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## How active are rural children in Australian physical education?

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Physical education lessons offer a venue for children to accrue valuable and health-conferring time being physically active. The first Australian direct observational data are presented on activity of year 3 and 4 children during physical education. Analysis accounts for the nested nature of the data through multi level logistic regression using 13,080 records within 231 lessons within 18 randomly selected schools. Activity was analysed in relation to lesson context (focus of lesson), child gender, school year of child, teacher gender, lesson duration and start time. Children spent 36.7% of a lesson in moderate to vigorous and 12.9% in vigorous activity. Most of the lesson was spent in the context of management/instruction (37.4%), followed by games (25.0%), skill (21.4%), and fitness (14.7%). The highest level of moderate to vigorous activity was observed in the fitness lesson context (61.9%), followed by skill (46.4%), games (42.6%) and management/instruction (17.1%). Moderate to vigorous activity was significantly higher for boys than girls. There was no significant difference in moderate to vigorous activity in lessons led by male or female teachers. However vigorous activity was significantly higher for female led lessons. Children participated in less physical activity during physical education lessons timetabled in the afternoon, compared to physical education lessons time-tabled in the morning. Physical activity levels were not related to lesson duration. Physical education lessons can potentially be more active. However improvement rests on school capacity and may require a health promoting schools approach to implement curricular policy.

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### Introduction

Physical inactivity is a major public health concern (Bauman et al., 1996; Blair et al., 1989; Cale & Almond, 1992; Pate et al., 1996; Stone et al., 1998). It has been linked to increased risk of coronary heart disease, non-insulin dependant diabetes, hypertension, stroke, osteoporosis, colon cancer and depression (Bauman et al., 1996; US Department of Health & Human Services, 1996). Reversible risk factors such as atherosclerotic lesions and high blood lipids are already evident in childhood (Rowland, 1990).

While establishing a definite link between physical activity (PA) in childhood and subsequent PA in adulthood requires more long-term tracking studies (Malina, 1996), there is evidence for tracking between early and middle childhood and between adolescence and adulthood (Malina 1996; Pate et al., 1996; Washburn, Heath, & Jackson, 2000).

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The United Kingdom Expert Consensus Conference has recommended that: "...all young people should participate in PA of at least moderate intensity for one hour per day. Young people who currently do little activity should participate in PA of at least a moderate intensity for at least half an hour per day" (Cavill, Biddle, & Sallis, 2001). Australian guidelines for children's PA recommend that children accumulate 30 minutes of moderate PA on at least five days of the week and in addition engage in three to four 30 minutes sessions of vigorous PA per week (Commonwealth Department of Health & Aged Care, 1999).

Despite such recommendations, child PA in Australian schools is decreasing (Senate Standing Committee on Environment, 1992) and, while it would seem that Physical Education (PE) classes might provide an opportunity to counter the decline, many primary schools provide less than 45 minutes of PE per week (Booth et al., 1997). Furthermore, as there are no existing data on PA within PE lessons in Australia gained through validated direct observational methods, it is unclear what contribution these lessons really make towards recommended PA levels. In Britain PA levels in PE lessons are concerning with moderate to vigorous physical activity (MVPA) amounting to between 8% and 32% of the lesson time (Simons-Morton et al., 1993; Simons-Morton et al., 1994; Sleep & Warburton, 1992). The American picture is similar, with moderate to vigorous (MVPA) amounting to between 18% and 37% of the lesson time (Luepker et al., 1996; McKenzie et al., 1995; Sallis et al., 1997).

These figures are markedly lower than the US national objective that at least 50% of PE lesson time should be spent in MVPA (Centers for Disease Control and Prevention and President's Council on Physical Fitness and Sports, 2000). Whilst the US goal is ambitious it is also considered feasible within American schools (Centers for Disease Control and Prevention and President's Council on Physical Fitness and Sports 2000). Whether the target is realistic for Australia depends on existing PA levels and similarities between Australian and American schools in terms of capacity to increase PA.

