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Patterns of time use among regional and rural adolescent girls: Associations with correlates of physical activity and health-related quality of life

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ABSTRACT

Objectives: To describe patterns of time use among regional and rural adolescent girls and compare identified clusters with respect to correlates of physical activity (PA) and health-related quality of life (HRQoL).
Design: Cross-sectional PA and lifestyle survey.
Methods: Data were from Year 7–9 adolescent girls (aged 12–15 years) from 16 schools involved in a cluster-randomised trial in regional and rural Victoria, Australia ($n = 494$). Time use data were collected using 24-h Previous Day Physical Activity Recall (PDPAR-24) questionnaire, collapsed into 17 categories of time use. Differences between time use clusters with regard to demographics, correlates of PA and HRQoL measured using PedsQL 4.0 Generic Core Scales, were investigated.
Results: Two time use clusters were identified and were associated with correlates of PA and HRQoL. Girls who spent significantly more time in teams sports, non-team sports, school classes, watching TV and sleeping had higher levels of positively aligned PA correlates (e.g. self-efficacy, perceived sports competence) and HRQoL than girls characterised with high levels of computer use and video gaming.
Conclusions: These findings highlight how different activity patterns of regional and rural girls affect HRQoL and can inform future intervention strategies to improve PA levels and HRQoL. Clusters characterised by low levels of PA and high computer use and video gaming require targeted interventions to address barriers to their participation

1. Introduction

It is consistently reported that levels of physical activity (PA) decline during adolescence[1] whilst the proportion of time spent in sedentary activities increases.[2] The way in which adolescents spend their day can influence long-term health outcomes. The most physically active are at lowest risk of chronic diseases and premature death;[3] whereas screen-based sedentary behaviours, independent of PA levels, are associated with increased risk of poor health.[4] Consequently, adolescent health and wellbeing is a global priority[5] particularly for adolescent girls who are less physically active than boys.[6,7] Time use is recognised as a determinant of adolescent well-being[8] and provides insight into the daily activities of adolescents to inform public health interventions.

The majority of time use studies have included populations from the United States and Europe using national lifestyle data sets or national time use data sets[8,9] and have examined time use in terms of specific behaviour categories like PA or sedentary behaviour rather than overall activity patterns of daily living.[8] Capturing patterns of time use using 'person-centred' methods, which involve examining the overall activity pattern rather than discrete activities or behaviours in isolation, has been recommended.[8] One of the few studies that examined multidimensional units of activity was a time use study of 9–16 year old Australians.[9] This study identified three time use clusters for each gender, indicating that boys and girls have different patterns of behaviour, from which the authors concluded that intervention strategies should be gender-specific and targeted to youth based on their time use grouping.[9] For instance, girls classified as a "social-screenie" spend high amounts of time

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using TV and computers and engaging in social interaction (e.g. talking, texting) and might benefit from interventions that use group or online sessions; whereas "techno-studious" boys who have high usage of video gaming, computer use, study and reading might benefit from converting passive video gaming to active video gaming.[10]

Very few studies, however, have examined time use of adolescents in relation to health, correlates of PA participation, wellbeing, or quality of life.[8] Some studies have examined objective indicators of health such as weight status or body mass index,[8] or medical conditions (e.g. hearing problems, mental illness), but it has been suggested that these measures may not be sensitive enough to capture the consequential health effects.[10] Studies that include reliable and valid instruments to examine time use in relation to health, wellbeing and quality of life are needed, to "inform adolescent policy development and service provision targeting increased positive behaviours, relationships and competencies" (p. 6).[8] This would enhance our understanding of how different activity patterns affect adolescent health, wellbeing, and quality of life.[11]

This study builds on the work of others[8,10,12] to examine time use of adolescents using the person-centred approach, and to the authors' knowledge is the first to examine time use in relation to health-related quality of life (HRQoL). HRQoL encompasses the physical, mental and social health dimensions as outlined by the World Health Organization. The aims of this study were first to identify clusters of adolescent girls based on patterns of time use, and second to investigate differences between clusters with respect to potential correlates of PA participation and HRQoL.

2. Methods

This study was drawn from a larger cluster-randomised trial of a school-community linked program aimed at improving PA levels and HRQoL among adolescent girls, described elsewhere.[13] Data regarding time use, demographics, PA, potential correlates of PA participation and HRQoL were collected from a baseline cross-sectional PA and lifestyle survey of adolescent girls in Years 7–9 (generally aged 12–15 years) from 16 schools in rural communities and regional cities in the Australian state of Victoria.

Time use data were collected using the validated[14] 24-h Previous Day Physical Activity Recall (PDPAR-24) questionnaire, which lists 58 activities modified slightly to reflect the Australian female context (e.g. netball).

