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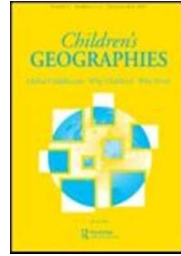
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Capturing the geography of children's active and sedentary behaviours at home: The HomeSPACE Measurement Tool.

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1 **Title**

2 **Capturing the geography of children's active and sedentary behaviours at home: The**
3 **HomeSPACE Measurement Tool.**

4 **Abstract**

5 Children spend much of their time at home, indoors and sedentary. This study reports on
6 the development, exploratory factor analysis, validity and reliability of the HomeSPACE
7 Instrument. The instrument assesses features of the home physical environment that
8 influence children's sedentary behaviour and physical activity, and the family influences that
9 create this environment. The space and equipment audit achieved good to excellent
10 criterion validity and test-retest reliability for equipment, outdoor features and home design
11 measures (Study 1, n=36 parents). Family influence scales showed acceptable internal
12 consistency and test-retest reliability (Study 2, n=96 parents). Factor analysis highlighted
13 fifteen scales to assess the importance, preferences and supportiveness of the home
14 environment for activity. The HomeSPACE Instrument extends previous tools to provide a
15 valid and reliable assessment of home influences on children's sedentary behaviour and
16 physical activity, that is adaptable for varying home physical environments.

17

18 **Keywords**

19 Home, children, physical activity, sedentary behaviour, space

20

21 **Introduction**

22 Participation in physical activity (PA) provides school-aged children and youth with
23 numerous health benefits (Janssen and LeBlanc 2010), while time spent sedentary,
24 particularly watching television, has been associated with decreased fitness, unfavourable
25 body composition and poorer psychosocial health (Tremblay et al. 2011). Ecological models
26 designed to understand health behaviours propose that environmental factors influence both
27 PA and sedentary behaviour (SB) (Stokols 1992). Both behaviours are domain specific and
28 most likely to be affected by features of the setting in which they occur (Sallis, Owen, and
29 Fisher 2008; Owen et al. 2011). Children's geographies though are changing, with reduced
30 independent mobility and active free play in the neighbourhood compared to previous
31 generations (Witten et al. 2013; Schoeppe, Tranter, et al. 2016; Woolley and Griffin 2015).
32 Now, many children spend a large amount of time in their private home space (Karsten
33 2005), most of which is indoors and sedentary (Biddle et al. 2009; Liao et al. 2014; Loebach
34 and Gilliland 2016). In a recent study which used accelerometer data to measure children's
35 activity levels during waking hours over seven days, primary school-aged children averaged
36 189 minutes of home-based SB and 62 minutes of home-based moderate to vigorous PA
37 (MVPA) per day (Tandon et al. 2012). Forty-eight percent of the children's total sedentary
38 time (396 mins/day) and 42% of their total MVPA (147 mins/day) was accumulated at home.
39 Hence, the home environment is a crucial sphere of influence on children's PA and SB.

40 Within the home, physical and social environmental factors influence children's PA and SB.
41 Reviews conclude that media equipment and its placement in the bedroom are positively
42 associated with screen-related SB (Verloigne et al. 2012; Pate et al. 2011). However, there
43 is limited evidence for an association between PA equipment (e.g., a trampoline, bicycle,
44 sports equipment) and PA (Ferreira et al. 2007; Davison and Lawson 2006; Verloigne et al.
45 2012). On the other hand, PA equipment and SB, as well as electronic media (EM)
46 equipment and PA, may be inversely related (Verloigne et al. 2012; Maitland et al. 2013).
47 Reviews note a lack of objective measurement of environmental attributes, inadequate
48 reporting of validity and reliability of measures, and little exploration of the home physical

1
2 49 environment excepting equipment as limitations of previous research (Maitland et al. 2013;
3
4 50 Davison and Lawson 2006; Ferreira et al. 2007).
5
6
7 51 Within the home space, parents play a direct role in influencing children's PA and SB.
8
9 52 Parental PA, co-participation and social support are all associated with children's PA
10
11 53 (Verloigne et al. 2012; Edwardson and Gorely 2010). Additionally, there is a positive
12
13 54 relationship between parent and child SB, and an inverse relationship between EM rules and
14
15 55 SB (Pate et al. 2011; Verloigne et al. 2012). Despite this, the need for more comprehensive
16
17 56 and rigorously evaluated PA parenting measures has been identified (Trost, McDonald, and
18
19 57 Cohen 2013). Furthermore, parents control how electronic media are introduced and
20
21 58 incorporated into their family household (Willet 2017). Therefore, parents are key
22
23 59 intermediaries for interventions aiming to create activity supporting home environments. Yet,
24
25 60 precise measures of parents' preferences and priorities that influence the creation and use
26
27 61 of family home space and equipment are absent from the literature.
28
29 62 To better understand how the home physical environment influences children's PA and SB,
30
31 63 robust measurement tools other than self-report surveys or dichotomous checklists are
32
33 64 required. The PAMI (PA equipment and EM inventory) is a room-level home audit
34
35 65 developed to provide valid and reliable summary scores of equipment in homes of pre-
36
37 66 adolescents (Sirard et al. 2008). In contrast, the CHES instrument used a parental survey to
38
39 67 assess PA and media equipment (Pinard et al. 2013). Authors of both studies
40
41 68 recommended more comprehensive assessment of media equipment to incorporate
42
43 69 technological advances and neither instrument assessed features outside of equipment such
44
45 70 as stairs, trees and fences, or availability of space to play. Furthermore, CHES authors
46
47 71 suggested further criterion validity assessment using in-home observation as the gold
48
49 72 standard would be beneficial.
50
51
52 73 Perhaps the most comprehensive home environment measurement tool is the HomeSTEAD
53
54 74 PA and screen time physical environment inventory (Hales et al. 2013). This instrument
55
56 75 assessed items for reliability and validity covering a large range of PA and media equipment,
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1
2 76 as well as yard characteristics. While this instrument has undergone more rigorous reliability
3
4 77 and validity testing than previous tools, criterion validity for yard size was poor. The
5
6 78 instrument does not include room-level location for the majority of items or assess the
7
8 79 number and size of rooms in the indoor space, where children spend much of their time
9
10 80 (Karsten 2005; Loebach and Gilliland 2016) and therefore it is limited in its potential to
11
12 81 understand the microgeography of the home. Thus, while tools for measuring home
13
14 82 equipment are available, robust measures of the home physical environment outside of
15
16 83 equipment, including indoor home features and family preferences that influence the creation
17
18 84 of the home physical environment, are not available.

19
20 85 The purpose of this study was to address previous limitations and develop a valid and
21
22 86 reliable instrument to assess the parameters of the home physical environment that
23
24 87 influence children's SB and PA. The study further aimed to develop and test the
25
26 88 psychometric properties of scales measuring family factors that influence the creation of the
27
28 89 home physical space. We present the development of the HomeSPACE Instrument, and the
29
30 90 results of criterion validity, test-retest reliability and exploratory factor analysis of relevant
31
32 91 items and scores.

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35 92

36 37 38 93 **Methods**

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40
41 94 The research was part of The HomeSPACE Study into the influence of the home physical
42
43 95 environment on children's SB and PA. The study was approved by the Human Research
44
45 96 Ethics Committee of UWA (RA/4/1/6074; 10/05/2013).

46 47 48 97 **HomeSPACE Instrument Development**

49
50 98 A mixed methods two-step approach was used to inform the development of the
51
52 99 HomeSPACE Instrument. First, a systematic literature review identified elements of the
53
54 100 home physical environment associated with the SB and PA of children aged 8-14 years, and
55
56 101 evidence limitations [citation removed]. Second, home-based interviews with families (n=29)

1
2 102 of children aged 9-13 years were conducted [citation removed]. Families perceived the
3
4 103 home physical environment influenced children's SB and PA through overall size, space and
5
6 104 design, and allocation of equipment within and perceived safety of the home space.
7
8 105 Furthermore, the home was a dynamic environment where physical elements were chosen,
9
10 106 controlled and changed according to the preferences and priorities of family members.
11
12 107 Together, the findings from the literature review and family interviews informed the first draft
13
14 108 of the HomeSPACE Instrument.