One factor that may contribute is the degree to which teachers specialise. In many Australian schools, particularly in NSW, generalist teachers teach PE. Studies comparing children's PA levels in lessons led by PE specialist teachers with those led by generalist teachers have found children to be more active with specialist teachers (McKenzie et al., 1995; Sallis et al., 1997).

Lesson context, lesson length and child gender also appear to influence PA levels in PE (McKenzie et al., 1995) although the influence of gender is less clear (Dworetzky, 1990; Sarkin, McKenzie & Sallis, 1994). Other potential contributing factors are lesson start time, as it was hypothesised that children would tire as the day progressed, and teacher gender, of which only one major study has examined in relation to lesson context, finding no relationship (McKenzie et al., 1995).

Our study is the first to characterise PA levels of Australian children in PE using a validated observational methodology and then to explore factors which might underlie these levels. Data were gathered during the formative phase of the broader Move It Groove It (MIGI) program, a multisectoral one-year intervention targeting PA and fundamental movement skill development in primary schools. It involved an Area Health Service, the Department of Education and Training, and a University. The specific research questions

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were a) How active are Year 3 and 4 children in rural Australian PE lessons in terms of MVPA/vigorous physical activity (VPA)? b) How does PA level vary with lesson context (focus of a lesson) during PE lessons? c) Does length of the lesson predict PA levels during PE lessons? d) Are the PA levels of boys higher than that of girls during PE lessons? e) Does start time of the class predict PA levels during PE lessons? f) Does the teacher's gender influence PA levels of the children during PE lessons?

The findings from this research provide a benchmark for rural Australian children as a basis for determining a realistic percentage of time that children should be active in PE lessons. Furthermore it can assist health promotion practitioners and schools in tailoring school interventions to optimise PA outcomes.

### **Method**

#### **Sample and setting**

Two hundred and thirty one Year 3 and 4 lessons (Year 3, Year 3/4 multi-age, Year 4) from 18 primary schools in three school districts in northern NSW in rural Australia were surveyed between February and May 1999. Schools were invited to indicate expressions of interest in the project and were then randomly selected and stratified by school district and size. Cross-country and swimming lessons were excluded due to difficulty in observing. Primary schools in the sample varied in size from 18 to 575 pupils.

#### **Observation tool**

The validated System for Observing Fitness Instruction Time (SOFIT) instrument was used to assess both PA levels and lesson context (McKenzie, Sallis & Nader, 1991; McKenzie et al., 1994). SOFIT involves the direct observation of lessons by trained observers and has been used to assess PA categories in the Child Adolescent Trial for Cardiovascular Health (CATCH) project (McKenzie et al., 1995; McKenzie et al., 1996; McKenzie et al., 1994) and the Sports, Play and Active Recreation for Kids (SPARK) project (Sallis et al., 1997). SOFIT measures three aspects: PA levels, lesson context and teacher behaviour. A modified version of SOFIT was used in MIGI. Only PA levels and lesson context were deemed relevant to the project's intended intervention with the number of lesson contexts being reduced and some additional measures recorded. The additional measure recorded at the observation level was the gender of the observed child. Additional measures at the lesson level were school year of child, the teacher's gender, start time and length of the lesson.

Every observation period consisted of two discrete observations: 1. the PA level of a previously selected child and 2. the lesson context of the whole class (>50% of children). The observed PA categories ranged from 1-5 and corresponded to levels of energy expenditures. These categories have been validated and discussed by McKenzie, Sallis et al., (1991). Briefly, the categories are: 1= lying, 2= sitting, 3= standing, 4= walking and 5= more active than walking. Vigorous activities conducted while in sitting or lying positions (eg sit-ups) were categorised as 5. Categories 4 and 5 were classified as MVPA (ie moderate to vigorous PA) and category 5 as VPA (vigorous PA), ie VPA is a subset of MVPA. By reporting in this manner, the data are directly comparable with other major studies in the area (Luepker et al., 1996; McKenzie et al., 1995; Simons-Morton

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et al., 1991; Sleep & Warburton 1992). In addition, the complexity of reporting a multinomial logistic model is avoided.

