Not all play equipment is created equal: associations between equipment at home and children's physical activity

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Abstract

Background: Play equipment at home could be targeted in interventions to increase children's physical activity (PA) but evidence is mixed, potentially because current methods do not reflect children's lived experience. We investigated associations between combinations of equipment and PA. **Methods:** Data were from the Mothers and their Children's Health study and the Australian Longitudinal Study on Women's Health. Mothers (N=2409) indicated the types of fixed active (e.g., trampolines), portable active (e.g., bicycles) and electronic (e.g., computers) equipment at home, and the number of days children (N=4092, aged 5-12 years, 51% boys) met PA guidelines. Latent class analysis was used to identify combinations of equipment, and linear regressions to investigate associations with PA. **Results:** Compared to children with high active (fixed and portable) and medium electronic equipment, children with portable active and medium (coefficient = -0.53, 95% CI = -0.72, -0.34) or high electronic equipment (coefficient = -0.58, 95% CI = -0.83, -0.33) met the guidelines on fewer days. Children with similar active equipment (but more electronic equipment) met the PA guidelines on fewer days (mean difference = -0.51, SE = 0.14, $p = .002$). **Conclusion:** Having the right combination of play equipment at home may be important for children's PA.

List of Abbreviations

Physical activity (PA); moderate to vigorous physical activity (MVPA); Australian Longitudinal Study on Women's Health (ALSWH); Mothers and their Children's Health study (MatCH)

Introduction

Physical activity (PA) has a range of benefits for children. It develops motor skills, improves cardiorespiratory and musculoskeletal fitness, is protective against injuries and contributes to cognitive development ¹⁻³. It is also reduces the risk of non-communicable diseases such as diabetes and obesity ^{2,4,5}. Yet PA and fitness have declined over recent decades, with children now less fit than their parents were at the same age ⁶. Worldwide, the majority of children do not complete the recommended amount of PA ^{2,3,7,8} and in Australia, less than 20% of 5 to 17 year old children meet PA guidelines ⁵. This suggests an urgent need for intervention to improve children's PA.

The availability of play equipment at home is modifiable and could be targeted in interventions. The home is the most proximal and influential environment for children and is a prime context for intervention ⁹, as the majority of children's PA occurs during free time ³. In particular, the type of equipment at home creates opportunities for play, targets different areas of motor development (e.g. fine and gross motor), and develops social skills such as turn-taking ³. Currently, evidence for the association between home equipment and children's PA is inconsistent, making it difficult to provide evidence based advice to parents on how to equip their home to effectively promote PA for their children. PA equipment at home has been positively associated with children's outdoor play ^{10,11}, participation in sports ¹², light PA ¹³, total PA ¹⁴, and MVPA ¹⁵⁻¹⁸. In contrast, other studies find no association between home equipment and MVPA ^{14,19-22} or meeting PA guidelines ²³. Further, it is unclear whether the association between equipment and PA is driven by the overall variety of equipment available in the home, or by access to specific types of equipment. The small number of studies investigating types of equipment have shown fixed equipment, such as basketball hoops, can be associated with higher levels of MVPA ^{14,16}, whereas portable equipment, such as balls, is not

associated^{14,16}, although one study found an association for bicycles¹⁹. Another study found that fixed but not portable equipment was associated with outdoor play, but not with MVPA¹¹. Active electronic games¹⁶ and bedroom electronics such as televisions⁴ can be associated with less MVPA^{4,18}.

Reviews tend to conclude there is no association between equipment and PA^{9,24-26}, but this broad statement fails to account for nuances. The association between equipment and PA can vary by several factors, including: the sex of the child^{15,17}; how PA is defined (e.g., as outdoor play time^{10,11}, meeting PA guidelines²³, or light versus moderate-to-vigorous PA (MVPA)¹³); when PA is measured (e.g., after school, weekdays or weekends¹⁸) and how PA is measured (e.g., accelerometer or self/parent report²⁷). Additionally, the majority of studies examine the overall variety of equipment available, which assumes all types of equipment are equally associated with PA. Conversely, studies that examine individual pieces of equipment assume that the mix of equipment types available in the home has no influence on PA. Neither of these approaches reflects children's lived experience. Children typically have more than one type of equipment at home^{14,16,19}, yet no studies have considered the mix of fixed, portable and electronic equipment available. In the current study we aimed to investigate associations between combinations of play equipment at home and children's PA.

Methods

Participants and procedures

Mothers were recruited to the Mothers and their Children's Health study (MatCH)²⁸ from the Australian Longitudinal Study on Women's Health (ALSWH)^{29,30}. ALSWH participants were randomly sampled from Australia's universal health insurance system in 1996 and have completed surveys every 3 years. In 2016, women in the cohort born

in 1973-78 who 1) had not died or withdrawn, 2) had consented to be contacted about sub-studies and 3) had not reported infertility, were invited to be part of MatCH. Ethics approval for the study was obtained from The University of Newcastle and The University of Queensland. Of the potentially eligible women, 3039 (48% of the women known to be mothers) completed online or paper surveys on their three youngest children aged up to 12 years ($N=5780$). The sample for this study is children aged 5 to 12 years with complete data on study variables ($N=4092$) and their mothers ($N=2409$) (see Figure S1 in supplement for recruitment flowchart).

