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Differences in Sitting Time by Club Sports Participation among Austrian Youth

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Abstract: Despite the well-documented detrimental health effects of prolonged engagement in sedentary behaviors, children and adolescents spent a large amount of time with seated activities. The present study examined the association between participation in club sports and various sedentary behaviors during weekdays and the weekend in youth between 11 and 17 years of age. A total of 1225 (50.1% male) adolescents completed a validated questionnaire that examined sitting time in activities related to work as well as during leisure time such as screen use, reading, and listening to music in addition to sleep time. Participants spent an average of 12.7 ± 1.7 and 9.9 ± 2.0 h/day during weekdays and the weekend, respectively, in seated behaviors while they were awake. Club sports participants reported less time spent sitting ($p < 0.01$), which was mainly attributed to recreational activities (e.g., screen use, reading, listening to music). Sleep time during weekdays, on the other hand, was higher in club sports participants. Sex-specific results further showed that differences by club sports participation were more pronounced in girls compared to boys. Despite the potential beneficial effects of club sports participation, additional efforts are needed to reduce sitting time in adolescents as either group spent the majority of their time awake with sedentary behaviors.

Keywords: sedentary behavior; screen use; leisure time use; sleep time; exercise; adolescents

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1. Introduction

Many studies have emphasized the importance of physical activity (PA) and motor competence for the development of children and adolescents [1–4]. Prolonged engagement in sedentary behaviors along with low PA, on the other hand, has been associated with detrimental health effects [5,6]. Accordingly, current PA guidelines recommend a minimum of 60 min per day of moderate-to-vigorous PA along with a reduction in sedentary time [7]. Despite the well-documented benefits of PA on health and development in children and adolescents there has been a dramatic behavioral shift in almost all industrialized countries over the last several decades that resulted in low PA among youth [8–10]. Sedentary behaviors, such as watching TV or playing computer games, on the other hand, became predominant behavioral leisure time choices [11–14]. Accordingly, the latest global estimates by the WHO show that more than three quarters of young people do not meet current PA recommendations and spend most of their leisure time sitting [9]. This negative lifestyle change is a major risk factor for the development of many chronic diseases such as overweight and obesity, type 2 diabetes, metabolic disorders, cancer, and even premature death [6,15,16]. Nevertheless, the reduction of sedentary time in the population has been a challenge, and sedentary behavior, therefore, has become a major health threat in modern society [17].

It should also be considered that sedentary behaviors can be accumulated in different domains, such as work/school related sitting as well as recreational sitting, including screen time and reading or listening to music. Among university students, for example, only one third of sedentary time was attributed to recreational behaviors [18]. To be able to address the problem of excess sedentary time, it is important to consider different domains and settings. In addition, intervention strategies should start at young ages as childhood and adolescence are critical periods for growth and development [19]. Furthermore, various habits start to be developed during adolescence since adolescents start to become more independent from their parents and begin to make their own life choices [20]. The importance of this age period is emphasized by the fact that 70% of premature deaths in adults can be attributed to behaviors that have been initiated or reinforced during adolescence [21]. It is, therefore, important to enhance the understanding of correlates with detrimental health choices such as excess sitting time.

Club sports participation has been associated with various health behaviors, including physical activity [22–24], dietary habits [25], and socio-emotional outcomes [23,26]. Particularly team sports (compared to individual sports) and outdoor sports (compared to indoor sports) have been shown to be associated with increased PA intensity within the variety of club sports [27]. In addition, there appears to be an inverse association between club sports engagement and sedentary behavior [24,28–32]. At this time, there remains limited information on the association of specific types of sedentary behaviors with club sports participation in youth. The novelty of this research, therefore, is in exploring differences in various school-related and recreational seated behaviors as well as sleep time, rather than total sedentary time, by club sports participation.

Specifically, this study examines differences in time spent sleeping, sitting for schoolwork, and recreational sitting among Austrian adolescents who are actively involved with club sports or not. It was hypothesized that club sports participants engage in less recreational sitting due to their engagement in more active recreational behaviors. Time spent in school-related sitting time, on the other hand, would be similar due to the similar workload and schedules of club sports and non-club sports participants.