15
16 109 The HomeSPACE Instrument consisted of: 1) an audit to measure the physical environment
17
18 110 of the home space and, 2) a questionnaire to measure family perceptions, preferences and
19
20 111 priorities within the home space. The home physical environment was defined as all physical
21
22 112 spaces and equipment within the boundary of the residential block and verge area
23
24 113 immediately adjacent. The audit format was based on the PAMI to allow for room-level
25
26 114 detail (Sirard et al. 2008). The contents were expanded to include new media equipment,
27
28 115 seated furniture, natural yard features and musical instruments. The audit was simplified to
29
30 116 include equipment categories most relevant to home based activities in Australia and assess
31
32 117 only availability (not accessibility), of each item. Room size was asked for each indoor and
33
34 118 outdoor room/area.

35
36
37 119 The questionnaire included Likert items to assess constructs identified in formative work that
38
39 120 influence the formation of the home physical environment. Family social and individual
40
41 121 factors included: importance of home features and equipment; child and parent activity
42
43 122 preferences at home; and importance of children's activity at home. Questions were newly
44
45 123 developed, except for children's and parent's activity preferences which were based upon
46
47 124 Janz, Broffitt & Levy (2005), and adapted for the home context by asking for preferences
48
49 125 'when at home' and adding current home specific activity examples such as watching TV,
50
51 126 playing e-games, riding a scooter and bouncing on a trampoline. To assess parents'
52
53 127 perceptions of the home physical environment, supportiveness of the home space for activity
54
55 128 was measured with newly developed items addressing space for play, safety, and

1
2 129 connection between areas, within the home environment. Finally, demographic questions
3
4 130 were included.
5

6 131 The draft HomeSPACE Instrument was reviewed by a team of researchers with experience
7
8 132 in children's PA and built environment research. The HomeSPACE Instrument and study
9
10 133 protocol was then pilot tested with a convenience sample of three families. At the end of
11
12 134 each home visit, parents provided feedback on the audit, questionnaire and home visit data
13
14 135 collection protocol. All parents were able to complete the pilot HomeSPACE Instrument.
15
16 136 Feedback resulted in: amendments in the audit, such as reformatting the equipment list for
17
18 137 ease and differentiating internal and external stairs; additions to the audit, including weights
19
20 138 equipment, smart phone and e-games examples; and protocol refinements such as
21
22 139 removing bathrooms from the validation process and clarifying written instructions.
23
24

25 140 **The HomeSPACE Instrument**

26
27
28 141 The final HomeSPACE Instrument (online appendix 1) allowed 34 equipment items (14 PA;
29
30 142 three musical; ten media; seven furniture) and room size (perceived and objective), to be
31
32 143 recorded for up to 14 indoor and eight outdoor rooms/areas. Ten items assessing the
33
34 144 presence of outdoor features were incorporated for the front yard, back yard and verge (i.e.,
35
36 145 the area between the property boundary and edge of the road). Home features (home type
37
38 146 [separate house; semi-detached/townhouse/terrace house/villa; flat/unit/apartment; other],
39
40 147 house size [small; medium; large], yard size [no, small; medium; large], number of stories,
41
42 148 stairs, fencing and adjacency to public space beside/behind the home [yes/no for public
43
44 149 open space e.g., park; laneway; vacant block; pedestrian cut-through]) were also gathered.
45
46 150 Additional questions that could not be assessed by audit included home equipment (books,
47
48 151 DVDs, TV channels, electronic games, active electronic games, smart phones, internet
49
50 152 service, pets), importance of home features (eight items); importance of home equipment
51
52 153 (13 items); supportiveness of home space for activity (16 items); child activity preferences at
53
54 154 home (seven items); parent activity preferences at home (seven items); importance of
55
56 155 children's activity at home (eight items); and demographics (14 items).
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1
2 156 **Study Design**
3

4 157 Two separate studies were conducted on the HomeSPACE Instrument. Study 1 assessed
5
6 158 the test-retest reliability of the parent-completed audit at Time 1 and time 2, and the criterion
7
8 159 validity of the parent completed audit at Time 1 by comparing it with the gold standard of
9
10 160 direct observation by an expert (Sirard et al. 2008; Hales et al. 2013). Study 2 explored the
11
12 161 factor structure, internal consistency and test-retest reliability of questionnaire items.
13
14

15 162 Study 1: Validity and Reliability of Audit Items
16

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18 163 *Participants and Procedures*
19

20
21 164 Parents were recruited through health promotion agencies and community groups. Parents
22
23 165 living in the Perth metropolitan area with at least one child aged 8-14 years were eligible.
24
25 166 Forty-four interested parents registered their address, age and gender of children, and
26
27 167 house type and size, via a webpage. To ensure an equal distribution of socio-economic
28
29 168 status (SES), 37 were contacted (including all parents who registered from low and mid SES
30
31 169 suburb tertiles as defined by Socio-Economic Indexes for Areas, 2011) (Australian Bureau of
32
33 170 Statistics 2013), and 36 agreed to participate. Parents were posted an information pack
34
35 171 including study details and consent forms, prior to the home visit. Parents provided written
36
37 172 consent at the beginning of the home visit and received a \$50 retail voucher after the second
38
39 173 HomeSPACE Instrument was returned.
40

41
42 174 To commence the audit at the home visit, parents were instructed to walk around their house
43
44 175 and yard and complete the items in each room/area. The researcher completed the same
45
46 176 audit at the same time to validate the room size, equipment and features present. A laser
47
48 177 measuring device (Bosch PLR 50) was used to determine the area (m²) of each indoor
49
50 178 room. For the criterion validation process parents were asked not to speak with the
51
52 179 researcher during the audit. If items were hidden, such as in cupboards, the parent was
53
54 180 asked to open these and make them visible to the researcher. After the audit, the parent
55
56 181 completed the questionnaire. To end the home visit, parents were left a second
57

1
2 182 HomeSPACE Instrument, and asked to complete it one week later and return via reply paid
3
4 183 envelope. Average time between completion was seven days. Home visits ranged from 45-
5
6 184 90 minutes.

7
8 185 When all instruments had been returned, objectively measured house, yard and verge size
9
10 186 was assessed using Geographic Information System software (ArcGIS 10.0). House size
11
12 187 was determined by the building footprint area. Yard size was calculated by subtracting the
13
14 188 building footprint and any additional building areas, such as garages, from the cadastral area
15
16 189 (the area inside the property boundary) (Carson, Rosu, and Janssen 2014). To assess
17
18 190 verge size, the area at the front of the house between the property boundary and the road
19
20 191 was digitised from digital aerial orthophotography (2013) supplied by the Western Australian
21
22 192 Land Information Authority. Participants living in apartments were not assessed for these
23
24 193 measures.

25 26 27 194 *Statistical Analysis*

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30 195 Individual items were totalled into category summary scores (online appendix 2). Density
31
32 196 measures were calculated by dividing category summary scores by the number of indoor
33
34 197 rooms, outdoor areas or total rooms/areas in the home.

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37 198 For continuous variables, validity was assessed by comparing the gold standard observer
38
39 199 completed audit to the Time 1 parent completed audit, using Pearson correlations, t-tests
40
41 200 (significance $p \leq 0.05$), and 95% Limits of Agreement. Test-retest reliability between parent
42
43 201 completed audits at Time 1 and Time 2, was assessed using one way single measures
44
45 202 intraclass correlation coefficients (ICC). ICCs were rated as: poor (< 0.40); fair (0.40-0.59);
46
47 203 good (0.60-0.74); and excellent (0.75-1.00) (Cicchetti 1994).