Measures

Children's physical activity

Children's PA was reported by mothers using an item adapted from the PACE+ Adolescent Physical Activity Measure ³¹. The PACE+ reliably measures the accumulation of MVPA, is consistent with PA recommendations, and significantly correlates with accelerometer data ³¹. Mothers were asked, "on how many days did your child spend a total of at least 60 minutes per day in moderate to vigorous physical activity?" Mothers reported PA over the last 7 days and response options were 0 to 7 days. MVPA was defined for parents as activity that includes bursts of high energy, raises the heartrate and makes children huff and puff, and it excluded physical education at school. PA scores indicate the number of days that children were meeting PA guidelines of 60+ minutes of MVPA ³².

Active and electronic play equipment

Play equipment at home was reported by mothers using items from the Healthy Active Preschool and Primary Years survey (HAPPY) ³³. Mothers reported the presence of 10 types of active play equipment in the home: balls, basketball/netball ring, bats/racquets/golf clubs, climbing equipment/trees, scooter/bicycle/tricycle,

skateboard/ripstick, skipping rope, swimming pool, trampoline, and slide/swing. Mothers also reported the presence of 4 types of electronic play equipment in the child's bedroom: television, computer/electronic games, mobile electronic device (including a tablet or phone) and books (including ebooks) and 1 type of electronic play equipment in the home (active electronic games e.g., Wii).

Covariates

Covariates included in the study were identified in the literature as being potentially related to children's PA ^{4,9,24}. The child's sex was reported by the mother and the child's age was calculated from their date of birth. Mothers were given written instructions on how to measure and report children's height (using the tape measure provided) and weight³⁴. Values were then converted to Body Mass Index (BMI) using established cut offs ^{35,36}. Mothers reported on the impact of children's health issues on the child's everyday life, with responses dichotomized as none/positive or negative. Household socioeconomic status was approximated by two variables: mother's highest educational qualification (secondary school or less, trade/diploma, university degree) and difficulty managing on income (easy, not too bad, difficult sometimes, difficult all the time/impossible). Mother's PA was calculated by asking mothers the number of times and the total time in the last week spent on walking briskly, moderate leisure activity (e.g., tennis, swimming), vigorous leisure activity that made her breathe harder (e.g., aerobics, running) or vigorous household or garden chores that made her breathe harder. We converted this to a metabolic equivalent of task (MET), with one MET defined as energy expenditure at rest (3.5mL of oxygen uptake/kilogram/minute). Based on MET we categorized mother's PA as very low (<33.3 MET), low (33.3 to <500 MET), moderate (500 to <1000 MET) or high (1000 or more MET)³⁷. Mothers reported the age and sex of all children aged under 18 years living at home, from which we

calculated the number of children at home and the composition of siblings (boys only, girls only or both). Mothers reported the size of the yard (none/small, medium or large) and whether their home was on a through road or cul-de-sac/court. Lastly, remoteness of residence was calculated from postcodes using the Accessibility/Remoteness Index of Australia (ARIA+)³⁸ and categorized as city, inner regional or outer regional/remote/very remote.

Statistical analysis

Descriptive statistics were calculated for each variable. Distributions were checked for normality, implausible values and outliers and no abnormalities were detected.

To identify different combinations of equipment available to children we conducted a latent class analysis (LCA) (proc LCA³⁹) to identify mutually-exclusive groups based on the combination of equipment. Excluding balls, bikes and books due to very high frequencies (and thus low variability), all remaining types of equipment were entered into a LCA, using a rho prior of 1 to stabilize the model and clustering by mother to account for nesting of children within families. Models were repeated with 2 to 6 classes. Based on AIC values, entropy and interpretability, a 4-class model was judged as the best fit to the data (Table S1 in supplement).

To investigate whether PA varied according to the equipment groups we used generalized estimating equations to account for children nested within mothers, specifying a normal distribution with an identity link, and estimating least square means (which take into account nesting and unbalanced cell sizes). We ran a series of models with child PA as the outcome: 1) equipment groups were entered in the same regression model; 2) the child's age and sex were added to model 1; and 3) all remaining covariates were added to model 2. We tested pair-wise differences between equipment groups, with Tukey's adjustment for multiple comparisons. All analyses

were conducted using SAS (version 9.4).

Results

The demographic characteristics for the sample are in the “overall” column of Table 1. On average, children were aged 8.4 years ($SD = 2.2$ years) and half of the sample were girls (49%). The majority of mothers (63%) were university educated and half of the households (51%) had 2 children, with only 6% reporting 1 child. On average, children met PA guidelines on 3.9 ($SD = 2.1$) days/week and 12.7% were overweight or obese. Children had access to 6.8 ($SD = 1.8$) types of active equipment and 1.9 ($SD = 1.0$) types of electronic equipment on average. Looking at the frequency of different types of equipment (Table 2), almost all children had access to balls, a scooter/bicycle/tricycle and books, and only a small percentage had access to a television or computer/electronic game in their bedroom.

