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Title; Are home-specific social and individual factors associated with children's behaviour and the physical environment at home

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1. Abstract

This study used linear regression analyses to investigate the influence of parent-reported home-specific social and individual factors on: (i) 235 children's home-based objectively measured overall sitting time, breaks in sitting, and PA, and; (ii) the home physical environment via an audit. Data was collected in South Wales between November 2017 and July 2018. Parental importance assigned to active play for children was positively associated with PA equipment (accessibility and availability), as well as light physical activity (LPA) and sitting breaks. Parental importance placed on time outdoors for children was positively associated with garden size, whilst parental preference for being active at home and limits on screen-time were associated with less household media equipment and portable media equipment, respectively. Greater parental importance placed on playing electronic games/using computers for fun was associated with less LPA and more sitting on weekdays. Further, children who preferred being sedentary sat more and engaged in less moderate-vigorous physical activity (MVPA). Parental and child preferences and priorities, as well as parental rules for activity at home, were associated with children's home-based sitting and PA, especially on weekdays. Such factors were also associated with the physical environment in the expected directions. The findings suggest interventions need to target social and individual factors, alongside adapting the physical environment to create homes more promotive of physical activity.

Keywords; Sedentary time, moderate-vigorous physical activity, youth, house, family

2. Introduction

The health benefits of physical activity (PA) during childhood have been well established [1]. Specifically, regular PA is essential for children's musculoskeletal and psychological health, and has also shown to be a preventative measure for poor CRF and obesity in children [1]. Moderate-to-vigorous physical activity (MVPA) is considered most important for health, however participation rates are low, especially in Wales, where only a third of children aged 3-17 years are sufficiently active [2]. Recently, light physical activity (LPA) has also been shown to provide health benefits [1], prompting the Canadian 24-hour movement guidelines to recommend children accumulate at least several hours of LPA daily [3]. Furthermore, sedentary

time [4], particularly for extended periods [5], is adversely associated with morbidity and mortality in adults and is of particular concern given that sedentary time tracks from childhood into adulthood [6]. Indeed, recent international guidelines recommend children limit their overall sitting time and break up long periods as often as possible [3,7,8]. However, children spend a significant amount of time being sedentary (7-8 hrs daily) [9], particularly undertaking screen-time behaviours [10].

Determining the correlates of PA and sedentary behaviour is central to the development of effective interventions [11]. Social ecological models propose that children's sedentary behaviour and PA have multiple levels of influence, including individual, physical and social environmental factors [12]. Such factors may be particularly influential within the home setting [13], where children spend most of their time [14,15]. Parents play an influential role in shaping their children's PA and sedentary time [13]. Indeed, parental PA, support and co-participation are positively associated with their children's PA levels [16,17]. In addition, there is a positive relationship between parent and child sedentary behaviour, and a negative relationship between screen-time rules and sedentary behaviour [13,18]. Individual characteristics, such as a child's preference for being sedentary or physically active, has also been shown to be a consistent predictor of children's PA [19,20] and screen use [21]. Although studies have investigated the influence of individual and social factors on children's sedentary behaviour and PA [13], few have examined factors specific to the home, and their influence on home-based behaviours. Investigating individual and social factors specific to the home, such as the leisure activity preferences and priorities of parents and children in this physical space [22] is important, given ecological models posit that behaviours is most likely influenced by the environment in which it occurs [23,24], and the amount of time children spend at home [15,25]. Further highlighting the important influence of the home environment, a high proportion of children's physical activity and sedentary behaviour occurs at home [25–27], with one study finding that 48 and 42 % of children's overall sedentary time and MVPA, respectively, was accumulated at home [25].

The physical environment has been shown to influence children's PA and sedentary behaviour within the home [13,28]. Specifically, whilst household and bedroom media equipment are consistent positive correlates of screen-time [13,18], PA equipment is associated with being more active [25,29] and less sedentary [13,25]. Furthermore, the availability of musical instruments is also inversely related to sedentary time [30]. The use of overall size, space and

living design of the home is largely shaped by family members, particularly parents [22], which in turn influences children's PA and sedentary behaviour. For example, parental concerns for television (TV) viewing have been associated with fewer TVs and less media equipment at home [31]. Moreover, parents who enforce rules limiting TV viewing are less likely to report the presence of a TV in their child's bedroom [32].

Whilst many aspects of the home physical environment are chosen by parents, research on what social and individual factors influence their decisions remains limited [22]. Although qualitative data suggest leisure activity preferences and priorities of parents and children, as well as parental rules, influence children's PA and sedentary behaviour at home directly and indirectly via the physical environment [22], this theory is yet to be supported quantitatively. Such research is imperative for interventions seeking to create activity-promoting home environments and will provide insight into pathways by which parents could positively influence their children's PA levels and reduce their sedentary time at home.

Therefore, the aim of this study was to investigate the influence of parental and child priorities and preferences, as well as parental rules regarding leisure activity at home on: (i) children's home-based sitting time, breaks in sitting, and PA: (ii) the home physical environment.

