



Differences in Motor Competence by TV Consumption and Participation in Club Sports in Children Starting Elementary School

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Abstract

Background: The development of motor competence during childhood has important implications for future health and well-being due to the association with physical activity. While associations between sports participation or TV time and motor competence have been examined previously, there remains limited research on the interaction of TV time and sports participation regarding motor competence. The present study; therefore, examines differences in motor competence by club sports participation and TV time in elementary-school children.

Methods: 15 elementary schools in the federal state of Tyrol, Austria, were randomly selected for participation. Motor competence was assessed between October and December 2017 using the German Motor Test in 455 (49.5% boys) children starting elementary school. Body weight and height were measured with children in sports clothes and being barefoot following standardized procedures. In addition, parents reported participation and time spent in club sports (hours/week), as well as time spent watching TV (hours/day) via standardized questionnaires. Further, parents reported whether there was a TV in the child's bedroom. Differences in motor competence by sports participation and TV time were analyzed via multivariate analysis of variance.

Results: In total, 24% of the participants exceeded the current recommendations for TV time (> 2 hours/day) and 46% participated in club sports. There was no difference in TV time and club sports participation between boys and girls. Nevertheless, boys displayed better standardized scores for flexibility (2.8 ± 0.8 ; $P = 0.001$), sprint (2.6 ± 0.9 ; $P = 0.005$), and sideways jumping (1.3 ± 0.6 ; $P = 0.030$) than girls. Significant interaction effects between TV time and club sports were observed for balance ($P = 0.020$), sit-ups ($P = 0.039$), endurance ($P < 0.001$), and overall motor competence ($P = 0.035$). In addition, club sports participation was associated with better performance on all motor competence tests (P -values ranging from 0.047 to < 0.001) while lower TV time was associated with better performance in sprint, sideways jumping, push-ups, 6-minute run, and total motor competence only (P -values ranging from 0.006 to < 0.001).

Conclusions: Club sports participation appears to be an important contributor to the development of motor competence while high TV time may impair motor development, particularly in children not participating in club sports. Parents and educators; therefore, should facilitate participation in the organized physical activity even in pre-school children while limiting TV time.

Keywords: Fitness, Sedentary Behavior, Physical Activity, Motor Skills, Youth

1. Background

Motor competence and physical activity (PA) are important determinants of physical and psychological health in youth while sedentary behavior and especially media use is associated with increased risk for overweight/obesity and associated health risks (1). Specifically, high PA has been associated with lower body weight, reduced chronic disease risk, increased bone mineral density, and psychological well-being (2-4). Effects of PA on various health

outcomes, however, also depend on intensity (2), with a minimum of moderate-to-vigorous intensity being recommended (5). Despite considerable efforts, there has been a decline in PA with increased sedentary behaviors in youth over the past decades, particularly in industrialized countries (6, 7). In addition to prolonged sitting times during school, sedentary behaviors have increased during leisure time in children and adolescents (8). Due to the emergence of the internet, computers, and smartphones, digital me-

dia have had a major influence on behavioral choices (9, 10). Accordingly, a majority of youth does not meet current PA recommendations of at least 60 minutes of moderate-to-vigorous PA (11).

PA during childhood and adolescence not only affects immediate health but also tracks into adulthood (1, 12) and, therefore, is an important indicator of a sustainable active and healthy lifestyle. Similarly, sedentary behaviors have been shown to track over time and sedentary children and adolescents often display high amounts of sedentary time in adulthood (12, 13). Accordingly, patterns for an active lifestyle should be established early in life and the age at school-entry has been identified as a critical period for future behavioral choices (14). Sports participation is a subcategory of leisure-time PA that is characterized by organized exercise training in a specific discipline/sport (15). In addition to providing opportunities for PA, participation in sports has been associated with a beneficial psychosocial development and the acquisition of life skills, including cooperation, self-control, discipline, and leadership (16, 17).