Household employment was dichotomised as two parents/caregivers both in full-time (F/T) or part-time (P/T) employment versus lower levels of employment.[15] Parental education was dichotomised as sole or both parents/caregivers having Year 12 or less versus at least one above Year 12.[15] Socio-economic Status (SES) of home postcode was represented by the Socio-economic Indices for Areas (SEIFA) Index of Relative Socio-economic Advantage and Disadvantage (IRSAD).[16] Nationally, IRSAD scores are centred around a score of 1000 and mostly range from around 800 to 1200, with low/high values of the IRSAD representing relative disadvantage/advantage.

Other potential correlates of participation in PA were collected using established tools, mostly validated and reliable, reported in detail previously.[13] Briefly, these included perceived sports competence, self-management strategies, outcome expectations and outcome expectancy-value, self-efficacy, enjoyment of PA and sedentary activities, barriers to participation, and influence of family and friends.

HRQoL data were collected using the validated PedsQL 4.0 Generic Core Scales for Teens aged 13–18.[17] PedsQL includes questions on physical functioning (8 items, e.g. "It is hard for me to walk more than a block"), emotional functioning (5 items, e.g. "I feel sad or blue"), social functioning (5 items, e.g. "Other kids tease me") and school functioning (5 items, e.g. "It is hard to pay attention in class") which are used to derive summated scores for physical health, psychosocial health (emotional, social and school functioning) and a total score.[18] The summated scores were transformed to a 0–100 scale, with high scores indicating better HRQoL.

3. Analysis

The 58 activities of the PDPAR-24 were aggregated into 17 categories of time use identified by Ferrar et al.[10] which are listed in Table 1. The times spent in each of the 17 types of activity were used as inputs to a cluster analysis, using the Two Step Cluster algorithm in SPSS© Version 21. The analysis produced a two-cluster solution i.e. two groups with distinct patterns of time usage. Differences between the two time-usage clusters with respect to each of the 17 input variables, demographics, PA, correlates of PA participation and HRQoL were investigated. Analysis methods included multilevel linear mixed models (LMM) incorporating a random effects term to allow for any differences between schools, independent samples *t* tests, and chi-squared tests of independence.

4. Results

The 16 participating schools had a total of 3963 students in the target cohort. Parental consent was obtained and baseline survey forms were completed by 900 students (response rate 22.7%). For the present study 292 students (32.4%) were excluded because they did not fully complete the PDPAR-24 questionnaire. Apart from a few exceptions due to special arrangements made because of absences from the survey sessions, the forms were completed at school, and so there were few surveys completed on Saturdays or Sundays pertaining to Fridays or Saturdays. Because the different pattern of activities on weekends and schooldays had the potential to dominate and distort a cluster analysis, data pertaining to the weekends were excluded, resulting in 114 students (12.7%) being excluded because they completed the survey on a Sunday ($n = 4$) or a Monday ($n = 110$). Consequently data from 494 girls were included in this study. Comparisons between the girls included in ($n = 494$) and excluded from ($n = 406$) the study, with respect to the 30 potential correlates listed in Table 2, revealed only one significant difference, with included girls being slightly older ($M = 13.5$ years, $p = 0.002$) than excluded girls ($M = 13.3$ years).

The mean times spent on weekdays in each of the 17 aggregated activity categories are shown in Table 1. The clustering procedure produced a two-cluster solution, with 455 girls in one cluster and 39 in the other. The mean times spent by girls in each of the clusters in each of the 17 aggregated activity categories are also shown.

In initial LMM analyses, significant school effects were found for 14 of the 17 time use variables, however in no case did this affect the results of the test for the difference between clusters. In light of this, and because of violations of the assumption of homogeneity of variance underlying LMM (evidenced by the large differences between the standard deviations of the two clusters for some variables in Table 1), independent samples *t* tests were conducted with adjustment for unequal variances where appropriate. Results of these tests are shown in Table 1. Where differences between cluster means are statistically significant, the cluster means and the difference between means are shown in boldface.

The cluster means differed significantly for seven of the 17 activity categories. Cluster 1 girls spent significantly more time in team sports, non-team sports, school classes, watching TV and sleeping, and Cluster 2 girls spent significantly more time on video games and computer activities. On the basis of the activities that dominate each cluster and activities with high cluster discrimination

Table 1
Time usage (mins per weekday) in 17 activity categories for two clusters of girls.