Lesson context described what most (>50%) children were engaged in at the time of observation. The SOFIT lesson contexts of 'management' and 'knowledge content' were collapsed into one category termed 'management/instruction'. The modifications were necessary as in our piloting it was not possible to reach a reliability level of over 80%. The tapes that were used for piloting were of American PE classes and some of the teaching strategies used in the classes are not commonly used in PE lessons in this area. This meant that it was difficult for observers to categorise lesson context.

The management/instruction lesson context referred to class time when children were not engaged in PA; rather they were being *instructed* in physical education or *managed*, ie managerial/organisational activities were taking place (team forming, explaining activity rules etc.). If on the other hand children were *engaged* in physical activity, the major purpose of the activity had to be considered to determine lesson context. Three lesson contexts were used to describe engagement in activity. 1. 'Fitness': activities whose major purpose is to alter the physical state of the individual in terms of cardiovascular endurance, strength, or flexibility, eg aerobic dance, distance running, weight training, fitness testing, and warm-up and cool down activities. 2. 'Skill': activity time devoted to practice of skills with the primary goal of skill development including the refinement and extension of skills in an applied setting and 3. 'Game': activity time devoted to a game or competitive setting when participants generally perform without major intervention from the teacher, eg volleyball and tag games. An 'other' lesson context category was used to describe engagement in free activity or conversation with the teacher on topics unrelated to the PE class.

Four children were randomly selected prior to the start of the PE lesson. The first child was observed for 12 periods of 20 seconds each and the PA level (1-5) and lesson context (management/instruction, skill practice, game, fitness or other) was recorded at the moment the time period ended.

Once the 12 observations were completed on the 1st child, the 2nd child was observed for 12 periods, followed by the 3rd and 4th child. If any lesson time remained after the 4th child was observed, the 1st child was observed again and the cycle repeated until the lesson ended.

#### **Reliability**

The 15 observers were undergraduate students (School of Education and School of Exercise Science & Sports Management) enrolled at the local University and trained in the modified SOFIT system of observation. Observer accuracy (Intra-rater reliability) was repeatedly measured during training until an agreement rate of >90% was achieved against a SOFIT gold standard (McKenzie et al., 1995). This involved trainees viewing videoed PE lessons, in which expert observers had previously rated both PA and lesson context of selected students.

Inter observer reliability checks were conducted opportunistically on 13% (30/231) of the lessons. A check consisted of two observers rating the same child for the same period from a common viewing position using a shared timer tape recorder. Percentage agreement rates were calculated separately for

observer ratings of PA and Lesson context. Cohen's kappa ( $k$ ) agreement coefficient was also calculated for PA ratings.

Twenty-eight pairs from among the 15 observers provided 1915-paired observations for inter-observer reliability checks. Within the check sample the agreement rate for student activity level ranged from 72.2% to 100% with a mean rate of 96.1%. Three quarters (75.0%) of the observer pairs exceeded 95% agreement and only 3.6% failed to reach 85% agreement. Kappa ranged from 0.7 to 1.0 with 17 of the 28 comparisons returning  $k > 0.95$ .

For the lesson context the agreement rate between the pairs ranged from 73.2% to 100% with a mean rate of 97.9%. Most (85.7%) of the observer pairs exceeded 95% agreement and only 1 (3.6%) failed to reach 90% agreement. Both these rates compare favourably with the rates reported by McKenzie (McKenzie et al., 1995).

#### **Data structure and statistical model**

The data consisted of observations of children's PA, within a PE lesson, within a school. There were thus three possible levels at which variation might occur: The observation level, the lesson level, and the school level. The data were therefore 'hierarchically structured' with 'nested sources of variation' (Brooks, 2000).