Along with the behavioral changes (i.e. declined PA and increased sedentary pursuits), there has been an increase in children and adolescents displaying poor physical fitness and low motor competence (18-20). High media consumption, on the other hand, has been associated with low motor competence and increased body weight (21-24). Limited research, however, is available on the combined association of media consumption and PA on motor competence, independent of body weight. The present study, therefore, examines potential differences in motor competence by TV time and sports participation in Austrian children starting elementary school. We hypothesize that motor competence is lower in children who exceed current recommendations for TV time and that motor competence will be higher in children participating in club sports. Further, we hypothesize that the detrimental effects of high TV time will be more pronounced in children not participating in club sports.

2. Methods

A total of 20 schools out of the 361 elementary schools in the federal state of Tyrol, Austria were randomly selected via a computer-generated random sampling algorithm. 15 elementary schools with 24 first grade classes agreed to participate, providing a total sample of 483 children. The study was approved by the institutional review board of the University of Innsbruck and the Tyrolean school board. Written consent was obtained from 455 parents prior to data collection and children provided oral consent on the day of data collection.

Data were collected between October and December 2017. Physical measurements were performed during regular school hours in a gymnasium by trained staff. Body weight and height were measured according to standard procedures for participants wearing gym clothes and being barefoot. Specifically, body weight was measured to the nearest 0.1 kg with a portable scale (SECA® 803, Hamburg, Germany) and height was measured to the nearest 0.1 cm with a portable stadiometer (SECA® 217, Hamburg, Germany). BMI percentiles were calculated based on German reference values (25) and children were classified as either non-overweight or overweight/obese using the 90th percentile as the cutoff point.

Subsequently, participants completed the German motor test (Deutscher Motorik Test 6-18, DMT 6-18), which has been shown to provide valid and reliable information on motor development. Based on a test-retest design, an average reliability score of 0.85 was shown for the various test items (26). Content validity was established by interviewing 40 selected fitness experts from 25 European countries on test contents and construct validity was determined via exploratory and confirmatory factor analysis (26). The DMT6-18 provides information on various motor competences, including endurance, strength, power, speed, flexibility, as well as agility and balance. Specifically, participants performed a 20 m sprint, backward balance, sideways jumping, standing long jump, sit-ups, push-ups, stand-and-reach and 6-minute run following oral instruction and practice trials as specified by the test manual. In addition to the raw performance measures, the DMT6-18 allows determining normative scores based on age- and sex-specific reference values. Based on these scores, an overall motor competence score can be calculated. The normative scores were also used in the statistical analyses.

Participation in club sports and information on TV use were obtained via a parental questionnaire. Questions were based on the KiGGS study, which is a representative study of German youth, including more than 17,000 children and adolescents (27). Parents reported whether the child was a member in a club sport and how much time (hours/week) was spent with organized exercise in a club sports setting. In addition, parents reported the average time their child spent watching TV (hours/day) and whether there was a TV in the child's bedroom. According to the recommendations of the American academy of pediatrics, a cutoff point of 2 hours/day was used to stratify participants into low TV time (≤ 2 hours/day) or high TV time (> 2 hours/day) (28).

2.1. Statistical Analysis

Descriptive statistics were calculated separately for boys and girls and data were checked for normal distribution. Chi-square was used to examine differences in the

prevalence of club sports and TV utilization. Multivariate analysis of variance was used to examine the association of sports participation and TV time with the test items of the DMT, which indicates various components of motor competence. In a second analysis, BMI was used as a covariate to examine whether associations between active/sedentary behaviors and motor competence were independent of body weight. All statistical analyses were performed with SPSS 24.0 (IBM Austria, Vienna, Austria) using a significance level of $\alpha = 0.05$ and Bonferroni adjustment for multiple comparisons.

3. Results

A total of 455 children (50.5% girls) with an average age of 6.4 ± 0.5 years provided valid data. The prevalence of overweight/obesity was 13.6% with no significant difference between boys and girls (14.7% vs. 12.6%). Club sports participation was reported by 46.2% of the children with those participating in club sports spending 2.7 ± 1.0 hours/week in organized PA. High TV time was reported by 24.0% of the participants and 29.7% had a TV in their bedroom. While there was no significant difference in the prevalence of overweight/obesity between club sports participants and non-participants (11.4% vs. 15.5%), overweight/obesity was significantly higher in children with high TV time (22.0% vs. 11.0%, $P = 0.003$) and those having a TV in the bedroom (23.7% vs. 9.4%, $P < 0.001$). Club sports participation, however, was associated with significantly lower TV time (1.8 ± 0.7 vs. 2.1 ± 0.8 hours/week, $P < 0.001$). Further, TV time was higher in children with a TV in the bedroom (2.6 ± 0.7 hours/day vs. 1.7 ± 0.6 hours/day, $P < 0.001$).