48
49
50 204 For categorical items, validity and test-retest reliability was assessed by Cohen's Kappa
51
52 205 using cut off points of: poor (< 0.00); slight (0.00-0.20); fair (0.21-0.40); moderate (0.41-
53
54 206 0.60); substantial (0.61-0.80); and almost perfect (0.81-1.00) (Landis and Koch 1977).

55
56 207 Validity of house, yard and room size estimates was assessed against objectively measured
57

1
2 208 size using Spearman's Rank Correlation Coefficient (significance $p \leq 0.05$). Analysis was
3
4 209 conducted in SPSS version 19.

5
6 210 Study 2: Factor Analysis, Internal Consistency and Reliability of Scales

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9 211 *Participants and Procedures*

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12 212 A second recruitment was conducted to generate a larger sample for Study 2. Sixty-five
13
14 213 parents of children aged 8-14 years responded and were provided with study details,
15
16 214 consent forms and the HomeSPACE questionnaire, and 60 parents returned the
17
18 215 questionnaire. Data were added to the 36 participants from Study 1 to assess the factor
19
20 216 structure and internal consistency. Test-retest reliability of final scales and sub-scales were
21
22 217 conducted on the data collected in Study 1.

23
24
25 218 *Statistical Analysis*

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27
28 219 Independent samples t-tests and chi-square tests (or Fisher's Exact Test where $>20\%$ of
29
30 220 expected cell counts were >5) (significance $p \leq 0.05$), were used to compare the Study 1 and
31
32 221 Study 2 samples.

33
34
35 222 Exploratory factor analysis (EFA) was undertaken on six sets of items: 1) Child Activity
36
37 223 Preferences at Home; 2) Parent Activity Preferences at Home; 3) Importance of Children's
38
39 224 Activity at Home; 4) Importance Home Features; 5) Importance of Home Equipment; 6)
40
41 225 Supportiveness of Home Space for Activity. All sets of items met minimum sample size
42
43 226 requirements of a least five cases per variables, showed correlations between variables in
44
45 227 the correlation matrix, were significant on Barlett's test of sphericity and had KMO values of
46
47 228 0.6 and above (Hair et al. 2006) (see online appendix 3). EFA was conducted using
48
49 229 principal component analysis (PCA) with oblique rotation. A conservative factor loading
50
51 230 value of ± 0.55 was applied due to sample size (Hair et al. 2006). Items with factor loadings
52
53 231 of ± 0.55 on one factor and with no cross loading above ± 0.30 were retained, while items
54
55 232 with lower factor loadings or cross loading were removed stepwise to produce a solution.
56
57 233 Where items were within ± 0.05 of the applied loadings a final decision was made based

1
2 234 on theoretical rationale. Internal consistency was assessed using Cronbach's Alpha.
3
4 235 Finally, items scores for each scale and sub-scale were summed and test-retest reliability
5
6 236 was assessed using the same method as Study 1.
7
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11 237

12 238 **Results**

13 14 239 **Study 1 Results**

15
16
17 240 Demographic characteristics of the sample are presented in Table 1. Thirty-six parents
18
19 241 completed the HomeSPACE Instrument at Time 1 and 35 of these (97.2%) completed the
20
21 242 instrument at Time 2. At Time 1, 91.7% of participants were female, 55.6% held a university
22
23 243 degree and 44.4% lived in the highest SES tertile. Over 90% lived in a separate house and
24
25 244 61.1% had two children at home. Approximately one third (33.4%) reported a small or no
26
27 245 yard, and 22.2% reported a small house.
28
29

30 246 *Validity*

31
32
33 247 Pearson correlation coefficients between the observer and parent at Time 1 were >0.90 for
34
35 248 all room/area summary variables, and >0.7 for all outdoor features, PA equipment, musical
36
37 249 equipment and media equipment, excepting density of media equipment at home ($r=0.67$)
38
39 250 (Table 2). There were no significant mean differences in summary variables within these
40
41 251 categories (t-test p-values=0.17–1.00). For seated furniture four of seven correlation
42
43 252 coefficients fell below 0.70 and one had significantly different means (density of seated
44
45 253 furniture at home, $p=0.03$).
46
47

48 254 Most categorical variables assessing home design and adjacent space showed either
49
50 255 substantial or almost perfect agreement ($K=0.64$ – 1.00) between the observer and parent at
51
52 256 Time 1 (Table 3). Only agreement regarding adjacency to vacant block was moderate
53
54 257 ($K=0.58$), and presence of external stairs was fair ($K=0.38$). Validity of size measures was
55
56 258 below $K=0.40$ for five out of seven measures indicating fair, slight or poor agreement. Only
57
58
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60

1
2 259 back yard size showed moderate agreement between the observer and the parent at Time 1
3
4 260 ($K=0.61$). Results of validation analysis between objectively measured and parent
5
6 261 perceptions of room/area size showed a range of Spearman correlation coefficients (0.13-
7
8 262 0.82). Verge size ($r_s=0.13$, $p=0.49$) and open plan living room size ($r_s=0.41$, $p=0.05$) were
9
10 263 the only two variables where the correlation coefficient between objective measurement and
11
12 264 parent report was not significant.

14 265 *Reliability*

16
17 266 ICCs for test-retest reliability were excellent for all 34 continuous summary variables (≥ 0.80)
18
19 267 (Table 2). Cohen's Kappa was either substantial or almost perfect ($K \geq 0.60$) for the majority
20
21 268 of the 26 categorical variables including all items in home design, adjacent space and pet
22
23 269 ownership categories (Table 3). For room and yard size, four or eight questions recorded
24
25 270 Kappa values under 0.60 with front yard size having the lowest agreement ($K=0.32$). Only
26
27 271 one other item, e-games in the home equipment category, fell below substantial agreement
28
29 272 ($K=0.42$).

31 273 **Study 2 Results**

32
33
34
35 274 Ninety-six parents completed the HomeSPACE Instrument questionnaire. The only
36
37 275 differences in family and home characteristics between additional participants in Study 2 and
38
39 276 those in Study 1 were the primary child was younger ($t(94)=2.55$, $p=0.01$), and there was a
40
41 277 lower proportion of families with a primary language other than English ($p=0.05$) in Study 2
42
43 278 (Table 1).

44 45 279 *Child and Parent Activity Preferences at Home*

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47
48
49 280 For Child Activity Preferences at Home all seven items loaded significantly onto one of two
50
51 281 factors interpreted as 'Active Preferences' or 'Social Preferences' (Table 4). The factor
52
53 282 solution accounted for 71.4% of the total variance. Internal consistency for both factors and
54
55 283 the scale was acceptable ($\alpha=0.85-0.89$) and test-retest reliability was good (ICC=0.63-
56
57 284 0.73). For Parent Activity Preferences at Home results showed all items loaded onto one

285 factor. The seven-item factor accounted for 56.2% of the total variance, and showed
286 acceptable internal consistency ($\alpha=0.86$) and good test-retest reliability (ICC=0.68).

287 *Importance of Children's Activity at Home*

288 The final factor solution for Importance of Children's Activity at Home contained two factors
289 and explained 63.1% of the variance (Table 5). Internal consistency for the scale ($\alpha=0.67$)
290 and the 'Active Play' factor was acceptable ($\alpha=0.75$) and test-retest reliability was excellent
291 (ICC=0.77 and 0.79 respectively). The factor "EM Use" had a lower internal consistency
292 ($\alpha=0.59$) and good test-retest reliability (ICC=0.65). Two items, 'do homework' and 'spend
293 time reading', loaded together as a third factor but were removed due to low internal
294 consistency.