Combinations of equipment

LCA identified 4 mutually-exclusive groups with distinct combinations of play equipment (excluding balls, bikes/scooters and books). The demographics and equipment associated with each group are in Tables 1 and 2 (respectively). There were significant differences between groups on the variety of active and electronic equipment on average ($p < 0.001$), and on every individual type of equipment ($p < 0.001$) except books ($p = 0.591$). We called the first group “Plenties” ($n = 1509$, 36.9%) as they had more of all types of active equipment, with a medium amount of electronic equipment (mobile device, active electronic game). We called the second group “Sliders” ($n = 920$, 22.5%) as they had a medium amount of active equipment that tended towards fixed (e.g., swings/slide, climbing equipment, trampolines) and very low electronic equipment. We called the third group “Batters” ($n = 1330$, 32.5%) as they had the

lowest amount of active equipment, tending towards portable (e.g., bats/racquets, skipping rope, skateboards/ripstick) and medium electronic equipment. We called the last group "Techies" ($n = 333$, 8.1%) as they had a medium amount of active equipment, tending towards portable, and the highest amount of electronic equipment.

There were significant differences between groups on child PA ($p < 0.001$), age ($p < 0.001$) and BMI ($p < 0.001$), on maternal PA ($p = 0.004$), education ($p < 0.001$), and difficulty managing on income ($p < 0.001$), and on the number of children at home ($p < 0.001$), sibling composition ($p < 0.001$), remoteness ($p < 0.001$), and yard size ($p < 0.001$) (Table 1). The "Plenties" group had more active mothers, more children in the family, more families with both boys and girls (compared to single sex), and lived outside of cities with larger yards. The "Sliders" group had more younger children, higher maternal education, little difficulty managing on income, and lived in cities with larger yards. The "Batters" group had fewer children in the family and lived in cities with smaller yards. The "Techies" group had more boys, more older children, lower maternal education, more difficulty managing on income, and more only-child families.

Home equipment and children's PA

The series of regression models showed that the groups of equipment were associated with children's PA (Table 3). Children in the "Plenties" group and children in the "Sliders" group had similar PA (regression coefficient (B) = -0.07, 95% CI = -0.28, 0.14, $p = 0.531$). However, children in the "Batters" ($B = -0.49$, 95% CI = -0.69, -0.29, $p < 0.001$) and "Techies" ($B = -0.56$, 95% CI = -0.81, -0.31, $p < 0.001$) groups met PA guidelines on fewer days of the week on average compared with children in the "Plenties" group.

The average number of types of active equipment was similar between the "Sliders" ($M = 6.38$) and "Techies" ($M = 6.77$) groups, but children in the latter group met PA guidelines on fewer days (estimated difference in LS means = -0.51, $SE=0.14$, adjusted p -

value = .002). In contrast, the "Sliders" group had fewer types of active equipment on average ($M = 6.38$) than the "Plenties" group ($M = 8.17$), yet there was no significant difference in the number of days on which children met the PA guidelines (estimated difference in LS means = -0.07 , $SE = 0.11$, adjusted p -value = 0.926).

Discussion

In this study, we investigated the associations between the types of play equipment available at home and children's PA. We investigated combinations rather than individual types of equipment, as children typically have more than one type of equipment at home and looking at the mix of equipment better reflects children's lived experience. We found that children's PA differed by combinations of play equipment.

Compared to children with high active and medium electronic equipment ("Plenties"), children with predominantly fixed active and low electronic equipment ("Sliders") were not significantly different in their PA. This is despite children in the "Sliders" group having fewer types of active equipment on average than children in the "Plenties" group. This suggests children can be just as active with less equipment, as long as it includes fixed equipment such as swings, slides, climbing equipment and trampolines. It also affirms the value of investigating combinations of equipment rather than only the overall variety.

In contrast, children with predominantly portable active and either medium ("Batters") or high ("Techies") electronic equipment met PA guidelines on fewer days of the week on average. This is in line with previous research that has found fixed equipment is more likely to be positively associated with PA than portable equipment^{11,14,16,19}, and that electronic equipment can be associated with less PA^{4,18}. This suggests portable equipment does not necessarily encourage PA, particularly when paired with

high amounts of electronic equipment. It is possible that across the 24-hour cycle, children with more electronic equipment are spending less time on PA and more time sedentary or on screens. It is also possible that, if equipment is in children's bedrooms, it is more difficult for parents to monitor usage and direct children to other types of play. Interventions can successfully reduce the amount of electronic equipment in the home ⁴⁰, or reduce access to it ⁹, and this should be further investigated. Interestingly, even though the average variety of active equipment was equivalent between children in the "Sliders" and "Techies" groups, children in the "Techies" group met the PA guidelines on fewer days on average. This again emphasises that it is the combination of equipment that is linked to PA, not the overall variety.