2. Materials and Methods

This cross-sectional study examined the association of sitting times during weekdays as well as during the weekend with club sports participation among 11- to 17-year-old secondary school students. In the present study, "sitting" represents a collective term for sedentary or reclining behavior during waking hours with low energy consumption (<1.5 MET (=metabolic equivalent)) [33].

Ten secondary schools (grades 5 through 12) within the Federal State of Tyrol in Western Austria were randomly selected for participation in the study. Four schools declined to participate due to organizational difficulties; from the six remaining schools, 1225 (50.2% male) students provided valid data. The study was approved by the responsible school authority (Tyrolean Directorate of Education), the principals of the participating schools, and the Institutional Review Board of the University of Innsbruck (Certificate of good standing, 31/2022). Prior to data collection, parents/guardians were informed in writing about the study and their written consent was obtained. Participants provided assent during data collection, which took place between March 2023 and April 2023.

2.1. Assessment of Daily Sitting Times

The validated "Heidelberg questionnaire for recording sitting behavior of children and adolescents" [34] was used to determine the time spent in various sedentary activities. Specifically, participants indicated how much time (hours/day) they spent on the following activities on an average school or weekend day, rounded up to the nearest 0.5 h:

- Sleeping (time spent lying down)
- Eating (time spent sitting down)
- Working while sitting at school

- Working while sitting at home
- Travelling while sitting
- Sedentary activities in leisure time (games, computer, television, cinema, reading)
- Other sedentary activities
- Sport activities

Questionnaires were completed on site at the participating schools. To ensure the accuracy of the data, the individual dimensions were first checked for plausibility. Questionnaires with logically incomprehensible outliers (e.g., total hours per day > or <24) were excluded from the analysis.

2.2. Assessment of Sports Club Membership and Weight Status

Participation in club sports was recorded using the question: "Are you a member of a sports club" (yes/no). Based on this information, the participants were categorized into two groups: sports club members and non-sports club members.

In addition, body weight and height were measured with participants wearing sports clothes and no shoes (barefoot) in the school gymnasium. Body weight was measured to the nearest 0.1 kg using a calibrated electronic scale (SECA® 804, Seca, Hamburg, Germany) and height was measured to the nearest 0.1 cm using a mobile stadiometer (SECA® 217, Seca, Hamburg, Germany). Based on these values, body mass index (BMI, kg/m^2) was calculated and converted into BMI percentiles using the German BMI reference system of Kromeyer-Hauschild et al. [35]. A BMI between the 90th and 97th percentile was considered overweight and values above the 97th percentile were considered obese.

2.3. Data Analysis

Descriptive characteristics were calculated with continuous data being reported as mean with standard deviation, while frequencies are used for nominal scaled data. ANOVA was used to examine differences in anthropometric characteristics and MANOVA was used to examine differences in various sedentary behaviors during weekdays and the weekend by club sport participation across the total sample and separately for boys and girls. In addition, MANCOVA was used to account for differences in age between club sports and non-club sports participants. Partial eta squared (ηp^2) was used to estimate effect sizes with values between 0.01 and 0.06 indicating a small effect, values between 0.06 and 0.14 indicating a moderate effect, and values above 0.14 indicating a large effect [36]. All statistical analyses were performed with SPSS 29.0 (SPSS Inc., IBM Corp., Armonk, NY, USA) with a significance level set at $p < 0.01$ due to multiple comparisons. Accordingly, there remains a 1% chance of reporting false positive associations between club sports participation and sedentary behaviors in adolescents.

3. Results

A total of 1225 (50.2% male) provided complete and valid data. The average age of the participants was 13.3 ± 1.9 years and the prevalence of overweight/obesity was 20.2%. Among the total sample, 39.5% participated in club sports, with a higher participation rate being observed in boys compared to girls (43.4% vs. 35.6%; $p < 0.01$).

Table 1 displays anthropometric characteristics for those reporting club sports participation and no club sports participation. Club sports participants were significantly younger than those with no club sports engagement ($p < 0.01$). Accordingly, their body weight and height were lower while there was no significant difference in BMI percentile by club sports participation. Nevertheless, the prevalence of overweight/obesity was lower in club sports participants compared to those not participating in club sports (16.1% vs. 22.8%; $p < 0.01$). Sex-specific analyses showed similar results in boys, while in girls there were no differences in body weight and height between club sports and non-club sports participants. There was also a higher prevalence of overweight/obesity among boys compared to girls (24.6% vs. 15.7%; $p < 0.01$). Both boys and girls engaging in club sports, however, displayed a

lower prevalence of overweight/obesity than their peers not participating in club sports (boys: 21.0% vs. 27.3%; girls: 10.1% vs. 18.8%).