There were no significant sex differences in the prevalence of club sports participation (girls: 44.8%, boys: 47.6%), high TV time (girls: 24.8%, boys: 23.1%), and having a TV in the bedroom (girls: 32.6%, boys 26.7%). Similarly, time spent in club sports did not differ between boys and girls. Boys, however, performed significantly better in the sprint, sideways jumping, sit-ups, long jump, and the 6-minute run while girls performed better on the stand and reach (Table 1). Using age- and sex-specific normative values, significant differences only remained for sprint and sideways jumping. Based on normative values, boys also performed better at the stand-and-reach test. Nevertheless, there was no significant difference in total motor competence scores between boys and girls.

Using age and sex-specific normative values, the multivariate analysis of variance revealed significant interaction effects of club sports participation and TV time for balance ($P = 0.020$), sit-ups ($P = 0.039$), 6-minute run ($P < 0.001$), and total motor competence ($P = 0.035$) (Table 2).

Specifically, differences in motor competence by club sports participation were limited with low TV time, while no club sports participation was associated with significantly lower motor competence in participants reporting high TV time (Figure 1). In addition, the significant main effects of club sports participation were observed for all motor competence measures with better motor performance in participants reporting club sports participation (P value ranged from 0.047 to < 0.001). Main effects for TV time were observed for sprint ($P = 0.003$), sideways jumping ($P = 0.006$), push-ups ($P = 0.004$), 6-minute run ($P < 0.001$), and total motor competence ($P < 0.001$) with better motor competence with low TV time (Figure 2). All results remained essentially unchanged after adjusting for BMI.

4. Discussion

The purpose of the present study was to examine the association between motor competence and correlates of PA (e.g. club sports participation, TV consumption) in children starting elementary school. Almost half of the sample participated in club sports and a quarter of the children exceeded current recommendations for TV time. Similar results have been reported previously in a large German sample regarding TV time (29) while club sports participation in the present sample was lower than that reported in a large German sample of elementary school children (1). This may be explained by including only children starting elementary school compared to the entire elementary school range as club sports participation most likely increases with age. Further, data collection occurred in a rural area of Austria where children may have limited access to organized PA and therefore, engage in a larger amount of non-organized PA.

Consistent with previous research, club sports participation was associated with higher motor competence (15, 30, 31) while high TV time was associated with lower motor competence (9). The present study further revealed some interaction effects. Differences in motor competence between those participating in club sports and those not participating in club sports were more pronounced with high TV time. This suggests that children with low TV time engage in various forms of PA even if they are not participating in club sports, which mitigates the effects of club sports participation on motor competence. With high TV time, participation in non-organized PA may be limited and thus, organized PA, such as club sports, is an important contributor to total PA. It should also be emphasized that almost one-third of the children had a TV in their bedroom, which was associated with higher TV time.

Interestingly, club sports participation was not associated with body composition. Nevertheless, children participating in club sports reported lower TV time and dis-

Table 1. Anthropometric Characteristics and Motor Competence for the Total Sample and Separately for Boys and Girls^a