It should also be noted that these combinations of equipment were available to different families, with significant differences in the demographic profiles between groups. It may be that purchasing decisions differ between groups, perhaps informed by educational level. In our study, the group with the highest amount of electronic equipment ("Techies") also had the lowest percentage of mothers with a university education. Another Australian study has found that education level is associated with the play equipment available at home ¹⁹. It may also be that the groups experienced different financial and environmental constraints ⁹. Fixed equipment, such as a slide, is more expensive to purchase than portable equipment, such as a bat or racquet, and generally requires a larger yard. However, in our study the group with the lowest amount of fixed equipment ("Batters") were not the group with the most difficulty managing on income ("Techies"), but they did report the highest percentage of having no yard or a small yard. Yard sizes have decreased in countries such as Australia and the USA ⁹. The availability of parks and recreational areas is positively associated with PA ²⁵, and is an important consideration in the urban design of neighbourhoods with smaller

yards.

These findings suggest that the type of play equipment available to children matters. Increasing access to fixed active play equipment and reducing access to electronic equipment may have a beneficial effect on PA, although it should be noted that these findings are in addition to balls, bikes and books which were excluded from the combinations as almost all children in our sample had access to these. The combination of equipment available to children, and the association with PA, is an important area for future research as it can inform parental purchasing decisions and potentially be an effective intervention strategy.

Strengths and limitations

Our study has several strengths. It used a large national sample and included children from a wide range of ages. It included as covariates some of the most important correlates of children's PA, such as maternal PA. It also suggested a new way of investigating specific types of equipment using LCA. Our study also has several limitations. Primarily, because the study was cross-sectional we cannot look at the direction of the association between children's equipment and PA. Also, PA data were reported by the mother, which may capture different information than objectively-measured data ²⁴. Parent-reports typically capture structured and planned activities that are more likely to be recalled, while accelerometers capture incidental and sporadic activities ²⁷ but can still under-report PA ^{14,19}. A more robust design might include both objectively-measured and self- or parent-reported data, however our findings were in line with those from studies using objective data ¹⁸. Mothers were only able to report on the 15 types of play equipment listed, which may not fully capture the variety of equipment in the home. However, a similar study ¹¹ that provided a list of 30 types of play equipment also found that fixed rather than portable equipment was

associated with children's PA. Studies in this area typically measure play equipment by indicating the types of equipment available ^{4,12,15,17,19,20}, as we have done, however future studies should consider assessing how frequently each type of equipment is used. This could further our understanding of why specific types of play equipment are more strongly associated with physical activity and could inform both interventions and advice to parents. Compared to mothers in the ALSWH cohort, mothers who completed the MatCH survey were more likely to have a university education and be employed ²⁸, and this should be taken into account when generalizing findings. Finally, we did not measure determinants of children's PA outside the home, such as school, neighbourhood and public transport.

Conclusions

Our study provides evidence from a large Australian community sample that the combination of play equipment at home is associated with children's PA. Play equipment is modifiable and could be targeted as part of public health campaigns aimed at increasing PA. Specifically, it may be beneficial for children to have access to fixed active play equipment; to support families living in urban areas with a higher proportion of small yards; and to suggest that parents limit access to electronic play equipment, particularly in children's bedrooms ^{18,32}. Overall, having the right combination of equipment, rather than the most equipment, is what matters for children's PA.

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In terms of author contributions, GDM and AJD conceptualised, coordinated and supervised data collection of the ALSWH and MatCH studies. GDM, AJD, KH, KMM, KE and YC designed the current study; AJD and KE provided input on the statistical analyses. KM, YC and GDM analysed and interpreted the data. KM wrote and revised the manuscript. All authors critically reviewed the manuscript and approved the final version as submitted.

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References

1. Poitras VJ, Gray CE, Janssen X, et al. Systematic review of the relationships between sedentary behaviour and health indicators in the early years (0-4 years).(Clinical report). *BMC Public Health*. 2017;17(Suppl 5).
2. World Health Organisation. *Physical activity strategy for the WHO European Region 2016-2025*. Copenhagen, Denmark: World Health Organisation;2016.
3. Clemens SL, Lincoln DJ. Where children play most: physical activity levels of school children across four settings and policy implications. *Australian and New Zealand Journal of Public Health*. 2018:1-7.
4. Kaushal N, Rhodes RE. The home physical environment and its relationship with physical activity and sedentary behavior: A systematic review. *Preventive Medicine*. 2014;67(C):221-237.
5. Schranz N, Olds T, Boyd R, et al. Results From Australia's 2016 Report Card on Physical Activity for Children and Youth. *Journal of Physical Activity and Health*. 2016;13(11):S87-S94.
6. McAnally HM, Reeves LM, Sligo JL, Hancox RJ. Intergenerational changes in adolescents' physical fitness and weight in New Zealand. *The New Zealand medical journal*. 2018;131(1482):16-28.
7. Jaeschke L, Steinbrecher A, Luzak A, et al. Socio-cultural determinants of physical activity across the life course : a 'Determinants of Diet and Physical Activity' (DEDIPAC) umbrella systematic literature review. *International Journal of Behavioral Nutrition and Physical Activity*. 2017;14(1).
8. Tremblay MS, Barnes JD, González SA, et al. Global Matrix 2.0 : Report Card Grades on the Physical Activity of Children and Youth Comparing 38 Countries. *Journal of Physical Activity & Health*. 2016;13(11 Suppl 2):S343-3080.