Table 1. Descriptive characteristics by sports participation for the total sample and separately for boys and girls. Values are mean ± SD.

	Total Sample		Girls Only		Boys Only	
	Club Sports (N = 484)	**No Club Sports (N = 741)**	**Club Sports (N = 217)**	**No Club Sports (N = 393)**	**Club Sports (N = 267)**	**No Club Sports (N = 348)**
Age (years) [1,2,3]	12.9 ± 1.8	13.5 ± 1.9	13.0 ± 1.9	13.4 ± 1.9	12.9 ± 1.7	13.6 ± 1.9
Height (cm) [1,3]	159.6 ± 10.7	162.5 ± 11.0	158.0 ± 8.9	159.4 ± 8.7	160.8 ± 11.8	166.1 ± 12.2
Body weight (kg) [1,3]	52.0 ± 13.6	55.7 ± 13.8	50.3 ± 12.4	52.7 ± 11.8	53.4 ± 14.4	59.1 ± 15.0
BMI percentile	59.4 ± 25.8	61.6 ± 27.7	55.1 ± 25.6	57.4 ± 28.1	63.0 ± 25.5	66.4 ± 26.5

[1] sig. difference between club sports and no club sports in total sample ($p < 0.01$); [2] sig. difference between club sports and no club sports in girls ($p < 0.01$); [3] sig. difference between club sports and no club sports in boys ($p < 0.01$).

During weekdays, participants spent almost 13 h per day with seated behaviors and more than half of sitting time was attributed to school. On weekends, total average sitting time amounted to almost 10 h/day but the contribution of schoolwork was limited. There were significant differences, albeit with a small effect size, in sitting time between club sports participants and those with no engagement in club sports on weekdays (Wilks Lambda = 0.95, $p < 0.01$, $\eta p^2 = 0.05$) and during the weekend (Wilks Lambda = 0.95, $p < 0.01$, $\eta p^2 = 0.05$) (Table 2). Sitting for leisure activities (e.g., screen use, reading, listening to music) was significantly higher in those not engaging in club sports on weekdays and during the weekend ($p < 0.01$) while no differences were observed for school-related seated activities. Sleep time during weekdays and sitting while eating during the weekend, however, were higher in club sport participants. Nevertheless, total sitting time was significantly lower in club sports participants compared to their peers not engaging in club sports ($p < 0.01$). These results stayed essentially the same after adjusting for age, except for time spent sitting while reading or listening to music, which did not differ during weekdays between club sports and non-club sports participants.

Table 2. Sedentary behavior by sports participation. Values are mean ± SD.

		TOTAL Sample	**Club Sports**	**No Club Sports**	**Effect Size (ηp^2)**
Weekday	Sleep time (h) *	7.8 ± 1.1	8.1 ± 1.1	7.7 ± 1.1	0.034
	Sitting while eating (h/d)	1.2 ± 0.6	1.2 ± 0.5	1.2 ± 0.6	0.001
	Sitting in school (h/d)	5.3 ± 0.4	5.3 ± 0.4	5.3 ± 0.4	<0.001
	Sitting for work at home (h/d)	1.5 ± 0.9	1.6 ± 0.9	1.5 ± 0.8	<0.001
	Sitting for screen use (h/d) *	2.7 ± 1.2	2.5 ± 1.1	2.8 ± 1.2	0.013
	Recreational sitting (e.g., reading, listening to music) (h/d) *	1.8 ± 1.1	1.7 ± 1.1	1.9 ± 1.2	0.005
	Total sitting time (h/d) *	**12.7 ± 1.7**	**12.4 ± 1.7**	**12.9 ± 1.8**	**0.021**
Weekend	Sleep time (h)	9.9 ± 1.3	9.9 ± 1.2	9.9 ± 1.4	<0.001
	Sitting while eating (h/d) *	1.7 ± 0.6	1.8 ± 0.7	1.7 ± 0.6	0.008
	Sitting for work at home (h/d)	1.2 ± 0.9	1.2 ± 0.8	1.2 ± 0.9	<0.001
	Sitting for screen use (h/d) *	3.9 ± 1.6	3.7 ± 1.5	4.1 ± 1.6	0.016
	Recreational sitting (e.g., reading, listening to music) (h/d) *	3.1 ± 1.3	2.9 ± 1.3	3.2 ± 1.3	0.015
	Total Sitting time (h/d) *	**9.9 ± 2.0**	**9.5 ± 1.9**	**10.2 ± 22.0**	**0.026**