	Total Sample, (N = 455)	Girls Only, (N = 230)	Boys Only, (N = 225)	P-Value ^b
Age (y)	6.4 ± 0.5	6.3 ± 0.5	6.4 ± 0.5	0.011
Height (cm)	123.2 ± 6.2	122.6 ± 6.2	123.7 ± 6.2	0.060
Weight (kg)	24.8 ± 4.8	24.5 ± 4.8	25.0 ± 4.8	0.270
BMI (kg/m ²)	16.2 ± 2.1	16.2 ± 2.2	16.2 ± 2.0	0.946
Time spent in club sports (h/week) ^c	2.7 ± 1.0	2.7 ± 0.9	2.6 ± 1.0	0.401
20m sprint (s)	4.9 ± 0.5	5.0 ± 0.6	4.7 ± 0.4	< 0.001
Balance (steps)	26.6 ± 10.0	26.9 ± 10.1	26.3 ± 10.0	0.501
Sideways jumping (#/15 s)	23.7 ± 6.3	23.1 ± 6.3	24.4 ± 6.3	0.027
Stand and reach (cm)	1.6 ± 5.3	1.8 ± 5.0	1.4 ± 5.6	0.399
Push-ups (#/40 s)	11.8 ± 4.2	11.7 ± 3.9	11.9 ± 4.4	0.551
Sit-ups (#/40 s)	15.3 ± 5.7	14.7 ± 6.1	15.9 ± 5.1	0.023
Long jump (cm)	113.4 ± 18.9	110.0 ± 18.6	116.9 ± 18.5	< 0.001
6-Minute run (m)	854 ± 147	834 ± 150	875 ± 140	0.002
Total score (z)	103.8 ± 6.4	103.3 ± 6.7	104.3 ± 6.1	0.088

^a All values are represented as mean ± SD.

^b Differences between boys and girls.

^c Only for participants reporting club sports participation.

Table 2. Motor Competence Based on Sports Participation and TV Time^a

	Sports & Low TV Time	Sports & High TV Time	No Sports & Low TV Time	No Sports & High TV Time
20m sprint (s) ^{b,c}	4.7 ± 0.4	4.8 ± 0.4	4.9 ± 0.5	5.1 ± 0.7
Balance (steps) ^{b,d}	26.8 ± 9.2	27.9 ± 9.7	27.3 ± 10.4	23.5 ± 10.7
Sideways jumping (#/15 s) ^{b,c}	24.9 ± 6.5	23.1 ± 6.0	23.6 ± 5.9	21.8 ± 6.6
Stand and reach (cm) ^b	2.2 ± 4.8	1.7 ± 4.7	1.4 ± 5.6	0.8 ± 5.9
Push-ups (#/40 s) ^{b,c}	13.0 ± 4.4	11.1 ± 3.1	11.3 ± 3.9	10.5 ± 4.0
Sit-ups (#/40 s) ^{b,d}	15.6 ± 5.3	15.9 ± 5.3	15.4 ± 5.8	13.9 ± 6.2
Long jump (cm) ^b	118.1 ± 17.5	116.2 ± 19.2	111.0 ± 18.3	106.1 ± 20.3
6-Minute run (m) ^{b,c,d}	917 ± 122	830 ± 173	869 ± 107	676 ± 131
Total score (z) ^{b,c,d}	106.1 ± 5.6	104.0 ± 7.0	103.5 ± 5.4	98.6 ± 7.0

^a All values are represented as mean ± SD.

^b Significant main effect for club sports using sex- and age-specific normative values ($P < 0.05$).

^c Significant main effect for TV time using sex- and age-specific normative values ($P < 0.05$).

^d Significant interaction effect using sex- and age-specific normative values ($P < 0.05$).

played higher motor competence. Particularly, the participation in a variety of sports has been associated with better motor competence (15, 31). As high motor competence is a critical aspect for future participation in various forms of PA, including sports, an emphasis on motor competence at younger ages has important implications for PA participation in the long term (32). Children with lower motor competence, on the other hand, may experience a proficiency barrier that limits their ability to acquire sport-specific skills (33). This could hinder participation in PA, and especially sports, in the long term (34, 35), resulting in

the increased risk for various non-communicable diseases. The importance of organized PA and sports has also been emphasized by the fact that children's motor competence is more strongly associated with organized PA compared to non-organized PA (36, 37). Another aspect of sports participation is the potential higher amount of vigorous PA, which has been associated with lower cardiovascular disease risk in children and adolescents while associations with moderate PA have been limited (38-41).