295 *Importance of Home Features and Equipment*

296 For Importance of Home Features, two factors, 'Internal Living Space' and 'Space for Play',
297 explained 55.5% of the variance (Table 6). Internal consistency of the scale and factors was
298 acceptable ($\alpha=0.63-0.67$) and test-retest reliability was excellent (ICC=0.77–0.87) for all.

299 One item did not load onto either factor so remained as an individual item. A three factor
300 solution was found for Importance of Home Equipment, explaining 65.1% of the total
301 variance with acceptable internal consistency ($\alpha=0.71$) and excellent test-retest reliability
302 (ICC=0.88). The first factor 'EM in Home' consisted of four items and had acceptable
303 internal consistency ($\alpha=0.73$) and excellent test-retest reliability (ICC=0.88). The two-item
304 factor 'EM in the Bedroom' showed a lower alpha of 0.56 and ICC for test-retest reliability of
305 0.55. 'Active Play Equipment' was the third factor with two items ($\alpha=0.60$; ICC=0.73). Five
306 items were removed either as they did not load onto any factor or to improve internal
307 consistency.

308 *Supportiveness of Home Space for Activity*

309 Five factors were identified that explained 68.2% of the total variance (Table 7). Factors
310 were 'Indoor Space for Play', 'Front Outdoor Visibility and Connection', 'Front Outdoor'

1
2 311 Safety & Access', 'Back Outdoor Supportiveness', 'Outdoor Space for Play'. All factors
3
4 312 showed acceptable internal consistency ($\alpha=0.60-0.88$) and excellent test-retest reliability
5
6 313 (ICC=0.79-0.86), except for 'Front Outdoor Visibility and Connection' where test-retest
7
8 314 reliability was good (ICC=0.66), and "Back Outdoor Area Supportiveness" where internal
9
10 315 consistency was lower ($\alpha=0.57$). Alpha for the overall scale was 0.78 and test-retest
11
12 316 reliability was excellent (ICC=0.90). One item was removed as it did not load significantly
13
14 317 onto any factor.

15
16 318

19 319 **Discussion**

22 320 The home environment is an important influence on children's SB and PA. This study aimed
23
24 321 to develop a valid and reliable instrument to comprehensively assess home physical
25
26 322 environmental features that may influence children's SB and PA at home. The instrument
27
28 323 was developed following a systematic review and qualitative study to cover a broader range
29
30 324 of parameters than previous home inventories, by including measures of indoor and outdoor
31
32 325 size, seated furniture and location of items. In addition, the questionnaire assessed family
33
34 326 factors that influence the creation of the home physical environment, an aspect not
35
36 327 measured previously. Good criterion validity and test-retest reliability of the audit was
37
38 328 achieved, except for size and space variables. The majority of final scales and factors
39
40 329 showed acceptable internal consistency and test-retest reliability. Results suggest the
41
42 330 HomeSPACE Instrument can provide a valid and reliable assessment of the home physical
43
44 331 environment regarding children's SB and PA and be useful for determining factors that
45
46 332 influence the creation of this environment.

48 333 The HomeSPACE Instrument was tailored to collect indoor and outdoor home physical
49
50 334 environmental measures specific to home based SB and PA of pre-adolescent children. The
51
52 335 walk through completion format of the audit was based on the PAMI (Sirard et al. 2008) to
53
54 336 maximise objectivity and provide room-level detail lacking in other checklists. The audit
55
56 337 extends the PAMI by including yard features, seated furniture, musical instruments and room

1
2 338 size, and updates media equipment. In addition to differentiating indoor rooms to allow the
3
4 339 creation of density measures, it also differentiates outdoor spaces. Of all equipment
5
6 340 availability and accessibility scores, the PAMI found that equipment density
7
8 341 (equipment/number of rooms) was most important for construct validity, with PA equipment
9
10 342 density most strongly related to MVPA and media equipment density most strongly related to
11
12 343 screen time (Sirard et al. 2010). While the HomeSTEAD inventory (Hales et al. 2013)
13
14 344 provides the most comprehensive measurement of PA and media equipment to date,
15
16 345 assessing amount, accessibility and condition, and also includes natural features and yard
17
18 346 size, it does not assess indoor room size or provide area/room-level detail. Additionally, the
19
20 347 HomeSPACE Instrument is the first to assess individual factors that may determine how
21
22 348 families shape their home environment.

23
24 349 The audit demonstrated good criterion validity and test-retest reliability for the majority of
25
26 350 equipment, feature and design measures, confirming that it can be accurately completed by
27
28 351 parents at home. For the more regularly investigated items of PA and media equipment,
29
30 352 results were similar to previous inventories measuring their availability in the home (Sirard et
31
32 353 al. 2008; Hales et al. 2013). Furthermore, validity for the ten outdoor features across three
33
34 354 areas performed better than another recent equivalent natural features measure (Hales et al.
35
36 355 2013). For the new categories, musical instrument summary scores indicated good validity
37
38 356 and reliability. Although seated furniture measures also showed good reliability, validity
39
40 357 results were mixed. Scores that included outdoor seated furniture were the poorest
41
42 358 performing with the observer recording higher amounts than the parent. This may be
43
44 359 because the observer recorded all outdoor chairs and tables despite their format or
45
46 360 condition, whereas parents may have either missed furniture in poor condition, not
47
48 361 recognised pieces of outdoor seating or grouped outdoor furniture together (e.g., table and
49
50 362 chairs as one piece). The only other item to fall below acceptable reliability limits was the
51
52 363 number of e-games, which may indicate the difficulty in assessing e-games across a range
53
54 364 of platforms, such as gaming consoles, computers and smartphones, and online options.
55
56 365 Although these items may benefit from clarification in future iterations of the HomeSPACE

1
2 366 Instrument, the majority of items showed good criterion validity and compared favourably
3
4 367 against similar inventories.
5
6 368 The validity of home size measures was determined by comparison of parent estimate
7
8 369 against observer, as well as against objectively measured size from either GIS (outdoor
9
10 370 areas) or laser measurement (indoor rooms). Our results concur with previous attempts to
11
12 371 validate self-reported yard size against an observer that found a lack of agreement (Hales et
13
14 372 al. 2013; Bryant et al. 2008). This is also supported by neighbourhood-level assessments,
15
16 373 where criterion validity is likely to be higher when individuals report on relatively concrete
17
18 374 attributes such as the presence of a footpath, and lower for less tangible aspects such as
19
20 375 distances and aesthetics (Brownson et al. 2009). These lower levels of agreement can be
21
22 376 expected as individuals filter objective characteristics through their own experiences and
23
24 377 expectations (St John 1987). In research into the influence of the built environment, self-
25
26 378 report measures are usually considered as perceived environmental measures and
27
28 379 differentiated from objective measures (Brownson et al. 2009). To this end, our results
29
30 380 substantiate that parents are not able to accurately assess the size of their home, and that
31
32 381 perception of house, yard and room size should be a separate construct to objective size.
33
34
35 382 The results of EFA on items hypothesised to influence the creation of the family home
36
37 383 physical environment indicated the existence of several factors within all but one construct.
38
39 384 Almost all subscales exhibited good or excellent reliability, and the majority showed
40
41 385 acceptable internal consistency for exploratory work (Hair et al. 2006). Scales that were
42
43 386 adapted to the home context from previously validated items (i.e., Child Activity Preferences
44
45 387 at Home, and Parent Activity Preferences at Home) (Janz, Broffitt, and Levy 2005;
46
47 388 Bielemann et al. 2011), showed better consistency than newly developed items. We found
48
49 389 two factors within the Children's Activity Preferences at Home scale – 'Active Preferences',
50
51 390 and 'Social Preferences' – and this is in accord with previous findings where children's
52
53 391 activity preferences, and not social preferences were significantly related to overall PA
54
55 392 (Janz, Broffitt, and Levy 2005).
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1
2 393 The remaining items included in the EFA were informed by qualitative formative work and
3
4 394 represent the first attempt to capture these constructs in the home environment. Predictably
5
6 395 the Importance of Children's Activity at Home scale revealed two factors identified as Active
7
8 396 Play and EM Use. Items around the importance of reading and homework were removed as
9
10 397 they exhibited low reliability and reduced internal consistency. Factors identified within the
11
12 398 Importance of Home Equipment scale were similarly aligned to those in the Importance of
13
14 399 Children's Activity at Home scale, with Active Play Equipment, EM in the Home, and EM in
15
16 400 the Bedroom, identified as factors. Interestingly, the importance of EM in the home and
17
18 401 bedroom were separate factors, indicating that parents' perceive the importance of EM
19
20 402 differently by its location.