ηp^2 . . . partial eta squared; * Sig. difference between club sports and non-club sports ($p \leq 0.01$).

Sex-specific analyses also showed significantly lower sitting time during weekdays (girls: Wilks Lambda = 0.93, $p < 0.01$, $\eta p^2 = 0.07$; boys: Wilks Lambda = 0.95, $p < 0.01$, $\eta p^2 = 0.05$) and the weekend (girls: Wilks Lambda = 0.93, $p < 0.01$, $\eta p^2 = 0.07$; boys: Wilks

Lambda = 0.96, $p < 0.01$, $\eta p^2 = 0.04$) among club sports participants compared to their peers without club sports (Table 3). Among girls, the higher sitting time in non-club sports participants was attributed to a higher sitting time for screen use on weekdays and the weekend. Among boys, non-club sport participants reported higher recreational sitting time (e.g., reading, listening to music) while the difference in sitting for screen use was only significant during weekdays. As was shown for the total sample, there were no differences in work-related seated activities by club sports participation in the sex-specific analyses.

Table 3. Sedentary behavior by sports participation, separately for girls and boys. Values are mean ± SD.

		GIRLS ONLY			BOYS ONLY		
		Club Sports	**No Club Sports**	***ηp²***	**Club Sports**	**No Club Sports**	***ηp²***
Weekday	Sleep time (h) [1,2]	8.1 ± 1.1	7.7 ± 1.1	*0.038*	8.0 ± 1.2	7.6 ± 1.1	*0.032*
	Sitting while eating (h/d)	1.2 ± 0.5	1.2 ± 0.6	*<0.001*	1.2 ± 0.5	1.2 ± 0.6	*0.001*
	Sitting in school (h/d)	5.4 ± 0.4	5.3 ± 0.4	*<0.001*	5.3 ± 0.4	5.3 ± 0.4	*<0.001*
	Sitting for work at home (h/d)	1.6 ± 0.9	1.6 ± 0.9	*0.001*	1.6 ± 0.9	1.5 ± 0.8	*0.003*
	Sitting for screen use (h/d) [1,2]	2.4 ± 1.0	2.7 ± 1.2	*0.018*	2.6 ± 1.1	2.8 ± 1.2	*0.010*
	Recreational sitting (e.g., reading, listening to music) (h/d) [2]	1.8 ± 1.0	1.8 ± 1.1	*<0.001*	1.6 ± 1.1	1.9 ± 1.2	*0.014*
	Total sitting time (h/d) [1,2]	***12.4 ± 1.6***	***12.9 ± 1.8***	***0.021***	***12.4 ± 1.7***	***12.9 ± 1.8***	***0.020***
Weekend	Sleep time (h)	9.9 ± 1.2	9.9 ± 1.3	*<0.001*	9.9 ± 1.2	9.9 ± 1.4	*<0.001*
	Sitting while eating (h/d) [1]	1.8 ± 0.6	1.7 ± 0.7	*0.015*	1.8 ± 0.7	1.7 ± 0.6	*0.004*
	Sitting for work at home (h/d)	1.2 ± 0.8	1.2 ± 1.0	*<0.001*	1.2 ± 0.8	1.1 ± 0.8	*0.001*
	Sitting for screen use (h/d) [1]	3.5 ± 1.5	4.1 ± 1.6	*0.039*	3.9 ± 1.5	4.1 ± 1.6	*0.004*
	Recreational sitting (e.g., reading, listening to music) (h/d) [2]	3.0 ± 1.4	3.2 ± 1.3	*0.006*	2.8 ± 1.3	3.2 ± 1.4	*0.025*
	Total Sitting time (h/d) [1,2]	***9.5 ± 1.9***	***10.3 ± 2.0***	***0.034***	***9.6 ± 1.9***	***10.1 ± 1.9***	***0.019***

[1] sig. difference between club sports and no club sports in girls ($p \leq 0.01$); [2] sig. difference between club sports and no club sports in boys ($p \leq 0.01$).