3. Materials and methods

a. Sample

Twenty-three socio-demographically representative primary schools in South Wales were invited to take part between November 2017 and July 2018, of which 11 consented to participate. Children in years 5 and 6 (n=890) and their parents received information about the study. Entry into a prize draw to win a family pass for an outdoor activity centre and the child's sitting and PA results were offered as incentives. In total, of 235 children (26% response rate) returned consent and assent forms. Procedures complied with the declaration of Helsinki and ethical approval was obtained from the Swansea University ethics committee. To be considered for the study, children needed to be aged 9-11 years, without a physical disability that would affect their PA and have one parent participant from the home where they spend most of their time.

b. Physical environment of the home

The home physical environment in relation to children's PA levels and sedentary time was assessed using the HomeSPACE-II instrument, which has been demonstrated to have strong validity and reliability [33]. Parents were instructed to walk around their house and garden and audit items in each room/area. The audit, which accounts for the presence, quantity and accessibility of 34 media (e.g., TV, computer), PA (e.g., balls, trampoline) and musical (e.g., drums, piano) for up to 22 room/areas, has been described elsewhere [33]. For each item, accessibility was rated on a scale of (A) 'put away and difficult to get to' to (D) 'in plain view and easy to get to'. Additionally, there were questions referring to TV service (Freeview/Digital TV/Other) and space to play in the back garden and inside the house [34]. Open plan living areas were also noted. Summary scores (reflecting availability and accessibility) for PA equipment, musical instruments, as well as overall, fixed, portable and bedroom media equipment were created by multiplying each item by their accessibility score (A=1; B=2; C=3; D=4). A larger summary score indicates a greater overall "presence" in the home. Physical activity equipment included active video game systems (e.g., PlayStation move, Wii fit, X-box Kinect). The total number of each type of item and the number of rooms/areas were also determined for descriptive purposes only. Missing entries and queries were clarified with families when necessary.

c. Home-based PA, sitting and sitting breaks

Physical activity (LPA and MVPA) and postural behaviours (i.e., sitting and sitting breaks) were assessed with the ActiGraph GT9X (Pensacola, Florida, USA) and the activPAL3 micro (PAL Technologies, Glasgow, UK), respectively. A sit-to-stand/step transition was considered a sitting break [35]. The monitors were fitted at school to ensure correct attachment and that children knew how to reattach them. Children were asked to wear the monitors continuously (including when bathing, but excluding swimming) for seven consecutive days. Parents completed a diary recording when the child was at home [30], asleep, awake, periods when the device was removed and illness days. "Home" meant one single location, including the house and garden, where the child spent most time (i.e., not including other parent's homes). To minimise missing data, children completed the diaries when parents were unable to. Families were contacted for further information, if the diary was incomplete.

The activPAL has previously been validated in children [36]. A nitrile sleeve was fitted with a hypoallergenic dressing (3M Tegerderm or Hypafix Transparent) on the midline of the upper right thigh to ensure the device was waterproof. Participants received supplementary sleeves,

dressings, and instructions for correct attachment. A detailed explanation of how the data was processed can be found elsewhere [37]. Briefly, activPAL data was downloaded using the manufacturer software (V8.10.8.32, PAL technologies, Glasgow, UK) and the subsequent event.csv files were processed in PAL-V1.1 (Leicester, UK) with a validated algorithm that identified waking hours, prolonged non-wear time (≥ 5 h) and invalid data [38]. Diary-reported non-wear periods deemed plausible were removed. Additionally, based on inspections of the data and methods used elsewhere, sitting/lying or standing bouts lasting ≥ 3 hours with no transitions were also classified as non-wear and removed in the software [39].

The ActiGraph GT9X was placed on the child's non-dominant wrist [40], which has been shown to improve compliance [41] and have good validity when compared with hip-placement [42]. The device data was collected at a 30 Hz sampling rate [43] and summed over 5-sec epochs. Files were initialised, downloaded and processed using ActiGraph software (ActiLife V6.13.3). Wrist-worn vector-magnitude cut-points [44] were utilised, whereby LPA and MVPA were categorised as 306-817 and ≥ 818 counts/5 secs, respectively. An algorithm was used to identify non-wear time (≥ 90 consecutive minutes of zero counts) [45].

Time at home, imported into the ActiLife V6.13.3 and processing PAL software, was paired with time-stamped data, allowing time spent in PA and postural behaviours at home to be calculated, respectively. To be included in the weekday and weekend day analyses, participants needed satisfactory completed home logs, and at least one day with ≥ 3 hours of data at home [46] when the device was worn for ≥ 75% of the time [47] (children without a valid weekend day were only included in the weekday analysis). Sickness days were also excluded from analyses. Minutes in PA and postural behaviours were divided by wear time at home and multiplied by 60, constituting the dependent variables as averages/hr [48].

d. Children demographic and anthropometric measures

At their respective schools, children's stature and body mass were measured using a portable stadiometer (Seca 213, Hamburg, Germany) and electronic weighing scales (Seca 876, Hamburg, Germany), respectively, and standardised procedures [49]. Body mass index (BMI), and subsequently BMI z-scores, were calculated using WHO growth reference data [50].

