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Life on holidays: differences in activity composition between school and holiday periods in Australian children

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Abstract

B : Recently, a small number of studies have suggested that gains in fitness and reductions in body fat achieved during the school term are reversed or stagnate during the holiday period. This may be associated with changed activity patterns. The aim of this study was to compare 24-h activity compositions between school and holiday periods in Australian children.

: The participants in this study were 366 children (53% female, 13.4 ± 2.3 years) who were a subgroup of the 2007 Australian National Children's Nutrition and Physical Activity Survey. Each child recalled use of time on at least one school day, one weekend day and one holiday using the Multimedia Activity Recall for Children and Adults. Composite "in-term" and "holiday" use-of-time profiles were generated by weighting school days by 5, and weekends by 2 where data were available. Difference between holiday and in-term time use was assessed using a compositional multivariate linear model for repeated measures. Subsequent models tested for interaction between time of measurement and socio-economic status or body mass index.

: Time use was significantly different between holidays and in-term days (F = 103, p

entire year is spent on holidays. The holiday break constitutes a major hiatus in learning, and a body of literature has documented relative declines in cognitive skills over the holiday period (the so-called *e ea i g* ; [8]. Losses are greater among children from disadvantaged families [9], such that the gap grows ever larger over successive years.

More recently, a small number of studies, mainly from North America, have addressed whether changes in measure of SES based on a basket of measures such as education, income and employment. The IRSD has a national mean of 1000 and a standard deviation of 100, with higher values indicating less disadvantage. Parents also reported the highest level of education of either parent, which was collapsed into one of three categories: university (= 162), some post-secondary (= 140), or high school (= 61). IRSD and parental education values were not available for three participants. The three missing IRSD values were imputed by multivariate imputation using chained equations, via the R package *ice* [25]. The predictive mean matching method was used, based on complete data for parental education level and child zBMI.

Use of time was assessed using the Multimedia Activity

Results

Participant characteristics are shown in Table 2. The subgroup was not significantly different from the larger NCNPAS sample in terms of age (mean for both 13.4 years), BMI z-score (both + 0.54), % overweight or obesity (subgroup mean 29% vs 26% for NCNPAS), SEIFA (1003 vs 1002), % female (53 vs 51), geographical distribution (56% vs 54% living in a major city), or educational characteristics of parents (44% vs 40% university-educated).

There was a significant interaction between time of measurement and time-use composition *i*, coordinates (F = 119.1, p < 0.0001). Time use (arithmetic means) during holiday and in-term periods are shown in Table 3 and Fig. 1. A 140 min/day reduction in School-related time was compensated by 58 min/day more Screen Time (mainly TV and Videogames), 40 min/day more sleep, 35 min/day more Domestic/Social time (mainly Chores and Work), and 12 min/day more Passive Transport. In terms of energy expenditure bands, children experienced less VPA (– 10 min/day, associated with less Sport) and sedentary time (– 33 min/day). There were no differences in LPA, MPA or MVPA. Estimated TDEE was 5.4% lower during the holiday period. Additional file 1 shows the median (25%ile-75%ile) time use during in-term and holiday periods.

There were no significant interactions for time of measurement, time-use composition (*i*, number) and either highest parental education level (F = 1.2, p = 0.26), IRSD (F = 1.4, p = 0.0.21) or BMI (F = 1.2, p = 0.32).

Discussion

As hypothesised, there were significant differences in activity compositions between in-term and holiday periods in Australian children. In the holiday period, to compensate for the 140 min/day reduction in School-related time, children slept for 40 min/day longer, and experienced 58 min/day more Screen Time. They also accumulated more Domestic/Social time and spent longer in Passive Transport. However, they accumulated 10 min/day less VPA. As a result, estimated TDEE fell by more than 5%. However, contrary to our hypothesis, these differences were consistent across both area- and household-level SES tertiles, with only minor, non-significant differences across weight status categories.