The previously reported, results remained essentially unchanged in girls after adjusting for age, except for the difference in sleep time during weekdays, which was no longer significant. Among boys, on the other hand, differences in sitting times during weekdays no longer differed between club sports and non-club sports participants after adjusting for age, while club sports participation was associated with a longer sleep time. During the weekend, the difference by club sports participation in recreational sitting time (e.g., reading, listening to music) remained significant (Figure 1).

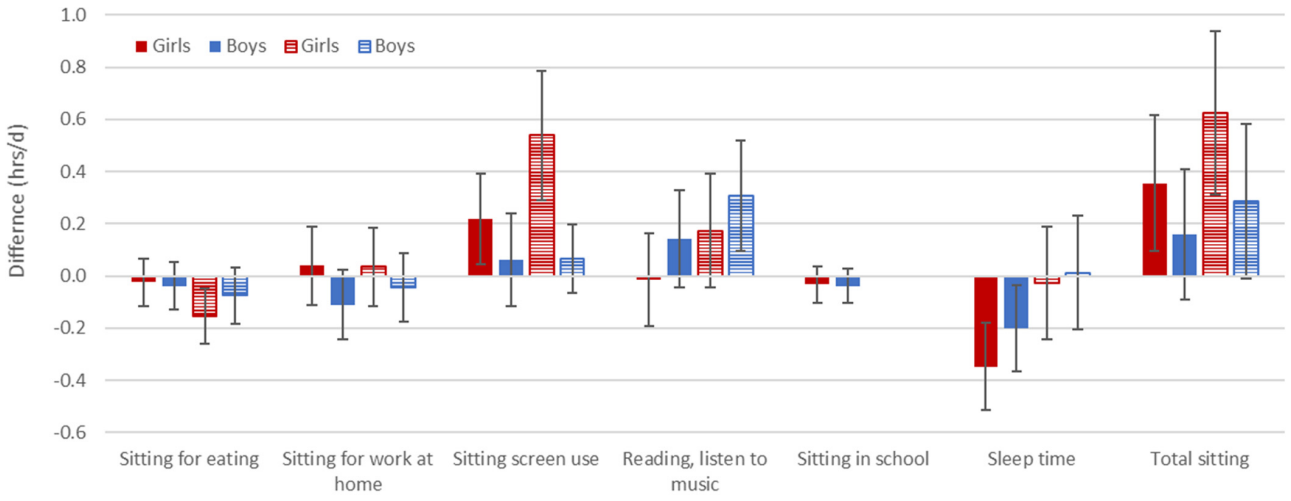

Figure 1. Differences in sitting time by sports participation among boys and girls during weekdays (□) and weekend days (▤). Values are mean differences (positive values indicate higher sitting time in non-club sports participants) adjusted for age with 95% CI.

4. Discussion

As research on correlates of distinct sedentary domains remains sparse, the aim of this cross-sectional study was to examine differences in various seated behaviors and sleep time between adolescents engaging in club sports and those not participating in club sports. The prevalence of club sports participation was almost 40%, and boys displayed a higher club sports participation rate than girls, which is consistent with previous studies [25,28,32]. Across the entire sample, participants spent almost 80% and 70% of their waking time with seated behaviors on weekdays and the weekend, respectively. More than half of the sitting time during weekdays was attributed to schoolwork, while time spent sitting for schoolwork was limited on weekend days. Nevertheless, club sports participation was associated with a lower sitting time during leisure time on weekdays and during the weekend, which confirms the hypotheses. Given a similar schedule during school time along with the same workload, it would be unlikely to expect beneficial effects of club sports on work-related sitting time. The beneficial effects of club sports participation on recreational sitting time may be attributed to the time spent being physically active in sports clubs. Even though these results were consistent among boys and girls, sex-specific analyses revealed a more pronounced effect of club sports participation on sitting time in girls than in boys. Furthermore, higher sitting time in non-club sports participants was predominantly attributed to screen-time among girls while differences among boys were predominantly attributed to sitting for reading and listening to music.