To account for possible clustering within levels the data were 'modeled' using multiple hierarchical binary logistic regression models via MlwiN (<http://www.ioe.ac.uk/mlwin>) (Goldstein, 1995; Snijders & Bosker, 1999). Binary response variables (0,1) were constructed from the 5-point PA ratings to indicate whether the child being observed was or was not rated as engaging in MVPA or VPA.

The models were built up from the basic null or variance components (intercept only) models by adding predictor variables one at a time. At the observation level, dummy-coded variables for lesson context were added in accordance with the expectations that levels of PA would differ among lesson contexts. At the lesson level, a dummy-coded variable for child gender was added in accordance with the expectation that boys would be more active than the girls. Dummy-coded variables for school year of child were added to adjust the estimates for subsequent variables regardless of whether school year was found to significantly relate to the response variables. Also, a dummy-coded variable for teacher gender and the variables lesson start time (hours from 9.00 am) and lesson duration (minutes) were added although no strong expectations were held about their effects. There were no predictor variables proposed at the school level. Apart from school year of child, any predictor variable found not to have a significant effect in either the MVPA or VPA models was removed, so that any variable having a significant effect in either of these models was included in both. Second order penalised quasi-likelihood (PQL2) (Goldstein 1995; Goldstein and Rasbash 1996) estimates and standard errors were obtained.

### **Results**

#### **Sample statistics**

The study sample consisted of 13,080 observations on 231 lessons (mean observations per lesson = 56.9) in 18 schools (mean lessons per school = 12.8).

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The gender breakdown of observations was 48.7% female and 51.3% male for children, and 54.7% female and 45.3% male for teachers. The distribution of lesson contexts was: management/instruction 37.4%, games 25.0%, skill 21.4%, fitness 14.7% and other 1.3%. The school year breakdown of lessons was: 21.0% in Year 3, 54.1% in Years 3/4 composite, and 24.9% in Year 4. Lessons started between 9.00 am and 2.55 pm and ranged from 12 to 46 minutes in duration (mean lesson duration = 21.2 minutes).

**Physical activity levels: null (variance components) and predictor models**

Table 1 describes the null and predictor models for both MVPA and VPA. When interpreting Table 1 each predictor variable is listed under the Level that it relates to (observation or lesson) and in addition has a subscript or number of subscript letters that refer to the levels of 'nesting' involved. Subscript "i" refers

Fixed effects	MVPA				VPA			
	Null Model Coeff.	S.E.	Predicted Coeff.	S.E.	Null Model Coeff.	S.E.	Predicted Coeff.	S.E.
Intercept (jk)	-0.545	0.094	-1.321	0.167	-1.910	0.134	-3.664	0.230
<b>Level 1 Observation (ijk)</b>								
girl child <sup>1</sup>			-0.132	0.042*			-0.098	0.057
fitness <sup>2</sup>			2.064	0.074 *			3.124	0.118*
game <sup>2</sup>			1.276	0.060 *			2.309	0.112*
skill <sup>2</sup>			1.432	0.063 *			2.387	0.115*
other <sup>2</sup>			0.994	0.272			0.750	0.553
start time <sup>3</sup>			-0.102	0.041 *			-0.199	0.053*
<b>Level 2 Lesson (ik)</b>								
year 3 <sup>4</sup>			0.227	0.144			0.26	0.172
year 3/4 <sup>4</sup>			0.039	0.127			-0.072	0.160
female teacher <sup>1</sup>			0.030	0.104			0.292	0.130*
<b>Random effects<sup>5</sup></b>								
school (k)	0.108	0.052	0.039	0.027	0.245	0.107	0.103	0.056
lesson (jk)	0.415	0.050	0.343	0.045	0.581	0.077	0.451	0.066
child (ijk) <sup>6</sup>	1.000	0.000	1.000	0.000	1.000	0.000	1.000	0.000
<b>Statistics</b>								
ICC <sup>7</sup>	0.207		0.102		0.297		0.186	
Reliability <sup>8</sup>	0.770				0.835			
R <sub>1</sub> <sup>2 9</sup>			0.270				0.329	
R <sub>2</sub> <sup>2 10</sup>			0.531				0.535	
* Significant p < 0.05 (Wald statistic = z = coeff./se)				5 Variance components and their standard errors (SE)				
1 Dummy codes to represent child and teacher gender (reference category = male)				6 These values are default				
2 Dummy codes to represent lesson context (reference category = class management)				7 Proportion of (school & lesson within school) variance at the school level				
3 Beginning time of lesson in hours from 9.00 am				8 Reliability of mean of 12 (the median) lessons as measure of a school				
4 Dummy codes to represent class year (reference category = year 4)				9 Proportion of lesson variance accounted for				
				10 Proportion of school variance accounted for				