The findings of this study are broadly consistent with the few other studies of holiday time-use in children. Like Zinkel et al. [18], we found that TDEE was greater during in-term time than in holidays: where Zinkel et al. [18] reported a non-significant 2.4% differential, we estimated a 5.4% difference. Staiano et al. [20] reported 30 min/day more TV time during the holiday break (vs 38 min/day in the current study), and 12 min/day more computer time (vs 20 min/day for computer and videogames combined).

The lower sitting time (– 33 min/day) during the Holiday period might seem surprising, especially given the increase

Table 3 Mean (SD) time use during in-term and holiday periods, and difference between the two periods (holiday minus in-term). All values are in min/day except TDEE (MET.min)

Superdomain	Macrodomain	In-term time	Holiday time	Difference
Domestic/Social		75 (65)	110 (131)	+ 35
	Social	20 (34)	27 (73)	+ 7
	Chores/Work	55 (56)	83 (112)	+ 28
Passive Transport		52 (32)	64 (85)	+ 12
Physical Activity		143 (76)	136 (127)	–7
	Sport	61 (55)	45 (76)	–16
	Play	38 (49)	40 (76)	+ 2
	Active Transport	44 (36)	50 (80)	+ 6
Quiet Time		77 (54)	80 (86)	+ 3
School-related		216 (80)	76 (109)	–140
	Classroom	164 (55)	31 (66)	– 133
	Study/HW/Music	31 (48)	20 (57)	–11
	Reading	22 (34)	25 (64)	+ 3
Screen Time		201 (110)	259 (174)	+ 58
	TV	135 (81)	173 (1237)	+ 38
	Computer	34 (47)	38 (82)	+ 4
	Videogames	32 (61)	48 (97)	+ 16
Self-care		99 (29)	99 (39)	0
	Eating	57 (19)	62 (29)	+ 5
	Grooming	42 (20)	37 (25)	–5
Sleep		576 (66)	616 (108)	+ 40
Energy expenditure				
TDEE (MET.min)		2405 (360)	2282 (490)	–123
TST		516 (101)	483 (162)	–33
LPA		245 (93)	245 (149)	0
MPA		64 (57)	67 (95)	+ 3
VPA		39 (43)	29 (56)	–10

HW homework, LPA light physical activity, MPA moderate physical activity, MVPA moderate-to-vigorous physical activity, VPA vigorous physical activity, TDEE total daily energy expenditure, TST total sedentary time

Fig. 1

rate of 6334 kJ predicted by the Schofield equations for children of this age and size [36], and using the MARCA-estimated physical activity level (PAL) of 1.67 METs, a decrement of 5.4% in TDEE would equate to a deficit in EE of about 570 kJ/day, or 23,940 kJ over the six-week summer holidays. Uncompensated by dietary changes, this would result in the accumulation of about 650 g of body fat.

Contrary to expectations, the differences between in-term and holiday activity compositions were not moderated by socioeconomic status or weight status. Brazendale and colleagues [37] have recently noted that children's activity patterns on holidays closely resembled weekend days, which they attribute to weekend days and holidays lacking daily structure, compared with school days (they call this the "Structured Day Hypothesis"). Our previous study of Australian children who participated in the National Children's Nutrition and Physical Activity Survey (the same study from which the current subset was drawn) found that children from lower socioeconomic backgrounds experienced less sport and less vigorous physical activity that their more well-off peers, and the gap widened on weekends [38]. Based on this, we might have expected to have found socioeconomic differences in the current analysis. However, it is possible that with its more modest sample size, differences failed to reach statistical significance in the current study.

This is one of very few studies to capture time use during the holiday period, and to our knowledge, the first limiting the amount of discretionary time for unfavorable activities such as recreational screen time). This may suggest that unfavourable activity patterns and health outcomes associated with children's holidays may be addressed by extending the school environment to holidays, through radical restructures of the school year, which have been mooted and are being trialed overseas [40], or by fostering residential or non-residential summer camps which are already widespread in Europe and North America. In France, for example, 25% of all students attend summer *c ie, de aca ce,*. Recently there has

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