9. Maitland C, Stratton G, Foster S, Braham R, Rosenberg M. A place for play? The influence of the home physical environment on children's physical activity and sedentary behaviour. *International Journal of Behavioral Nutrition and Physical Activity*. 2013;10(1).
10. Spurrier NJ, Curnow F, Magarey AA, Golley R, Sawyer MG. Relationships between the home environment and physical activity and dietary patterns of preschool children: A cross-sectional study. *International Journal of Behavioral Nutrition and Physical Activity*. 2008;5(1).
11. Guy PA, Clover M, Leanne L, et al. Associations between the home yard and preschoolers' outdoor play and physical activity. *Public Health Research & Practice*. 2019;29(1).
12. Timperio AF, Van Stralen MM, Brug J, et al. Direct and indirect associations between the family physical activity environment and sports participation among 10–12 year-old European children: testing the EnRG framework in the ENERGY project. *International Journal of Behavioral Nutrition and Physical Activity*. 2013;10(15).
13. Hnatiuk JA, Hesketh KR, van Sluijs EMF. Correlates of home and neighbourhood-based physical activity in UK 3-4-year-old children. *Eur J Public Health*. 2016;26(6):947.
14. Schmutz E, Leeger-Aschmann C, Radtke T, et al. Correlates of preschool childrens objectively measured physical activity and sedentary behavior: a cross-sectional analysis of the SPLASHY study. *International Journal of Behavioral Nutrition and Physical Activity*. 2017;14(1).
15. Patnode C, Lytle L, Erickson D, Sirard J, Barr-Anderson D, Story M. The relative influence of demographic, individual, social, and environmental factors on physical activity among boys and girls. *International Journal of Behavioral Nutrition and Physical Activity*. 2010;7(1):79.

16. Tandon P, Grow HM, Couch S, et al. Physical and social home environment in relation to children's overall and home-based physical activity and sedentary time. *Preventive Medicine*. 2014;66:39-44.
17. Crespo NC, Corder K, Marshall S, et al. An Examination of Multilevel Factors That May Explain Gender Differences in Children's Physical Activity. *Journal of Physical Activity & Health*. 2013;10(7):982-992.
18. Harrington DM, Gillison F, Broyles ST, et al. Household-level correlates of children's physical activity levels in and across 12 countries. *Obesity*. 2016;24(10):2150-2157.
19. Dumuid D, Olds T, Lewis L, Maher C. Does home equipment contribute to socioeconomic gradients in Australian childrens physical activity, sedentary time and screen time? *BMC Public Health*. 2016;16(1).
20. Cohen KE, Morgan PJ, Plotnikoff RC, Hulteen RM, Lubans DR. Psychological, social and physical environmental mediators of the SCORES intervention on physical activity among children living in low-income communities. *Psychol Sport Exerc*. 2017;32:1-11.
21. Salmon J, Veitch J, Abbott G, et al. Are associations between the perceived home and neighbourhood environment and children's physical activity and sedentary behaviour moderated by urban/rural location? *Health Place*. 2013;24(C):44-53.
22. Lee E-Y, Hesketh KD, Rhodes RE, Rinaldi CM, Spence JC, Carson V. Role of parental and environmental characteristics in toddlers' physical activity and screen time: Bayesian analysis of structural equation models. *International Journal of Behavioral Nutrition and Physical Activity*. 2018;15(1):17.
23. Kunin-Batson AS, Seburg EM, Crain AL, et al. Household Factors, Family Behavior Patterns, and Adherence to Dietary and Physical Activity Guidelines Among Children at Risk for Obesity. *J Nutr Educ Behav*. 2015;47(3):206-215.e201.