Table 1: Parameter estimates and standard errors from null model and predictive models for Moderate to Vigorous and Vigorous Physical Activity.

to the *i*th level 1 (observation), subscript "j" refers to the *j*th level 2 (lesson) and "k" refers to the *k*th level (school). Thus, variables that are at level 1 are represented by a "ijk" as they are nested within lessons firstly and then within schools, and variables that are at level 2 are represented by a "jk" as they are only nested within schools.

Fixed effects describe the mean effects of the predictor variables at the observation (level 1) and lesson (level 2) levels. The random effects are the variances of the residuals at each of the three levels, ie that part of the variance at each level that is unaccounted for by the predictors. The parameter estimates (labelled 'Coeff.' in Table 1) are regression coefficients. Mean levels for the various factors, derived from these coefficients are reported in Table 2.

The intercept logit for MVPA from the null Model (an estimate of the population grand mean) represents odds of 0.58 (36.7% MVPA over all observations). The variance within lessons (0.108) was 3.84 times that of the variance among schools (0.415). Based on these figures, the proportion of variance at the school and lesson levels that was at the school level was 0.207. This is an intraclass (intraschool) correlation representing the similarity within schools and a measure of the internal consistency reliability of a single lesson as a measure of a school. The median number of lessons within schools was 12 and the internal consistency reliability of the mean of 12 lessons as a measure of a school was 0.77.

The intercept logit for VPA from the null model represents odds of 0.15 and a percentage of 12.9% of VPA over all observations. The variance among lessons within schools was 2.37 times greater than the variance among schools, representing an intraclass (intraschool) correlation of 0.30 and a reliability of the mean of 12 lessons of 0.84.

#### **Predictors of physical activity during physical education**

Among the predictor variables entered into the models (Table 1), lesson duration was found to be non-significant for both MVPA and VPA and excluded. School year was also found to be non-significant but included to adjust the estimates for the remaining variables. Child gender was found to be significant for MVPA but failed to reach significance for VPA, although girls were observed to be less physically active in both the MVPA and VPA categories. In contrast, teacher gender was found to be clearly non-significant for MVPA but lessons taught by female teachers were found to have significantly higher levels of VPA. Lesson start time was found to be significant for both MVPA and VPA, with activity levels declining as the day progressed. Lesson context was found to be significant for both MVPA and VPA.

For MVPA, the variables included in the models explained 27% of the variance at the lesson level and 53% at the school level. For VPA they explained 33% of the variance at the lesson level and 54% at the school level.

Table 2 displays estimated mean percentages and confidence intervals of MVPA and VPA for each predictor variable. (See Note below Table 2 for information as to how these were computed).

MVPA was highest in the context of fitness at 61.9% (CI 56.0 to 67.5), followed by skill at 46.4% (CI 40.5 to 52.4), game at 42.6 (CI 37.0 to 48.4) and management/instruction at 17.1% (CI 14.1 to 20.7). The lesson context category of 'other' was not computed as it only constituted 1.3% of the sample.