	All (n = 494)		Cluster 1 (n = 455)		Cluster 2 (n = 39)		Mean diff.[a]	
Activity	Mean	SD	Mean	SD	Mean	SD		p-Value[b]
Sleep	530.2	79.6	**540.5**	60.4	**410.8**	150.5	**−129.7**	<0.001
TV	67.5	69.2	**70.6**	70.1	**30.8**	43.2	**−39.8**	<0.001
Video games	1.6	12.7	**0.3**	3.1	**16.2**	41.8	**15.8**	0.023
Computer	27.9	53.3	**22.7**	37.9	**87.7**	125.5	**64.9**	0.003
Social interaction	16.8	37.2	14.6	28.7	42.3	85.9	27.7	NS
Grooming	59.1	36.0	58.2	29.3	70.0	80.4	11.8	NS
Eating	94.6	68.8	91.3	52.2	132.3	165.0	41.0	NS
Quiet time	28.7	62.0	25.3	43.1	67.7	161.1	42.4	NS
Play	56.8	66.7	58.2	66.4	41.5	69.4	−16.6	NS
Team sports	28.2	54.9	**29.5**	56.3	**12.3**	30.6	**−17.2**	0.003
Non-team sports	83.3	96.3	**85.8**	98.4	**53.8**	62.0	**−32.0**	0.005
Active transport	23.1	48.2	20.7	36.2	51.5	116.8	30.8	NS
School (classroom)	267.0	84.9	**270.9**	80.0	**221.5**	121.5	**−49.4**	0.017
Study/homework/music	54.4	60.7	54.0	57.2	59.2	93.5	5.2	NS
Reading	20.8	56.7	17.9	33.2	54.6	165.2	36.7	NS
Passive transport	63.7	53.3	64.0	52.2	60.0	65.3	−4.0	NS
Chores	16.3	30.5	15.3	26.4	27.7	60.2	12.4	NS

[a] Mean of Cluster 2 − mean of Cluster 1 = deviation of minority cluster from majority cluster.
[b] Independent samples t-test with adjustment for unequal variances where appropriate.

capabilities[10], the two clusters can respectively be labelled as "the majority with a broad balance of activities" (Cluster 1) and "a minority with strong computing and gaming focus" (Cluster 2).

Table 2 shows comparisons of the two clusters with regard to four sets of potential correlates of time usage patterns: individual and household characteristics, PA measures, potential determinants of PA, and measures of health and wellbeing.

Again, LMM analyses revealed school effects for some correlates, but in no case did this affect the results of the test for the difference between clusters. Again there were violations of the assumption of homogeneity of variance, and so independent samples t tests were conducted with adjustment for unequal variances where appropriate. Results of these tests are shown in Table 2.

Table 2
Comparison of two clusters of girls with regard to four sets of potential correlates.

	Cluster 1		Cluster 2		
Variables	n	Mean ± SD or percent	n	Mean ± SD or percent	p-Value[a]
Demographic characteristics					
Age (yr)	425	13.5 ± 0.9	37	13.7 ± 1.0	NS
Live in two parent households	455	76.0	39	61.5	0.045
Parent(s)/caregiver(s) with more than 12 years of education	259	57.5	22	45.5	NS
Parent(s)/caregiver(s) both employed	417	66.9	35	62.9	NS
Neighbourhood SES: SEIFA IRSAD	419	986.4 ± 41.0	31	983.5 ± 46.0	NS
Physical activity					
MET-mins of LTMVPA (24-h)	455	115.4 ± 108.3	39	66.2 ± 70.9	<0.001
Mins of LTMVPA (24-h)	455	778.6 ± 737.5	39	435.6 ± 508.6	<0.001
Days in past 7 with ≥60 min of LTMVPA	455	4.8 ± 1.8	39	4.2 ± 2.0	0.043
Met PA guidelines in past seven days	455	8.4	39	7.7	NS
Sport club/leisure centre member	453	54.5	38	28.9	0.002
Potential determinants of physical activity					
Perceived sports competence	444	3.3 ± 0.7	39	2.9 ± 0.8	<0.001
Self-management strategies	443	3.4 ± 0.7	38	3.0 ± 0.9	0.001
Perceived behavioural control	452	3.9 ± 0.6	39	3.6 ± 0.7	0.004
Outcome expectation	449	36.3 ± 5.3	37	33.4 ± 7.5	0.024
Outcome expectancy-value	442	155.3 ± 44.8	33	139.2 ± 43.9	0.047
Self-efficacy	429	2.8 ± 0.7	35	2.5 ± 0.8	0.004
Enjoyment of PA	444	23.8 ± 5.4	36	21.3 ± 6.2	0.008
Enjoyment of sedentary pursuits	442	4.7 ± 0.8	38	5.0 ± 0.7	0.030
Personal barriers	437	2.4 ± 0.8	39	2.9 ± 1.0	0.002
Organisational barriers	439	2.0 ± 0.7	38	2.4 ± 0.9	0.007
Family support	440	3.8 ± 0.9	38	3.2 ± 0.9	<0.001
Friends support	445	3.4 ± 0.9	39	3.1 ± 1.0	0.030
Health and wellbeing					
General health excellent or good	415	70.4	38	47.4	0.004
BMI	350	20.1 ± 5.4	28	20.2 ± 3.1	NS
PedsQL physical functioning	446	84.0 ± 12.6	39	76.7 ± 17.6	0.015
PedsQL emotional functioning	446	79.1 ± 18.1	39	69.6 ± 22.0	0.013
PedsQL social functioning	446	84.0 ± 16.9	39	78.7 ± 21.0	NS
PedsQL school functioning	446	76.9 ± 16.4	39	69.0 ± 21.3	0.029
PedsQL psychosocial functioning	446	80.0 ± 14.5	39	72.5 ± 18.1	0.015
PedsQL total score	446	81.4 ± 13.0	39	73.9 ± 16.6	0.009