Previous studies also reported a lower sitting time along with reduced screen time in club sports participants [24,30,31]. Examining different seated behaviors, it could be further shown that this difference is due to leisure time choices as differences in work-related sitting were limited. Furthermore, the results were more pronounced in girls with recreational screen time being the predominant contributor to the observed differences. Screen time has been shown to be particularly harmful to cardiometabolic health [37], and high screen time during childhood and adolescence has been associated with an increased risk for metabolic syndrome during adulthood [38]. As more than one third of total sedentary time in girls can be attributed to screen time [39], club sports may present a viable intervention strategy to reduce sedentary time and promote physical activity in female adolescents. A large-scale study further showed that lower screen time was associated with better self-rated health in girls but not in boys [40]. Given the fact that girls are less likely to engage in club sports [41], promoting organized sports participation among girls may be a viable strategy to enhance their future health and well-being.

Among boys, on the other hand, club sports participation was not associated with screen time. Dahlgren et al. [42] did not report a correlation between objectively measured physical activity and screen time in adolescents, which shows that adolescents can be active (e.g., engage in sports) but also engage in a high amount of sedentary time. The possibility of meeting PA recommendations while displaying a high amount of sedentary time is also emphasized by the high amount of sitting time in the present study. Even though previous studies reported lower total sitting times [42,43], sedentary behaviors have been the dominant recreational choice in adolescents. Furthermore, screentime has been shown to increase with age during adolescence [44]. Age differences in the studies, therefore, may explain the observed differences in total sedentary time. The higher sitting times observed in the present study may also represent a long-term effect of the movement restrictions implemented in response to the COVID-19 pandemic. Recent studies in Tyrolean youth [45,46] showed a significant increase in sedentary time during COVID-19 restrictions (e.g., distance learning, closure of sports facilities, etc.) and Salway et al. [47] reported higher screen time post COVID-19 restrictions in 10- to 11-year-old children. Participants in the present study, therefore, may still not have returned to their pre-COVID-19 routines and, therefore, report a higher amount of sedentary behavior.

In addition to a potential benefit regarding leisure time choices, club sports participation has been associated with longer sleep time. Previous studies also reported beneficial associations between sports participation and sleep time in adolescents [24,29], while pro-

longed sitting time has been associated with reduced sleep quality and duration [24]. Even though any form of PA has been associated with better sleep characteristics, benefits may be more pronounced with sports participation, as engagement in sports has been associated with a higher amount of vigorous PA [48]. As sleep habits change dramatically during adolescence [49], along with the fact that insufficient sleep is associated with various health risks in adolescents, including increased risk of obesity, reduced attention and executive functioning, along with mood disturbances [50], club sports participation could provide a variety of health benefits in this critical age period.

Some limitations of the present study, however, should be considered when interpreting the results of the present study. Due to the cross-sectional nature of the study, causal relationships cannot be established. In addition, information on sedentary behaviors and sports participation were obtained via questionnaires, which have an inherent risk of misreporting due to social desirability and recall error. This may result in underreporting of specific sedentary behaviors (e.g., recreational sitting time) while school-related work may be overreported. There was also no information on socio-economic background, living situation, and the type and volume of sports participants engaged in. Torstveit et al. [30], however, showed beneficial associations between sports participation and behavioral choice regardless of frequency of participation. The use of a validated questionnaire to assess different sedentary behaviors along with the large sample size should also be considered a strength of the study.

5. Conclusions

Given the harmful effects of sedentary behaviors on various health outcomes [6,51], the present study, along with previous research, provides important information on the beneficial role of club sports in youth as even modest participation has been associated with improved lifestyle habits [26,30]. Sports participation, however, declines with increasing age during adolescence [41], even though it offers an ideal opportunity to promote an active lifestyle among youth. The present study further indicates that the beneficial associations are particularly pronounced in girls, who are generally less active than boys [52]. As early participation in organized sports has been shown to have a lasting effect into adulthood [53,54], providing easy access to and promoting participation in club sports in youth appears to be a viable strategy to facilitate future health and well-being. Given the limited effects of club sports participation on school-related sitting time, additional efforts during school-time are warranted to reduce sitting time in adolescents.

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