24. Bingham DD, Costa S, Hinkley T, Shire KA, Clemes SA, Barber SE. Physical Activity During the Early Years: A Systematic Review of Correlates and Determinants: A Systematic Review of Correlates and Determinants. *Am J Prev Med*. 2016;51(3):384-402.
25. Davison KK, Lawson CT. Do attributes in the physical environment influence children's physical activity? A review of the literature. *International Journal of Behavioral Nutrition and Physical Activity*. 2006;3(1).
26. Ferreira I, Van Der Horst K, Wendel-Vos W, Kremers S, Van Lenthe FJ, Brug J. Environmental correlates of physical activity in youth—a review and update. *Obes Rev*. 2007;8(2):129-154.
27. Maddison R, Vander Hoorn S, Jiang Y, et al. The environment and physical activity: The influence of psychosocial, perceived and built environmental factors. *International Journal of Behavioral Nutrition and Physical Activity*. 2009;6(1):19.
28. Mishra GD, Moss KM, Loos C, et al. MatCH (Mothers and their Children's Health) Profile: offspring of the 1973-78 cohort of the Australian Longitudinal Study on Women's Health. *Longitudinal and Life Course Studies*. 2018;9(3):351-375.
29. Lee C, Dobson AJ, Brown WJ, et al. Cohort Profile: the Australian Longitudinal Study on Women's Health. *International Journal of Epidemiology*. 2005;34(5):987-991.
30. Dobson AJ, Hockey R, Brown WJ, et al. Cohort profile update: Australian Longitudinal Study on Women's Health. *International Journal of Epidemiology*. 2015;44(5):1547-1547f.
31. Prochaska JJ, Sallis JF, Long B. A physical activity screening measure for use with adolescents in primary care. *Archives of pediatrics & adolescent medicine*. 2001;155(5):554-559.
32. Department of Health. *Australia's physical activity and sedentary behaviour guidelines for children (5-12 years)*. ACT: Canberra2014.

33. Hinkley T, Salmon J, Okely AD, Crawford D, Hesketh K. The HAPPY Study: Development and reliability of a parent survey to assess correlates of preschool children's physical activity. *Journal of science and medicine in sport*. 2012;15(5):407-417.
34. Davies PS, Roodveldt R, Marks GC. *Standard methods for the collection and collation of anthropometric data in children*. Canberra: Department of Health and Aged Care;2001.
35. Cole TJ, Bellizzi MC, Flegal KM, Dietz WHJB. Establishing a standard definition for child overweight and obesity worldwide: international survey. *Br Med J*. 2000;320(7244):1240.
36. Cole TJ, Flegal KM, Nicholls D, Jackson AAJB. Body mass index cut offs to define thinness in children and adolescents: international survey. *Br Med J*. 2007;335(7612):194.
37. Brown WJ, Pavey T. Physical activity in mid-age and older women: Lessons from the Australian Longitudinal Study on Women's Health. *Kinesiology Review*. 2016;5(1):87-97.
38. Glover J, Tennant S. Remote Areas Statistical Geography in Australia: Notes on the Accessibility/Remoteness Index for Australia (ARIA + version). In. Vol No 9. Adelaide: Public Health Information Development Unit; 2003.
39. Lanza ST, Dziak JJ, Huang L, Wagner AT, Collins LM. *Proc LCA and Proc LTA users' guide*. Pennsylvania: Methodology Centre;2015.
40. Hayes J, Balantekin K, Conlon R, et al. Home and neighbourhood built environment features in family-based treatment for childhood obesity. *Pediatric Obesity*. 2018.

Tables

Table 1 Demographic characteristics and means (SE) by explanatory variables for active and electronic equipment

	Overall	PA		Plenties ^a	Sliders ^a	Batters ^a	Techies ^a	
	No. (%)	Mean (SE)	<i>p</i> -value	No. (%)	No. (%)	No. (%)	No. (%)	<i>p</i> -value
No. active equipment	6.82 (1.76) ^b	-	-	8.17 (0.04) ^c	6.38 (0.05) ^c	5.40 (0.05) ^c	6.77 (0.10) ^c	<0.001
No. elec. Equipment	1.92 (1.00) ^b	-	-	1.97 (0.03) ^c	1.29 (0.03) ^c	1.88 (0.03) ^c	3.75 (0.05) ^c	<0.001
PA (days)	3.89 (2.10) ^b	-	-	4.16 (0.07) ^c	4.00 (0.08) ^c	3.62 (0.07) ^c	3.57 (0.11) ^c	<0.001
Children								
Sex								
Male	2086 (51)	4.03 (0.05)	<0.001	787 (52)	440 (48)	678 (51)	181 (54)	0.111
Female	2006 (49)	3.74 (0.05)		722 (48)	480 (52)	652 (49)	152 (46)	
Age (years) (M, SD)	8.42 (2.20)	-		8.55 (2.09)	7.57 (2.08)	8.56 (2.21)	9.59 (2.14)	
5 to 8 years	2102 (51)	3.86 (0.05)	0.236	741 (49)	626 (68)	637 (48)	98 (29)	<0.001
9 to 12 years	1990 (49)	3.91 (0.05)		768 (51)	294 (32)	693 (52)	235 (71)	