[a] Independent samples t-test with adjustment for unequal variances where appropriate or chi-squared test of independence.

There was a significant difference between clusters for one of the five demographic characteristics. A significantly higher proportion in Cluster 1 lived in two-parent/caregiver households. Four of the five PA indicators differed significantly, with higher means or proportions in Cluster 1. The marked differences in mintues and MET-minutes of leisure-time moderate-to-vigorous physical activity (LTMVPA) in the past 24 h were to be expected, given that these measures were derived from the same data used to identify the clusters. However, the PA differences extended to patterns of activity over a one-week timeframe and to sports club membership, but not to meeting recommended levels of PA over the previous week, for which the proportions were extremely low in both clusters. There were significant differences between clusters with regard to all 12 potential determinants of PA, with Cluster 1 having higher levels of all nine positively aligned determinants, and lower levels of the three negatively aligned determinants.

With regard to measures of health and wellbeing, there was no significant difference between the clusters in BMI calculated from self-reported height and weight. A higher proportion of Cluster 1 girls reported 'excellent' or 'good' general health. Cluster 1 girls also had higher mean scores on all six PedsQL scales, with five of the differences being statistically significant.

5. Discussion

Two distinct clusters of rural and regional living adolescent girls were identified on the basis of time use, and these clusters were associated with correlates of PA participation and HRQoL. In this study girls characterised by team and non-team sports participation, and time spent in school classes, watching TV and sleeping, had higher PA levels, positively aligned correlates and better HRQoL than those characterised by high use of computers and video games. The clusters have some similarities to those of a previous study, which characterised girls as *Quiet actives* (high values on quiet time, non-team sports and active and passive transport), *Social screenie* (TV, computer use and social interaction) and *Techno-studious* (reading, doing homework, music and study and video games).[10] Overall, however, the rural and regional sample in this study reported lower values for time spent sleeping and watching TV, and higher values for time in non-team sports, school, eating and play, than those in the national sample.[10] Relatively more school time is likely to be influenced by the exclusion of weekends and holidays from the present study.[10] Others have also found that sedentary behaviour such as screen time can coexist with physical activities.[10,19] In this study, screen time, including TV and video gaming, was generally lower compared to the national sample of girls, but computer use was higher for girls in Cluster 2.[10]

This study extends the findings of others[8,10] regarding associations between adolescent girls' 24-h time use and correlates of PA and HRQoL. As expected, those with higher levels of PA behaviour (Cluster 1) reported positively aligned determinants of participation (e.g. self-efficacy, perceived sport competence, family support) and lower levels of negatively aligned determinants (e.g. enjoyment of sedentary pursuits, personal and organisational barriers). In terms of HRQoL, mean scores in Cluster 1 were comparable to a healthy sample of children aged 5–18 years, with slightly better physical functioning (+3.81). However, Cluster 2 had lower total scores (Mean difference: −5.72); and in particular low scores for emotional functioning (−8.50), school functioning (−6.87), psychosocial functioning (−6.87) and social functioning (−5.39). The difference between clusters in PedsQL total score was larger than the mean difference of −5.4 points for samples of young people with and without type 2 diabetes, suggesting that the differences are meaningful.[20]

PA behaviours may be protective against high body mass index,[4,10] however it is possible that the context of PA participation is also important for general health and HRQoL. Sport participation has been associated with both improved physical health and psychosocial health outcomes, which is most likely due to the social nature of sport participation.[21] Further, children who maintain their participation in sport have reported better mental health and HRQoL than children who do not participate in sport or who drop out of sport.[22] Girls in Cluster 1 were significantly more likely to be a member of a sports club or leisure centre, which no doubt contributed to the time spent in team and non-team sports. On the other hand, those in Cluster 2 were significantly less likely to be a member of a sports club or leisure centre and had lower levels of PA, characterised by some non-team sports and active transport participation, which contribute less to general health and HRQoL.