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Variable <sup>1</sup>	MVPA			VPA		
	Mean %	Lower	Upper	Mean %	Lower	Upper
boys	36.2	31.2	41.6	10.0	7.6	13.1
girls	33.2	28.4	38.4	9.2	6.9	12.0
male teacher	34.4	28.7	40.5	8.4	6.1	11.4
female teacher	35.0	30.1	40.3	10.9	8.4	14.2
9.00 am	39.5	32.7	46.7	11.9	8.4	16.5
11.00 am	34.7	29.8	39.9	9.6	7.3	12.5
1.00 pm	30.2	25.1	35.8	7.7	5.6	10.5
manage/instruct	17.1	14.1	20.7	2.2	1.6	3.1
fitness	61.9	56.0	67.5	33.6	27.1	40.8
game	42.6	37.0	48.4	18.3	14.2	23.3
skill	46.4	40.5	52.4	19.5	15.1	24.9

<sup>1</sup> The mean percentages and 95% confidence intervals for each variable were computed at 'average' levels of the other variables. Specifically, except for the 'boys' and 'girls' estimates themselves, the 'average' level of child gender employed was 0.5. Similarly, except for the 'male teacher' and 'female teacher' estimates, the 'average' level of teacher gender was 0.5. Except for the lesson context estimates, the estimates were computed using the whole sample lesson context proportions. The 'average' value of lesson time was taken as 2 hours from 9.00 am (11.00 am). All estimates were computed for a year 4 class.

Table 2: Estimated mean percentages and 95% confidence intervals of Moderate to Vigorous and Vigorous Physical Activity for each predictor variable computed at the 'average' levels of the other variables.

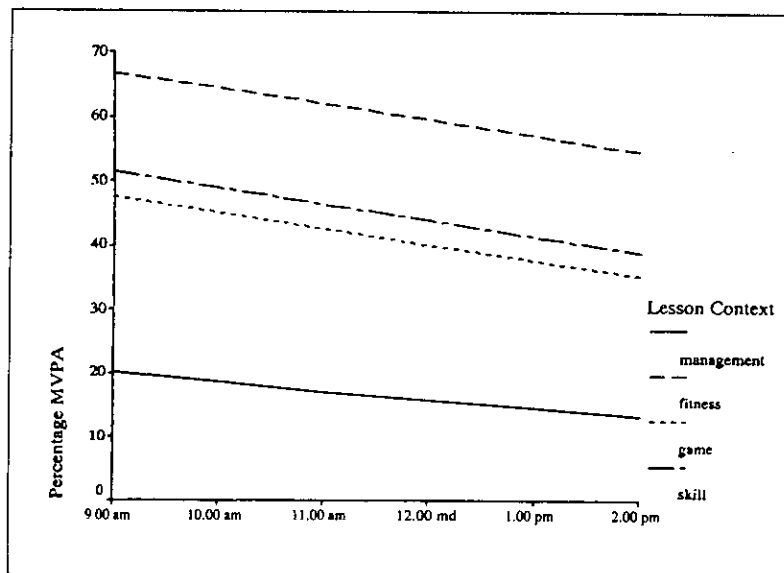


Figure 1: Percentage of Moderate to Vigorous Physical Activity in each lesson context by lesson start time.



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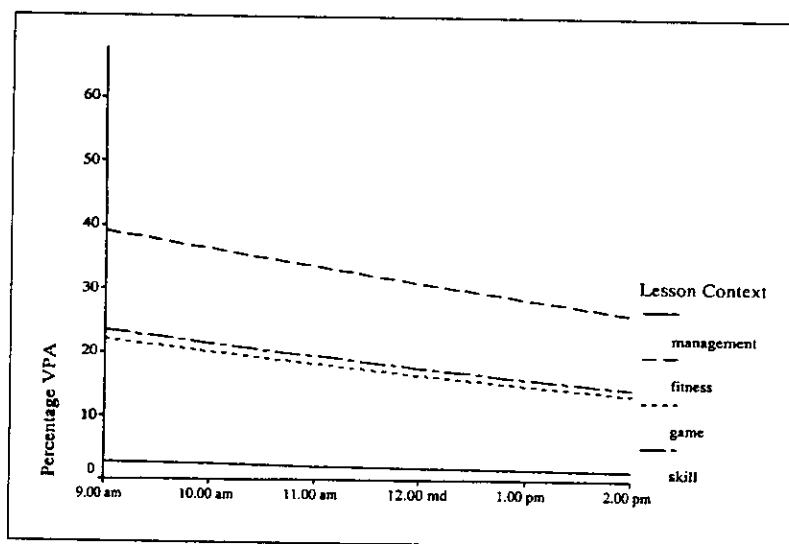