21
22 403 Scales to measure the importance parents place on home space, features and equipment
23
24 404 related to children's activity at home were informed by a proposed model for physical
25
26 405 environmental influences on children's SB and PA at home [citation removed]. There is
27
28 406 evidence that EM equipment, in the bedroom particularly, is related to EM use (Pate et al.
29
30 407 2011; Verloigne et al. 2012). Additionally, some studies have shown that play equipment is
31
32 408 inversely associated with SB (Sirard et al. 2010) and that outdoor space at home may
33
34 409 influence PA (Aarts et al. 2010). Furthermore, housing values and lifestyle have been
35
36 410 identified as factors influencing housing choices (Jansen 2014; Beamish, Carucci Goss, and
37
38 411 Emmel 2001) with space and functionality highly valued (Kauko 2006). However, we could
39
40 412 find no measures of relevant values or preferences past those informing overall housing
41
42 413 choices, or from the perspective of home-based activity. In summary, the HomeSPACE tool
43
44 414 is valid and reliable for investigating the role of parents' values in influencing the formation of
45
46 415 the home physical environment.

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48
49 416 Much of the research around children's geographies as they relate to physical activity, has
50
51 417 focused on the reduction in children's independent mobility, and how a range of factors
52
53 418 including safety concerns, parental restrictions and reduced social connectedness, have
54
55 419 *pushed* children inside (Whitten et al. 2013; Holt et al. 2015; Loebach and Gilliland 2016;
56
57 420 Wooley and Griffen 2015; Schoeppe, Duncan, et al. 2016), and subsequently reduced PA

1
2 421 and increased SB. However, families have also reported changing homes, increasing
3
4 422 technology and children's preferences for indoor play and electronic media as potential
5
6 423 contributors to reduced independent travel and outdoor play (Thomson 2010; Whitten et al.
7
8 424 2013; Loebach and Gilliland 2016). Yet, there has been less focus on how children may
9
10 425 have been *pulled* inside by changes in the geography of the home, including the physical
11
12 426 space and the way families interact with it. The HomeSPACE Instrument is an important step
13
14 427 towards better understanding the geography of the home environment and how it may
15
16 428 influence children's PA, SB and independent mobility, which has the potential to extend the
17
18 429 current body of research within children's geographies.

20 430 *Strengths and Limitations*

23 431 The strengths of the HomeSPACE Instrument are its rigorous testing procedure and broad
24
25 432 range of parameters, including size, seated furniture and location by room/area. Collecting
26
27 433 the location of equipment may provide additional insights, as to date bedroom EM has been
28
29 434 the only location-based home physical environment measure that has been repeatedly
30
31 435 investigated. Furthermore, the instrument does not pre-determine location, but is able to
32
33 436 capture the myriad of ways that families can configure their homes using EM, equipment and
34
35 437 furniture. Finally, the questionnaire also assesses factors that may contribute to the creation
36
37 438 of the home physical environment, an aspect not covered by previous instruments.

39 439 A limitation of the study was that even though participants were sampled by SES location
40
41 440 just over half of parents were university educated, similar to previous studies (Sirard et al.
42
43 441 2008; Hales et al. 2013). Hence, caution should be exercised when implementing the tool for
44
45 442 groups with lower education, and others with whom it has not been tested. Also, it should be
46
47 443 noted that in Australia over 90% of families live in separate housing (Australian Bureau of
48
49 444 Statistics 2007), and our sample is representative of that. There were differences identified
50
51 445 between the few families in apartments and villas versus those in separate housing, whereby
52
53 446 some families viewed adjacent space, and shared or communal areas as children's play
54
55 447 space, whereas others did not. The housing style also had implications for the generation of

1
2 448 house and yard area by GIS which cannot be used to extract house size of apartments.
3
4 449 Additionally, newer homes had inbuilt garages and patios that were automatically included in
5
6 450 the house footprint area by the GIS, while older home garages were separate and had to be
7
8 451 manually digitised for inclusion in the house footprint area. Furthermore, the checklist was
9
10 452 adapted to contain equipment and features relevant to the local context, so it is
11
12 453 recommended that future users include country specific terminology and examples. Still, the
13
14 454 room/area level checklist format has been successfully used in Australia and the USA
15
16 455 (Sirard et al. 2008) and therefore we believe it broadly suitable for higher income countries.
17
18 456 Hence, while the HomeSPACE Instrument is well suited to housing in many areas of
19
20 457 developed countries, these factors need to be considered when used with families in more
21
22 458 diverse housing, including higher density housing.

23 24 459 **Conclusion**

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26
27 460 The HomeSPACE Instrument builds on previous home equipment inventories to provide
28
29 461 additional measures of the indoor and outdoor home space that may influence children's SB
30
31 462 and PA at home. It is the first to attempt to assess individual factors, outside of socio-
32
33 463 demographics, that may influence how families shape their home physical environment. In
34
35 464 summary, the HomeSPACE Instrument is an important advancement in the measurement of
36
37 465 the home physical environment as it provides a comprehensive picture of the entire home
38
39 466 space, including the presence and location of items within the space, which can also be
40
41 467 separated into sub-categories and factors. Furthermore, the tool is highly relevant for
42
43 468 measuring the indoor space of home environments where media technology is effecting
44
45 469 rapid changes and facilitating children's SB.

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Table 1. Characteristics of Participants

| | | Study 1 | | Study 2 | |
|-------------------------------|-------------------|-------------|------|-------------|-------|
| | | n=36 | % | n=96 | % |
| Family Characteristics | | | | | |
| Parent Age, mean(SD) | | 43.83(4.65) | | 44.36(4.71) | |
| Parent Gender | Female | 33 | 91.7 | 86 | 89.6 |
| | Male | 3 | 8.3 | 10 | 10.4 |
| Primary Child Age, mean(SD) | | 11.58(1.62) | | 11.0(1.79)* | |
| Primary Child Gender | Male | 20 | 55.6 | 60 | 62.5 |
| | Female | 16 | 44.4 | 36 | 37.5 |
| Language at Home | English | 33 | 91.7 | 93 | 96.9* |
| | Other | 3 | 8.3 | 3 | 3.1 |
| No of Children at Home | 1 | 3 | 8.3 | 7 | 7.3 |
| | 2 | 22 | 61.1 | 56 | 58.3 |
| | 3 | 7 | 19.4 | 25 | 26.0 |
| | 4 or more | 4 | 11.1 | 8 | 8.2 |
| People in Household | ≤3 | 3 | 8.3 | 6 | 6.2 |
| | 4 | 22 | 61.1 | 56 | 58.3 |
| | ≥5 | 11 | 30.6 | 34 | 35.4 |
| Education Level | ≤Secondary School | 7 | 19.4 | 14 | 14.6 |
| | Trade/Diploma | 9 | 25.0 | 17 | 17.7 |
| | University | 20 | 55.6 | 65 | 67.7 |
| SES by Location | High | 16 | 44.4 | 52 | 52.1 |
| | Medium | 11 | 30.6 | 28 | 29.2 |
| | Low | 9 | 25.0 | 17 | 17.7 |
| Family Situation | Single | 5 | 13.9 | 9 | 9.3 |
| | Parent/Other | | | | |
| | Two Parent | 31 | 86.1 | 87 | 90.6 |
| Home Ownership | Rent | 5 | 13.9 | 7 | 7.3 |
| | Own/Paying Off | 30 | 83.8 | 88 | 91.7 |
| Home Characteristics | | | | | |
| House Type | Separate House | 33 | 91.7 | 90 | 93.8 |
| | Other | 3 | 8.3 | 6 | 6.3 |
| House Size | Small | 8 | 22.2 | 15 | 15.7 |
| | Medium | 20 | 55.6 | 55 | 57.3 |
| | Large | 8 | 22.2 | 26 | 27.1 |
| Yard Size | No/Small | 12 | 33.4 | 28 | 29.2 |
| | Medium | 13 | 36.1 | 37 | 38.5 |
| | Large | 11 | 30.6 | 31 | 32.3 |