Girls with high TV screen time, computer time and social interaction have been previously identified as "at risk" of poor health based on their relative time use and limited PA participation.[10] Interventions to increase PA and reduce sedentary behaviour have been suggested specifically for these girls, including group education sessions or online forums that reflect their tendency towards social interaction.[10] Information and communication technologies (ICTs) such as the Internet, email and mobile phones have been used for disseminating PA interventions, although few have focused on adolescents.[23] These interventions have demonstrated some positive outcomes by using behaviour change strategies such as specific goal setting, self-monitoring of behaviour, and provision of feedback on performance.[23] These ICT-based PA interventions, however, tend to focus on general PA delivered in the home or school setting[23], rather than specific activity types such as targeted sport, or sports club settings which might provide the social support and interaction needed by these girls to facilitate and maintain PA participation. Further, these interventions have not targeted specific subgroups at risk of low activity. The present study showed that girls characterised by high computer use and video gaming enjoyed sedentary activities and experienced personal and organisational barriers to PA participation. They also had significantly lower levels of positively aligned correlates such as perceived sports competence, self-efficacy, and family support. Therefore ICT-based PA interventions would need to be designed to address these determinants of participation.

ICT is ubiquitous in young people's lives, and consequently ICT-based interventions are growing across a range of fields including education, and more recently, physical education. For instance, it has been suggested that technology innovations be incorporated into physical education lessons through visual, auditory and kinesthetic learning channels.[24] ICT can give "instructions and pictorial sequences of skills used in playing sports and simulations of skills and tactical formations in a variety of sports" (p. 30)[24], and has been suggested to have a positive effect on student motivation, enjoyment and degree of engagement in activities.[25] The use of simulations of skills and tactics in a variety of sports via ICT can provide cognitive opportunities to understand and learn sports skills prior to application. This may help to address barriers associated with perceived sports competence by girls characterised with lower levels of PA, but high computer use and video gaming. Moreover, while empirical evidence is limited as yet, interventions using electronic gaming have been proposed to enhance young people's physical fitness, motor skills and motivation for PA.[26] Furthermore, sporting contexts can extend to include both in-school physical education and extra-curricular contexts and out-of-school community and home-based sporting contexts.

Using a person-centred, time-use approach to examine overall activity patterns rather than discrete activities or behaviours provided great detail about coexisting behaviours and is a key strength of the present study. However, the low response rate, attributable

at least in part to a school-based setting and the opt-in self/parental consent requirement, may have introduced a self-selection bias in the sample with the possibility that girls with more interest in PA were more likely to have given/obtained consent to participate in the study.[27] This likely also contributed to the fact that only two clusters were identified, and to the lack of balance in the cluster sizes. However this limitation does not invalidate the observed significant differences between the clusters with respect to time use, determinants of participation and HRQoL. Another potential limitation was the fact that many respondents were excluded, either because they did not fully complete the PDPAR-24 questionnaire or because they provided data pertaining to the weekend. However, comparisons between the girls included and excluded from the study revealed only one significant difference among all potential correlates, suggesting that the exclusion process was not a source of bias. Finally we acknowledge some limitations in the form of the data collected, including BMI based on self-reported height and weight, and the capacity of a previous day 24 h recall to represent "usual/typical" activities for adolescent girls. Day-to-day variation in the pattern of activities is likely to have some impact on the individual-level analyses conducted in this study.

6. Conclusion

This study identified time-use clusters, PA correlates and HRQoL of regional and rural adolescent girls which can inform future intervention strategies. Clusters characterised by low PA levels and high computer use and video gaming indicate that targeted interventions that engage adolescent girls and overcome barriers to their participation in PA are warranted to improve their HRQoL. Future research could explore the feasibility of ICT-based strategies for promoting participation in PA, and sport in particular, among girls characterised by high levels of screen time.

Practical implications

- Patterns of time use among regional and rural adolescent girls were associated with correlates of PA and HRQoL and can be used to inform interventions.
- Clusters characterised by low PA levels and high computer use and video gaming require targeted interventions.
- ICT-based strategies applied to a variety of sports might provide cognitive opportunities to understand and learn sports skills prior to application, helping to overcome barriers to participation for girls characterised by high computer use and video gaming.

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