Figure 2. Percentage of Vigorous Physical Activity in each lesson context by lesson start time.

VPA levels followed a similar pattern.

The mean MVPA for girls was 33.2% (CI 28.4 to 38.4) and for boys was 36.2% (CI 31.2 to 41.6). The mean VPA for girls was 9.2% (CI 6.9 to 12.0) and for boys was 10.0% (CI 7.6 to 13.1).

Mean percentage MVPA varied markedly according to the time of day that the lesson began. It was highest at 9.00am being 39.5% (CI 32.7 to 46.7). By 11.00am this had dropped to 34.7% (29.8 to 39.9) and by 1.00pm to 30.2% (CI 25.1 to 35.8). The mean percentage VPA followed a similar pattern. (Figure 1 and Figure 2 depict the percentages of MVPA and VPA by lesson start time and lesson context).

Mean percentage MVPA for lessons led by female teachers was 35.0% (CI 30.1 to 40.3) compared to lessons led by male teachers of 34.4% (CI 28.7 to 40.5). Mean VPA percent for lessons led by female teachers was 10.9% (CI 8.4 to 14.2) and 8.4% for lessons led by male teachers CI (6.1 to 11.4).

### Discussion

The study has provided the first accurate estimates for Australia of children's PA in the PE setting. The mean percent MVPA of 36.7% (Table 1) is comparable to that found by McKenzie et al. (1995) of 36.2% and unfortunately is well below American recommended levels (that at least 50% of PE lesson time should be spent in MVPA) (Centers for Disease Control and Prevention and President's Council on Physical Fitness and Sports 2000). The mean percent VPA level of 12.9% was lower than McKenzie et al. (1995) finding of 17.5%. One factor that may partially explain the lower levels of VPA in our study is that one of the larger schools had a period of cross-country lessons that were excluded and these are lessons that one would expect to have high levels of VPA.

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It is a concern that over a third of the lesson was spent on management/instruction. Our findings confirm McKenzie et al. (1995) in that MVPA and VPA levels were higher during the context of fitness than during the context of skill practice or games. An improvement to the study would be to have noted the primary lesson focus. MIGI only recorded broad context categories of 'fitness', 'skill', 'game', 'management/instruction' and 'other', rather than detail about the type of activity the children engaged in, eg soccer, dance, cricket etc. Such information may have enabled us to discover which particular games, skill practice activities, or fitness activities have higher PA levels. This information would be invaluable to schools wishing to increase PA levels and is recommended as one focus for future research.

It was thought that the lesson length might affect MVPA levels due to the students tiring with time. That this hypothesis was not supported by our data may indicate that the duration of even the longest PE lesson is insufficient to tire the children significantly. This is not hard to believe, when a lesson of average duration (21 minutes) has the equivalent of approximately 7 minutes of MVPA with only 2 minutes being spent in VPA. This is less than the 11.1 minutes MVPA per lesson for the CATCH project due to the longer average length of lessons (30 minutes) (Luepker et al., 1996; McKenzie et al., 1995).