Raw percentages provided; Samples not independent

*Significant difference ($p < 0.05$) between Study 1 (n=36) and additional Study 2 participants (n=60)

Word Count: 178

Table 2. Audit Validity and Reliability – Continuous Variables

| Home Equipment and Features | Mean(SD) | | | Validity Time 1 vs Observer (n=36) | | |
|-----------------------------|---------------------|---------------------|---------------------|---------------------------------------|------------------------------|---|
| | Observer (n=36) | Time 1 (n=36) | Time 2 (n=35) | Pearson Correlation (r) | t-test of Means (p-value) | Limits of Agreement (Mean difference; 95%) |
| Rooms/Areas | | | | | | |
| Living Rooms | 4.42(1.27) | 4.44(1.48) | 4.49(1.38) | 0.93 | 0.93 | -0.03(-1.13,1.07) |
| Bedrooms | 3.42(0.73) | 3.42(0.65) | 3.40(0.69) | 0.95 | 1.00 | 0.00(-0.47,0.47) |
| Total-Indoors | 10.19(2.27) | 10.00(2.32) | 9.60(2.40) | 0.95 | 0.72 | 0.19(-1.27,1.66) |
| Total-Outdoors | 4.42(1.42) | 4.50(1.46) | 4.63(1.35) | 0.94 | 0.81 | -0.08(-1.06,0.90) |
| Total-Home | 14.61(3.41) | 14.50(3.48) | 14.23(3.38) | 0.97 | 0.89 | 0.11(-1.69,1.91) |
| Outdoor Features | | | | | | |
| Back Yard | 5.86(2.49) | 5.86(2.60) | 5.83(2.63) | 0.90 | 1.00 | 0.00(-2.25,2.25) |
| Front Yard | 6.19(2.21) | 6.14(2.14) | 6.17(2.05) | 0.86 | 0.91 | 0.06(-2.24,2.35) |
| Verge | 3.86(1.62) | 3.91(1.93) | 3.86(1.95) | 0.73 | 0.90 | -0.06(-2.66,2.55) |
| Total-Outdoors | 15.92(5.50) | 15.92(5.65) | 15.74(5.04) | 0.93 | 1.00 | 0.00(-4.06,4.06) |
| PA Equipment | | | | | | |
| Sports | 16.28(10.53) | 13.14(9.01) | 13.40(8.81) | 0.78 | 0.18 | 3.14(-9.96,16.24) |
| Transportation | 8.03(4.00) | 7.61(3.96) | 7.74(4.17) | 0.77 | 0.66 | 0.42(-4.89,5.73) |
| Exercise | 1.5(1.80) | 1.19(1.64) | 1.20(1.49) | 0.85 | 0.45 | 0.31(-1.56,2.17) |
| Outdoor Play | 2.39(1.78) | 2.44(1.99) | 2.31(1.68) | 0.93 | 0.90 | -0.06(-1.46,1.35) |
| Indoor Play | 0.31(0.53) | 0.33(0.53) | 0.34(0.54) | 0.95 | 0.83 | -0.03(-0.35,0.30) |
| Total-Indoors | 6.56(6.91) | 4.92(5.37) | 5.46(5.95) | 0.76 | 0.27 | 1.64(-7.17,10.44) |
| Total-Outdoors | 22.00(13.14) | 19.81(12.37) | 19.62(11.30) | 0.86 | 0.47 | 2.19(-11.01,15.40) |
| Total-Home | 28.56(14.01) | 24.72(12.38) | 25.09(12.35) | 0.83 | 0.22 | 3.83(-11.52,19.18) |
| Density-Indoors | 0.73(0.99) | 0.54(0.65) | 0.64(0.80) | 0.79 | 0.37 | 0.18(-1.03,1.38) |
| Density-Outdoors | 5.05(2.53) | 4.51(2.61) | 4.30(2.52) | 0.87 | 0.44 | 0.50(-2.00,3.00) |
| Density-Home | 2.01(0.99) | 1.72(0.76) | 1.81(0.80) | 0.71 | 0.17 | 0.29(-1.08,1.66) |
| Media Equipment | | | | | | |
| Fixed | 8.22(3.64) | 7.26(2.87) | 7.20(3.25) | 0.87 | 0.23 | 0.94(-2.65,4.54) |
| Portable | 4.31(2.76) | 4.97(2.94) | 4.69(2.94) | 0.83 | 0.32 | -0.67(-3.95,2.61) |
| Bedroom | 3.14(2.89) | 3.42(2.97) | 3.49(3.05) | 0.94 | 0.69 | -0.28(-2.35,1.80) |
| Total-Home | 12.53(5.03) | 12.25(4.68) | 11.89(4.61) | 0.87 | 0.81 | 0.28(-4.33,4.88) |
| Density-Home | 0.88(0.32) | 0.88(0.38) | 0.88(0.37) | 0.67 | 0.95 | -0.01(-0.58,0.57) |
| Musical Equipment | | | | | | |
| Total-Home | 3.39(3.62) | 2.97(3.45) | 3.03(2.74) | 0.75 | 0.62 | 0.42(-4.48,5.32) |
| Density-Home | 0.22(0.21) | 0.20(0.21) | 0.22(0.18) | 0.79 | 0.68 | 0.02(-0.24,0.29) |

Children's Geographies

| Home Equipment and Features | Mean(SD) | | | Validity Time 1 vs Observer (n=36) | | |
|-----------------------------|--------------------|------------------|------------------|---------------------------------------|------------------------------|---|
| | Observer (n=36) | Time 1 (n=36) | Time 2 (n=35) | Pearson Correlation (r) | t-test of Means (p-value) | Limits of Agreement (Mean difference; 95%) |
| Seated Furniture | | | | | | |
| Bedroom | 2.75(2.29) | 2.39(2.81) | 2.43(2.51) | 0.88 | 0.55 | 0.36(-2.30,3.02) |
| Total-Indoor | 23.72(10.21) | 21.30(9.03) | 20.23(8.97) | 0.78 | 0.29 | 2.42(-10.25,15.09) |
| Total-Outdoor | 9.83(6.42) | 7.00(6.82) | 7.86(5.53) | 0.63 | 0.07 | 2.83(-8.41,14.07) |
| Total-Home | 33.56(13.17) | 28.30(14.55) | 28.09(12.71) | 0.80 | 0.11 | 5.25(-12.13,22.63) |
| Density-Indoors | 2.36(0.87) | 2.11(0.74) | 2.13(0.79) | 0.45 | 0.19 | 0.25(-1.42,1.92) |
| Density-Outdoors | 2.26(1.41) | 1.58(1.48) | 1.76(1.29) | 0.59 | 0.07 | 0.64(-1.88,3.17) |
| Density-Home | 2.35(0.82) | 1.92(0.83) | 1.98(0.79) | 0.48 | 0.03* | 0.42(-1.24,2.09) |

