characteristics (22) that dictate the movement quantity and skill exposure of a successful program.

Participant groups used in this study were considered similar because of anthropometric and sociodemographic similarities. Given the homogenous nature of the participants, generalization of the results of this study is limited and most

appropriately restricted to populations with similar age, body-mass index, and sociodemographics. The Ready Set Play program is yet to be tested in populations with a larger diversity in body composition and varying levels of socioeconomic status and family background. Within the acknowledged limitations of our study, positive results permit broader applications of similar exploratory models and support the need for further investigation.

Not all determinants of physical activity in young people were addressed in the present study. A number of additional parameters should be considered in future studies of community-based sporting programs for children. For example, measures of social interactions among children and social capital in the communities supporting junior-sports programs require consideration because they are recognized as key factors in successful sports participation (4,23). Having fun and making friends rank high in children's incentives for participating in physical activity (5,16). Therefore, social interactions, social capital, and a measure of enjoyment could provide additional indices of junior sport's long-term sustainability and value to children and families.

We concluded that there is merit in the rotational Ready Set Play model because it provides children with more movement opportunities than the modified junior-sports model. As alternatives to existing sporting models emerge in response to lowered participation rates, it should be a priority of researchers to objectively evaluate and critically appraise the efficacy of these sporting alternatives (18,21). Once evaluated, both established and emerging junior-sport models should be appropriately amended to maximize children's enjoyment, skill development, and cardiovascular and musculoskeletal health, with a major emphasis on socialization into lifelong participation in sport and physical activity.

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