In contrast to participation in club sports, high TV time was associated with a higher prevalence of over-

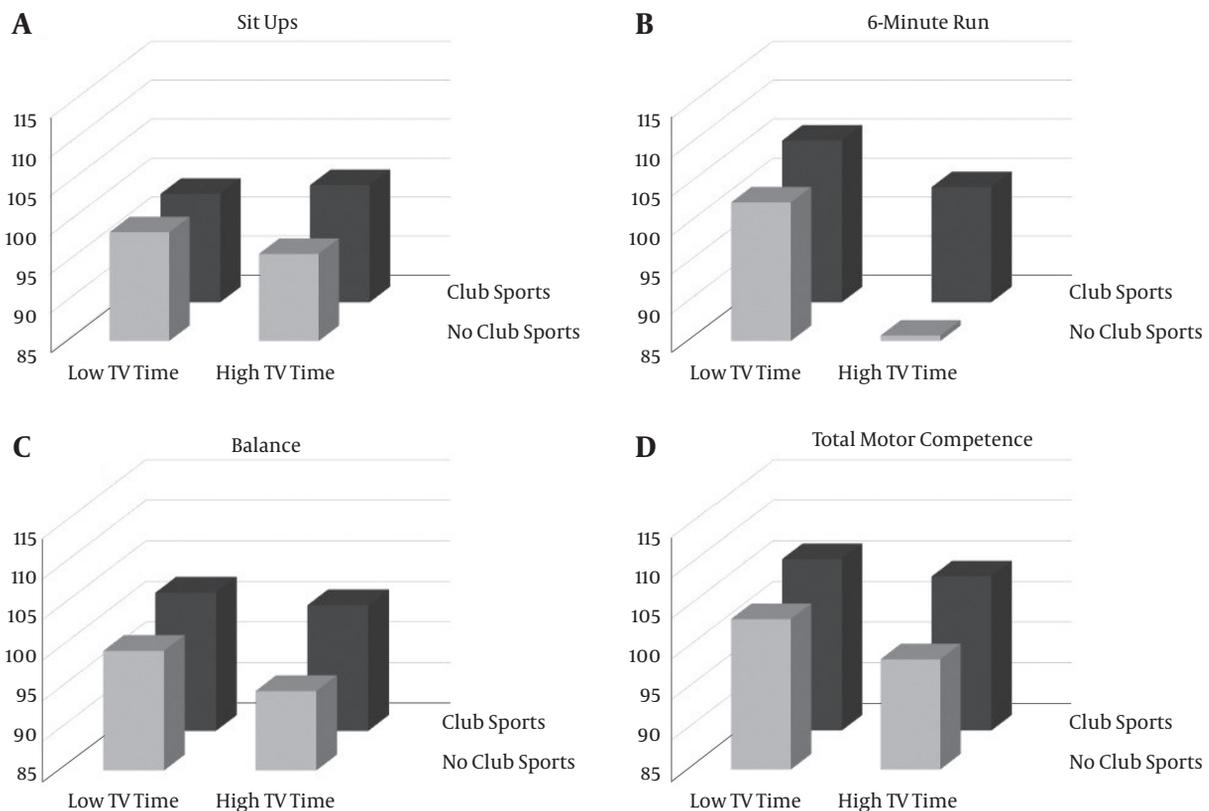


Figure 1. The combined association of club sports participation and media consumption with the measures of strength (A), endurance (B), balance (C), and total motor competence (D). Values are Means of age- and sex-standardized scores.

weight/obesity. The detrimental effects of TV time on body weight and other health outcomes have been attributed, at least partially, to unhealthy snacking behaviors while watching TV (42, 43). Chaput et al. also pointed out that TV time, rather than total sedentary time, is associated with increased cardiovascular disease (CVD) risk (44). High TV time was further associated with lower overall motor competence. Particularly endurance, upper body strength, speed, and agility were lower in children reporting high TV time. As all these abilities are crucial components for sports performance, this could have important implications for future participation in sports and overall PA. Consistent with previous research (22), the present study also showed a direct association between having a TV in the child's bedroom and TV time. Accordingly, the American Academy of Pediatrics recommends that TV and other audio-visual media devices should not be placed in children's bedrooms or play spaces in addition to limiting overall TV time to 2 hours/day (28).