Our finding that MVPA levels were significantly higher for boys than girls also supports McKenzie et al., (1995). However, McKenzie et al., (1995) found that the VPA levels of boys were significantly higher than the VPA levels of girls whereas in MIGI that was not the case (McKenzie et al., 1995). McKenzie et al., (1995) explained the higher PA level in boys as being due to boys being more active than girls during free play opportunities within PE lessons (McKenzie et al., 1995). Other studies confirm that, during free play in the playground, boys are significantly more active than girls in terms of MVPA (McKenzie et al., 2000), and PA generally (Sarkin, McKenzie & Sallis, 1994). In our study however free playtime is almost non-existent (1.3 % of lesson time) compared to the 5.2% reported by McKenzie (McKenzie et al., 1995). This may explain why VPA was not higher for boys in this study.

The finding that PA levels declined as the school day progressed could reflect heat stress, children tiring due to demands of the school day, and/or teachers' energy declining due to teaching demands. Further research is needed to explore which/if any of these factors contribute to the impact that start time of the lesson had on PA levels. If schools were willing to reorganise the timetabling of PE by scheduling PE lessons in the morning, this would potentially increase PA levels. Conducting a lesson of average duration for this study (21.2 minutes) at 9am will increase MVPA from 6.4 minutes to 8.4 minutes. If a short lesson of this nature were conducted each day during the school week at 9am, 10 more minutes of MVPA would have occurred during the week.

It is interesting that teacher gender was found to be non-significant for MVPA but lessons taught by female teachers were found to have significantly higher levels of VPA. Further research is needed to explore whether female teachers conduct lessons that contain more fitness context and less management/instruction which would raise VPA levels or whether female teachers structure lessons similarly to male teachers but simply encourage the children to be more active generally within a lesson. If as in the CATCH study,

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teacher time spent on varying contexts within a PE lesson was not significantly different, this would point to female teachers encouraging more activity generally over contexts (McKenzie et al., 1995).

Finding more variation between lessons than between schools may indicate that particular teaching styles had more influence on the delivery of PE lessons than particular school 'cultures'. Considering each lesson is likely to be conducted by a different teacher with very different aims, the greater variation in lessons is understandable. However, it could also be seen as undesirable. Perhaps if lessons were more standard in terms of achieving a minimum level of PA regardless of the focus of the lesson, (ie dance or hockey skills), this variation between lessons would decrease and the 'school culture' would become one of greater PA.

Increasing the PA levels of children is vital ultimately to improve the health of the future Australian population. Australian PE lessons are a venue for PA that does not currently provide adequate levels of PA for primary school children in terms of American recommendations. Whether the US recommendation is pertinent for Australian schools needs to be based on existing PA levels and the capacity to improve them. Other studies have demonstrated that PA levels in PE lessons can be improved, although the greatest improvements tend to arise with specialist PE teachers (Donnelly et al., 1996; McKenzie et al., 1996; Sallis et al., 1997). This study has demonstrated that existing PA levels are very comparable to those obtained in the US. However the capacity of schools in NSW Australia to achieve greater PA depends in part upon on the ability to train and resource generalist teachers to a specialist standard. If, as has been suggested in a US study, generalist teachers can be trained to restructure PE lessons to spend less time in management/instruction and more time generally in fitness activity, then children's PA levels may increase (Simons-Morton et al., 1994). Another alternative could be for the NSW Department of Education and Training to revisit the organisation of PE lessons within the State with a view to employing specialist PE teachers.

A possible approach may be to incorporate curriculum and timetabling policy change under a 'health promoting schools' banner (Denman et al., 1999). Schools that incorporate strategies addressing health issues into school planning and policy have been shown to make a difference to the quality of interventions in the school setting and are more effective in encouraging children to adopt health enhancing behaviours (Australian Health Promoting Schools Association, 2000; McBride, Midford & James, 1995). This would also enable other potential settings for PA within the school to be explored. With cooperation and collaboration between the Department of Education and Training, health promotion practitioners, schools and teachers, PE lessons could provide a venue for successful intervention in increasing PA levels. Children spend a large proportion of their time at school and therefore school should be considered to be an important and opportune setting for providing a substantial portion of overall PA.

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