*Significant difference ($p < 0.05$) between parent at Time 1 and Observer

Word Count: 355

Table 3. Audit Validity and Reliability – Categorical Variables

| Home Equipment and Features | Potential Score | Validity (n=36) | | Reliability (n=35) |
|----------------------------------|-----------------|--|--|---------------------------------------|
| | | Time 1 vs Observer Cohen's Kappa K | Time 1 vs m ² Spearman's Rho ρ(p-value) | Time 1 v Time 2 Cohen's Kappa K |
| Home Design | | | | |
| Type of Home | 4 options | 1.00 | - | 1.00 |
| No. of Stories | 3 options | 1.00 | - | 1.00 |
| Internal Stairs | Y/N | 0.84 | - | 0.77 |
| External Stairs | Y/N | 0.38 | - | 0.93 |
| Front Fence | Y/N/Partial | 0.74 | - | 0.90 |
| Home Size[^] | | | | |
| Open Plan Living Room (n=24) | S/M/L | -0.08 | 0.41(0.05) | 0.68 |
| Lounge Room (n=29) | S/M/L | 0.36 | 0.48(0.01) | 0.87 |
| Games Room (n=14) | S/M/L | 0.16 | 0.82(0.00) | 0.75 |
| Study (n=24) | S/M/L | 0.27 | 0.50(0.01) | 0.45 |
| Child's Bedroom (n=34) | S/M/L | 0.39 | 0.61(0.00) | 0.59 |
| Verge (n=29) | S/M/L | 0.45 | 0.13(0.49)* | 0.58 |
| Back Yard (n=32) | S/M/L | 0.61 | - | 0.72 |
| Front Yard (n=33) | S/M/L | 0.07 | - | 0.32 |
| Total House Size | S/M/L | 0.47 | 0.51(0.00) | - |
| Total Yard Size | No/S/M/L | 0.55 | 0.72(0.00) | - |
| Adjacent Space Next to... | | | | |
| Public Open Space | Y/N | 0.85 | - | 0.86 |
| Laneway | Y/N | 0.87 | - | 0.76 |
| Vacant Block | Y/N | 0.58 | - | 1.00 |
| Pedestrian Cut-Through | Y/N | 0.64 | - | 1.00 |
| Home Equipment | | | | |
| No. of Books | 6 options | - | - | 0.72 |
| No. of DVDs | 6 options | - | - | 0.60 |
| No. of TV Channels | 6 options | - | - | 0.60 |
| No. of E-games | 6 options | - | - | 0.42 |
| No. of Active E-games | 6 options | - | - | 0.76 |
| No. of Smart Phones | 6 options | - | - | 0.89 |
| Type of Internet | 3 options | - | - | N/A (constant) |
| Pet Ownership | | | | |
| Dog | Y/N | - | - | 1.00 |
| Other Pet | Y/N | - | - | 0.94 |

[^]Not all participant homes included every room/area

*Insignificant correlation of $p > 0.05$ between parent at Time 1 and Size (m²)

Word Count: 272

Table 4. Factor Analysis for Activity Preferences at Home

| Child Activity Preferences at Home Items | Factors | |
|---|---|--|
| Given the choice, when at home, my child prefers.... | Child Active Preferences at Home | Child Social Preferences at Home |
| Sitting around OR Running around | .853 | |
| Playing indoors OR Playing outdoors | .837 | |
| Playing electronic games/computer OR Active types of play | .830 | |
| Watching TV/movies OR Active types of play | .801 | |
| Quiet activities OR Energetic activities | .637 | |
| Be in their bedroom OR Be in communal living areas | | .967 |
| Be alone OR Be with other family members | | .917 |
| Eigenvalue | 3.74 | 1.26 |
| % variance explained | 53.43 | 17.95 |
| Cronbach alpha | 0.85 | 0.89 |
| Test-Retest Reliability (ICC)(95% CI) | 0.67(0.43,0.82) | 0.63(0.38,0.79) |
| Total % variance explained | | 71.38 |
| Total scale Cronbach alpha | | 0.85 |
| Test-Retest Reliability (ICC)(95% CI) | | 0.7 (0.52,0.85) |
| Parent Activity Preferences at Home Items | Factors | |
| Given the choice, when at home, I prefer.... | Parent Activity Preferences at Home | |
| Watching TV/movies with my child OR Doing PA with my child | | 0.829 |
| Watching TV/movies OR Doing something physically active | | 0.822 |
| Using the computer/electronic games OR Doing something physically active | | 0.759 |
| Playing electronic games/computer with my child OR Doing PA with my child | | 0.754 |
| Indoor activities with my child OR Outdoor activities with my child | | 0.736 |
| Be indoors OR Be outdoors | | 0.696 |
| Quiet pursuits OR Active pursuits | | 0.634 |
| Eigenvalue | | 3.94 |
| % variance explained | | 56.24 |
| Cronbach alpha | | 0.863 |
| Test-Retest Reliability (ICC)(95% CI) | | 0.68(0.46,0.83) |
| Total % variance explained | | 56.24 |
| Total subscale Cronbach alpha | | 0.86 |
| Test-Retest Reliability (ICC)(95% CI) | | 0.68(0.46,0.83) |

Word Count: 240

Table 5. Factor Analysis for Importance of Children's Activity at Home

| Items | Factors | |
|--|------------------------|------------------------|
| | Active Play at Home | EM Use at Home |
| When at home, how important is it to you for your child to: | | |
| Be physically active | 0.804 | |
| Do active types of play | 0.773 | |
| Play or practice sports | 0.746 | |
| Spend time outside | 0.681 | |
| *Play electronic games/computer | | 0.848 |
| *Watch TV/movies | | 0.799 |
| Eigenvalue | 2.45 | 1.33 |
| % variance explained | 40.85 | 22.20 |
| Cronbach alpha | 0.75 | 0.59 |
| Test-Retest Reliability (ICC)(95% CI) | 0.79(0.63,0.89) | 0.65(0.41,0.81) |
| Total % variance explained | - | 63.06 |
| Total Scale Cronbach alpha | - | 0.67 |
| Test-Retest Reliability (ICC)(95% CI) | | 0.77(0.60,0.88) |

*Item reversed

Items removed: Do homework ICC=0.45(0.15,0.68); Spend time reading ICC=0.30(-0.03,0.57)

Word Count: 106

Table 6. Factor Analysis for Importance of Home Features and Equipment

| Importance of Home Features Items | Factors | | |
|---|------------------------------|------------------------|------------------------------|
| How important is it for your family home to have: | Internal Living Space | Space for Play | |
| A dedicated activity/games room/area for children | 0.762 | | |
| ≥2 living areas so adults and children can have own space | 0.757 | | |
| Dedicated home theatre room/area | 0.734 | | |
| A dedicated music/craft/reading room/area | 0.558 | | |
| Space for children to play inside | | 0.818 | |
| Children's bedrooms with space to play | | 0.792 | |
| Space for children to play outside | | 0.730 | |
| Eigenvalue | 2.22 | 1.67 | |
| % variance explained | 31.64 | 23.83 | |
| Cronbach alpha | 0.66 | 0.67 | |
| Test-Retest Reliability (ICC)(95% CI) | 0.87(0.76,0.93) | 0.77(0.59,0.86) | |
| Total % variance explained | - | 55.47 | |
| Total subscale Cronbach alpha | - | 0.63 | |
| Test-Retest Reliability (ICC)(95% CI) | - | 0.83(0.69,0.91) | |
| Importance of Home Equipment Items | Factors | | |
| How important is it for your family home to have: | EM in Home | EM in BR | Active Play Equipment |
| *≥2 TVs so family members can watch own programs | 0.887 | | |
| *Home theatre system for watching TV/movies | 0.803 | | |
| *TV specifically for child's use | 0.704 | | |
| *Electronic games console | 0.501 | | |
| *Computer in child's bedroom | | 0.845 | |
| *TV in child's bedroom | | 0.792 | |
| Outdoor play equipment | | | 0.916 |
| Sports equipment | | | 0.735 |
| Eigenvalue | 2.69 | 1.42 | 1.10 |
| % variance explained | 33.67 | 17.73 | 13.69 |
| Cronbach alpha | 0.73 | 0.56 | 0.60 |
| Test-Retest Reliability (ICC)(95% CI) | 0.88(0.78,0.94) | 0.55(0.29,0.75) | 0.73(0.53,0.85) |
| Total % variance explained | - | - | 65.09 |
| Total subscale Cronbach alpha | - | - | 0.71 |
| Test-Retest Reliability (ICC)(95% CI) | - | - | 0.88(0.78,0.94) |