While this study provides valuable information on the combined association of sports participation and TV time

in 6-year-old children, there are certain limitations that need to be considered when interpreting the results. Due to the cross-sectional design of the study, causality cannot be established. Stodden et al., however, argue that the development of motor competence at younger ages depends on participation in various forms of PA, while during adolescence, motor competence may be a determinant for PA (32). Further, specific behaviors were assessed via parental questionnaire and there was no objective assessment of the total amount of time spent in moderate-to-vigorous PA and sedentary time. There was also no assessment on the type of sports in which children were participating. The objective assessment of motor competence with a widely used and validated test, on the other hand, should be considered a strength of this study.

In summary, the present study shows the beneficial association between sports participation and motor competence. High TV time, on the other hand, potentially impairs motor development, particularly with a lack of participation in organized sports. Accordingly, TV time should be limited and children should be educated on the respon-

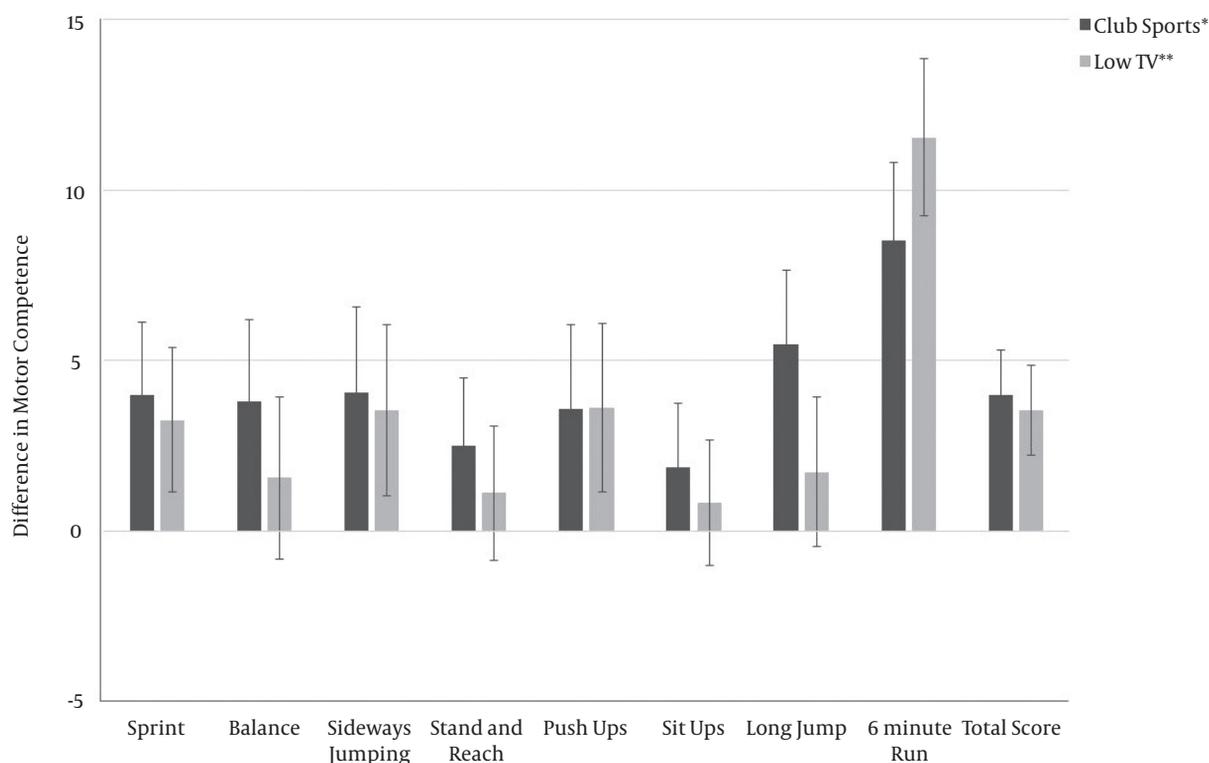


Figure 2. Difference in motor competence by club sports participation and media consumption. Values are mean differences in standardized scores relative to non-club sports participants* and low TV consumption ** with 95% CI.

sible utilization of screen-based media; providing limited access to a TV by not putting a device in the child's bedroom can support these efforts. The stronger association with participation in club sports compared to TV time, however, highlights the importance of external settings, including schools, in the promotion of the development of motor competence. As motor competence is associated with future participation in PA and associated health benefits, such efforts could have important implications for overall public health, as well.

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