Play equipment and children's physical activity

	Overall	PA		Plenties ^a	Sliders ^a	Batters ^a	Techies ^a	
	No. (%)	Mean (SE)	p-value	No. (%)	No. (%)	No. (%)	No. (%)	p-value
BMI								
Underweight	392 (17.9)	3.96 (0.08)	<.001	137 (9)	95 (10)	132 (10)	28 (8)	<0.001
Normal	2447 (59.8)	3.97 (0.04)		967 (64)	573 (62)	757 (57)	150 (45)	
Overweight/Obese	521 (12.7)	3.65 (0.08)		172 (11)	103 (11)	178 (13)	68 (13)	
Missing	732 (17.9)	3.77 (0.10)		233 (15)	149 (16)	263 (20)	87 (26)	
Impact of child's health								
None/positive	3323 (81)	3.97 (0.04)	<0.001	1250 (83)	732 (80)	1078 (81)	263 (79)	0.148
Negative	769 (19)	3.56 (0.07)		259 (17)	188 (20)	252 (19)	70 (21)	
Mothers								
Physical activity level								
Very low	522 (13)	3.27 (0.12)	<0.001	191 (12)	120 (13)	160 (12)	51 (15)	0.004
Low	1284 (31)	3.76 (0.07)		421 (28)	321 (35)	441 (33)	101 (30)	
Moderate	938 (23)	4.04 (0.09)		358 (24)	217 (24)	287 (22)	76 (23)	

Play equipment and children's physical activity

	Overall	PA		Plenties ^a	Sliders ^a	Batters ^a	Techies ^a	
	No. (%)	Mean (SE)	p-value	No. (%)	No. (%)	No. (%)	No. (%)	p-value
High	1348 (33)	4.17 (0.07)		539 (36)	262 (28)	442 (33)	105 (32)	
Education. qualification								
Year 12 or less	555 (14)	3.66 (0.08)	<0.001	209 (14)	77 (8)	170 (13)	99 (30)	<0.001
Trade/diploma	954 (23)	3.70 (0.11)		358 (24)	176 (20)	301 (23)	119 (36)	
University	2583 (63)	4.02 (0.05)		942 (62)	667 (73)	859 (64)	115 (34)	
Managing income								
Easy	762 (19)	4.03 (0.09)	0.055	283 (19)	204 (22)	242 (18)	33 (10)	<0.001
Not bad	1606 (39)	3.97 (0.07)		588 (39)	349 (38)	562 (42)	107 (32)	
Difficult sometimes	1155 (28)	3.77 (0.08)		451 (30)	248 (27)	345 (26)	111 (33)	
Diff. always/impossible	569 (14)	3.73 (0.12)		187 (12)	119 (13)	181 (14)	82 (25)	
Households								
No. children at home								
1 child	259 (7)	3.59 (0.14)	0.038	42 (3)	56 (6)	124 (9.3)	37 (11)	<0.001

Play equipment and children's physical activity

	Overall	PA		Plenties ^a	Sliders ^a	Batters ^a	Techies ^a	
	No. (%)	Mean (SE)	p-value	No. (%)	No. (%)	No. (%)	No. (%)	p-value
2 children	2100 (51)	3.89 (0.06)		672 (44)	493 (54)	765 (57)	170 (51)	
3 or more children	1733 (42)	3.98 (0.07)		795 (53)	371 (40)	441 (33)	126 (38)	
Sibling composition								
Boys only	901 (22)	4.14 (0.09)	<0.001	300 (20)	196 (21)	330 (25)	75 (23)	<0.001
Girls only	767 (19)	3.49 (0.09)		210 (14)	212 (23)	275 (21)	70 (21)	
Both	2424 (59)	3.93 (0.05)		999 (66)	512 (56)	725 (54)	188 (56)	
Remoteness								
City	2317 (57)	3.94 (0.05)	0.075	724 (48)	523 (57)	906 (68)	164 (49)	<0.001
Inner regional	1145 (28)	3.73 (0.08)		482 (32)	265 (29)	306 (23)	92 (28)	
Outer region./remote	630 (15)	3.97 (0.11)		303 (20)	132 (14)	118 (9)	77 (23)	
Yard size								
No/small yard	351 (9)	3.72 (0.14)	0.204	29 (2)	36 (4)	271 (20)	15 (5)	<0.001
Medium yard	2268 (55)	3.86 (0.05)		731 (48)	477 (52)	848 (64)	212 (64)	

Play equipment and children's physical activity

	Overall	PA		Plenties ^a	Sliders ^a	Batters ^a	Techies ^a	
	No. (%)	Mean (SE)	<i>p</i> -value	No. (%)	No. (%)	No. (%)	No. (%)	<i>p</i> -value
Large yard	1473 (36)	3.98 (0.07)		749 (50)	407 (44)	211 (16)	106 (32)	
Street type								
Through road	2834 (69)	3.91 (0.05)	0.451	1041 (69)	629 (68)	950 (71)	214 (65)	0.065
Cul-de-sac	1258 (31)	3.84 (0.08)		468 (31)	291 (32)	380 (29)	119 (35)	

^a Combinations of equipment were determined using latent class analysis. "Plenties" had more of all types of active equipment, with a medium amount of electronic equipment (mobile device, active electronic game). "Sliders" had a medium amount of active equipment that tended towards fixed (e.g., slide, climbing equipment) and very low electronic equipment. "Batters" had a slightly lower amount of active equipment that tended towards portable (e.g, bat, skipping rope) and medium electronic equipment. "Techies" had a medium amount of active equipment, tending towards portable, with a high amount of electronic equipment.