*Item reversed

Items removed: Features - Swimming pool ICC=0.90(0.82,0.95); Equipment - Musical instruments ICC=0.92 (0.85,0.96); Exercise equipment ICC=0.72(0.52,0.85); *Computer specifically for child's use ICC=0.77(0.59,0.88); *Computer in a place you can easily see ICC=0.77(0.59,0.88); Range of books ICC=0.80(0.63,0.89)

Word Count:268

Table 7. Factor Analysis for Supportiveness of Home Space for Activity

| Items | Factors | | | | |
|--|-----------------------------|--|--|--|------------------------------|
| | Indoor Space for Play | Front Outdoor Visibility & Connection | Front Outdoor Safety & Access | Back Outdoor Support- iveness | Outdoor Space for Play |
| There is enough space for my child to move around freely inside | .950 | | | | |
| There is enough space for my child to play inside | .837 | | | | |
| There is enough space for my child to play an active video game inside | .743 | | | | |
| It is easy to see clearly onto the verge from inside | | .947 | | | |
| It is easy to see clearly into the front yard from inside | | .687 | | | |
| Front yard and verge connect so my child can move freely between | | .509 | | | |
| Front yard is safe for my child to play | | | .906 | | |
| It is easy for my child to get from inside to the front yard | | | .718 | | |
| Verge is safe for my child to play | | | .588 | | |
| Back yard safe for my child to play | | | | .767 | |
| It is easy for my child to get from inside to the back yard | | | | .654 | |
| It is easy to see clearly into the back yard from inside | | | | .560 | |
| There is enough space for my child to play in the front yard | | | | | .862 |
| There is enough space for my child to play in the back yard | | | | | .752 |
| There is enough space for my child to play on the verge | | | | | .537 |
| Eigenvalue | 3.94 | 1.98 | 1.62 | 1.42 | 1.28 |
| % variance explained | 26.26 | 13.22 | 10.79 | 9.44 | 8.52 |
| Cronbach alpha | 0.82 | 0.60 | 0.70 | 0.58 | 0.63 |
| Test-Retest Reliability (ICC)(95% CI) | 0.79 | 0.66 | 0.82 | 0.85 | 0.86 |
| | (0.61,0.89) | (0.42,0.82) | (0.66,0.91) | (0.72,0.92) | (0.73,0.93) |
| Total % variance explained | | | | | 68.23 |
| Total subscale Cronbach alpha | | | | | 0.78 |
| Test-Retest Reliability (ICC)(95% CI) | | | | | 0.90 |
| | | | | | (0.79,0.95) |

Items removed: Front and back yard connect so my child can move freely between ICC=0.79 (0.63,0.89)

Word Count: 290

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3 **Online Appendix 2.**

4 **Description of HomeSPACE Instrument Items and Summary Scores**

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| Audit Categories - Room/Area Level | Individual Items | Summary Scores | |
|---|--|--|--|
| | | Sum of | Density |
| Physical Activity (PA) Equipment | Number and location of 14 types | Sports Equipment Transport Equipment Exercise Equipment Outdoor Play Equipment Indoor Play Equipment PA Equipment Indoors PA Equipment Outdoors PA Equipment Home | PA Equipment Indoors PA Equipment Outdoors PA Equipment Home |
| Musical Equipment | Number and location of 3 types | Musical Equipment Home | Musical Equipment Home |
| Media Equipment | Number and location of 10 types | Fixed Media Equipment Portable Media Equipment Bedroom Media Equipment Media Equipment Home | Media Equipment Home |
| Seated Furniture | Number and location of 7 types. | Seated Furniture Bedroom Seated Furniture Indoors Seated Furniture Outdoors Seated Furniture Home | Seated Furniture Home |
| Rooms/Spaces in House | Number and perceived size of up to 14 indoor rooms and 8 outdoor areas Perceived size of house and yard *Objective size of indoor living rooms and children's bedrooms ^Objective size of house, yard and block | Living Rooms Bedrooms Indoor Rooms Outdoor Areas Total Rooms/Areas | |
| Outdoor Features | Presence of 10 types of outdoor features in 3 outdoor spaces | Back Yard Features Front Yard Features Verge Features Total Outdoor Features | |

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| Audit Categories - Overall | Individual Items | Items Categories (n) |
|--|---|--|
| Home Features | Type of home | Separate house; semi-detached/ townhouse/ terrace house/ villa; flat/ unit/ apartment; other (4) |
| | Number of stories | one; two; more than two (3) |
| | Presence of: internal stairs; external stairs | yes; no (2) |
| | Presence of front fence that encloses yard | yes; no; partially (3) |
| | Location next to 4 types of public space (public open space; back/side laneway; vacant block; pedestrian cut-through) | yes; no (2) |
| Questionnaire Items | Individual Items | Items Categories |
| Home Equipment | Number of books | 0; 1-50; 51-100; 101-150; 151-200; >200 (6) |
| | Number of DVDs | 0; 1-25; 26-50; 51-75; 76-100; >100 (6) |
| | Number of TV channels | 0; 1-25; 26-50; 51-75; 76-100; >100 (6) |
| | Number of electronic games | 0; 1-10; 11-20; 21-30; 31-40; >40 (6) |
| | Number of active video games | 0; 1-5; 6-10; 11-15; 16-20; >20 (6) |
| | Number of smart phones | 0; 1-2; 3-4; 5-6; 78; >8 (6) |
| | Type of internet service | No internet access; dial-up modem; wireless broadband (3) |
| Pet Ownership | Ownership of: dog; other pets | yes; no (2) |
| Questionnaire Constructs | Individual Items | Summary Scores |
| Home Feature and Equipment Priorities | 8 Likert items on importance of home features | Importance of Home Features Scale |
| | 13 Likert items on importance of home equipment | Importance of Home Equipment Scale |
| Supportiveness of Home Space for Activity | 16 Likert type items on supportiveness of home space for activity (including space, safety, connection and flow) | Supportiveness of Home Space for Activity Scale |
| Activity Preferences and Priorities at Home | 7 choice items for child activity preferences at home | Child Activity Preferences at Home Scale |
| | 7 choice items for parent activity preferences at home | Parent Activity Preferences at Home Scale |
| | 8 Likert items on importance of children's activity at home | Importance of Children's Activity at Home Scale |

* Objective size in m² collected by observer using laser measuring device

^ Objective size in m² generated from GIS data

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3 **Online Appendix 3**

4 **Suitability of Scales for Factor Analysis**

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| HomeSPACE Environment Activity Scales | Number of Items | KMO | Cronbach's Alpha | Bartlett's Test |
|--|------------------------|------------|-------------------------|------------------------|
| Child Activity Preferences at Home | 7 | 0.80 | 0.85 | 316, p<0.00 |
| Parent Activity Preferences at Home | 7 | 0.85 | 0.86 | 301, p<0.00 |
| Importance of Children's Activity at Home | 8 | 0.68 | 0.47 | 168, p<0.00 |
| Importance of Home Features | 8 | 0.60 | 0.66 | 150, p<0.00 |
| Importance of Home Equipment | 13 | 0.65 | 0.63 | 276, p<0.00 |
| Supportiveness of Home Space for Activity | 16 | 0.61 | 0.80 | 577, p<0.00 |

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