^b Values represent mean and standard deviation

^c Values represent least-square means (or estimated marginal means), which are calculated from a linear model which takes into account clustering of children within families and unbalanced cell sizes, and provide standard errors rather than standard deviations.

Table 2 Active and electronic equipment at home overall and by equipment group

		"Plenties" ^a	"Sliders" ^a	"Batters" ^a	"Techies" ^a	
	Number (%) "yes"	<i>n</i> =1509	<i>n</i> =920	<i>n</i> =1330	<i>n</i> =333	p-value
Active equipment						
Balls	4060 (99)	1505 (100)	914 (99)	1309 (98)	332 (100)	<0.001
Scooter/bicycle/tricycle	4047 (99)	1500 (100)	907 (99)	1310 (99)	330 (99)	<0.001
Bats/racquets/clubs	3452 (85)	1461 (98)	680 (74)	1030 (78)	281 (85)	<0.001
Skipping rope	3406 (84)	1393 (94)	681 (74)	1049 (79)	283 (86)	<0.001
Trampoline	2668 (66)	1285 (88)	644 (70)	545 (41)	194 (60)	<0.001
Skateboard/ripstick	2413 (60)	1291 (89)	206 (22)	704 (53)	212 (64)	<0.001
Basketball/netball ring	2349 (59)	1245 (87)	291 (32)	602 (45)	211 (65)	<0.001
Climbing equipment/trees	2291 (57)	1224 (84)	702 (76)	212 (16)	153 (47)	<0.001
Slide/swing	1946 (49)	1075 (75)	715 (78)	0 (0)	126 (49)	<0.001
Swimming pool	1264 (32)	629 (45)	166 (18)	368 (28)	101 (31)	<0.001
Electronic equipment						

Play equipment and children's physical activity

Books (including ebooks)	3788 (93)	1391 (92)	854 (93)	1229 (92)	314 (94)	0.591
Active electronic game	2003 (50)	918 (64)	200 (22)	631 (48)	254 (77)	<0.001
Mobile device	1493 (36)	541 (36)	108 (12)	531 (40)	313 (94)	<0.001
Television	320 (8)	41 (3)	14 (2)	40 (3)	225 (68)	<0.001
Computer/electronic game	254 (6)	11 (1)	0 (0)	23 (2)	220 (66)	<0.001

^a Combinations of equipment were determined using latent class analysis. "Plenties" had more of all types of active equipment, with a medium amount of electronic equipment (mobile device, active electronic game). "Sliders" had a medium amount of active equipment that tended towards fixed (e.g., slide, climbing equipment) and very low electronic equipment. "Batters" had a slightly lower amount of active equipment that tended towards portable (e.g, bat, skipping rope) and medium electronic equipment. "Techies" had a medium amount of active equipment, tending towards portable, with a high amount of electronic equipment.

Table 3 Regression coefficients for associations between combinations of equipment and children's PA

	Model 1 ^a		Model 2 ^b		Model 3 ^c	
	B (95% CI)	<i>p</i>	B (95% CI)	<i>p</i>	B (95% CI)	<i>p</i>
Intercept	4.16 (4.02, 4.29)	<0.001	4.08 (3.85, 4.30)	<0.001	4.69 (4.36, 5.03)	<0.001
"Plenties" ^d	0 [Reference]		0 [Reference]		0 [Reference]	
"Sliders" ^d	-0.15 (-0.36, 0.06)	0.2	-0.11 (-0.32, 0.10)	0.3	-0.07 (-0.28, 0.14)	0.5
"Batters" ^d	-0.53 (-0.72, -0.34)	<0.001	-0.53 (-0.72, -0.34)	<0.001	-0.49 (-0.69, -0.29)	<0.001
"Techies" ^d	-0.58 (-0.83, -0.33)	<0.001	-0.68 (-0.93, -0.44)	<0.001	-0.56 (-0.81, -0.31)	<0.001

^a No covariates^b Controlling for age and sex^c Controlling for all covariates

^d Combinations of equipment were determined using Latent Class Analysis. "Plenties" had more of all types of active equipment, with a medium amount of electronic equipment (mobile device, active electronic game). "Sliders" had a medium amount of active equipment that tended towards fixed (e.g., slide, climbing equipment) and very low electronic equipment. "Batters" had a slightly lower amount of active equipment

Play equipment and children's physical activity

that tended towards portable (e.g, bat, skipping rope) and medium electronic equipment. "Techies" had a medium amount of active equipment, tending towards portable, with a high amount of electronic equipment.

1 Supplementary material

2

3 Figure S1 Recruitment flowchart

4 **Table S1** Fit statistics for latent class analysis (LCA) of active and electronic equipment

Number of classes	Log-likelihood	Degrees of Freedom	AIC	Entropy
2 classes	-26385.53	4070	4683.80	0.53
3 classes	-25986.37	4057	3911.49	0.57
4 classes	-25774.19	4044	3513.13	0.62
5 classes	-25666.63	4031	3324.00	0.60
6 classes	-25634.03	4018	3284.80	0.60

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