e. House and garden size estimates

For each postcode unit containing homes included in the study, both the house and garden size were assessed using geographic information systems (GIS) techniques, Ordnance Survey MasterMap (OSMM) [51,52] and AddressBase Premium (ABP) [53] [51]. The specific process

utilised has been described previously [30]. Due to significant variation in estimates between homes with the same postcode, median values were used.

f. Additional Measures

Parents reported their age, sex, whether they owned or rented their home, education status (some secondary school/ completed secondary school/trade qualifications or apprenticeship/diploma or certificate/ university degree or higher), family situation (single parent/two parent/other), annual household income before tax, home postcode and how many children lived at home. Season of measurement included four categories: Spring (March-May), Summer (June-August), Autumn (September-November) and Winter (December-February). Due to missing data for education status and income, the Welsh Index of Multiple Deprivation (WIMD), linked via a postcode lookup table, was used as an indicator of socioeconomic status (SES). Lower Layer Super Output Areas (LSOA) in Wales are ranked 1-1,909, where a higher ranking represents higher deprivation relative to other LSOAs in Wales. The WIMD scores were collapsed into three tertiles of SES; Low (1-636), medium (636-1,272) and high (1,272-1,909) for descriptive purposes only. The number of daylight hours for the participant's respective geographic locations during each monitoring day was also obtained from a valid and reliable online source [54].

g. Family social and individual factors

Items from the HomeSPACE-I were used to assess parental and child activity priorities and preferences [34]. Firstly, parents were asked how important it was to them for their child to do the following when at home: (1) participate in active play; (2) play electronic games/computer; (3) watch TV/movies; and (4) spend time outside. Responses were coded on a scale of (1) 'very unimportant' to (5) 'very important'. Parents were also asked which activities their child preferred at home when given the choice: (1) sitting OR running around; (2) playing indoors OR playing outdoors; (3) playing electronic games/computer OR active types of play; (4) watching TV/movies OR active types of play; and (5) quiet activities OR energetic activities. Similarly, parents were asked what activities they preferred to do when at home and given the choice: (1) watching TV/movies with my child OR doing PA with my child; (2) watching TV/movies OR doing something physically active; (3) using the computer/electronic games OR doing something physically active; (4) playing electronic games/computer with my child OR doing PA with my child; (5) indoor activities with my

child OR outdoor activities with my child; (6) be indoors OR outdoors; and (7) quiet pursuits OR active pursuits. The parental and child activity preferences were coded on a scale of (1) 'almost always' to (5) 'almost always', and the mean score was computed for each scale, with a higher score reflecting a preference for PA activities. Lastly, parents reported whether they enforce a maximum number of h/day of screen-time rule (yes/no) [55].

h. Statistical analysis

ActivPAL, ActiGraph, physical and social environment data were received for 207 (88%), 214 (91%), 213 (91%) and 207 (88%) children, respectively. Cases with missing data were deleted listwise. For all statistical analyses, SPSS version 26 (IBM SPSS Statistics Inc., Chicago, IL, USA) was used, where $p \leq 0.05$ was accepted as significant. Linear regressions were conducted to examine the association between social and individual factors and each of the home-based behaviour variables (min/hr spent sitting, in LPA, in MVPA and the number of sitting breaks/hr). Paired t-tests indicated that the behaviour variables differed significantly between weekday and weekend days; as such, analyses were run separately for weekday and weekend days. Separate regression models were conducted to examine the association between social and individual factors and each of the home physical environment variables. Univariate linear regression was used to assess unadjusted associations (Appendix A). Model 1 adjusted for home ownership, family situation, WIMD ranks, parent age and sex, season of measurement, number of daylight hours, number of siblings at home as well as the child's BMI, age and sex. Final model (model 2) included all the variables in model 1 with $p = \leq 0.10$ [56] and all adjustment variables. Final models were not run for house size and digital TV, since no social or individual factors were significant in model 1. All variables were tested to meet the assumptions of linear regressions analysis. The largest or second smallest values in observations replaced influential outliers [57] for overall (n=1) and bedroom (n=1) media equipment summary scores. Perceived importance of active play and spending time outside for child at home were strongly correlated ($r \geq 0.60$), therefore the variable more strongly associated with the outcome was included in the final models [58].

4. Results

Table 1 contains descriptive statistics. Overall, children (55% girls; mean age 10.2 ± 0.7 years) spent 40.3 ± 5.9 (67%), 14.9 ± 2.9 and 6.7 ± 2.3 minutes sitting and in LPA and MVPA, respectively, and engaged in 7.0 ± 1.9 sitting breaks per hour at home. There were

significant differences between weekdays and weekend days for all behaviour variables. Specifically, children spent more time sitting (41.4 vs 39.4 min), less time in LPA (14.2 vs 15.3 min) and MVPA (6.2 vs 7.0 min), and also completed fewer sitting breaks (6.6 vs 7.2) on the weekend per hour at home. Participating parents were generally female (83%), homeowners (86%), with a university degree (54%), living in the highest SES locations (59%). There were usually two parents (81%) and two children at home. Parents mostly had a maximum h/day of screen-time rule (69%) and believed it was 'important' or 'very important' that their child participated in active types of play (75%) and spent time outside (89%), and 'un-important' or 'very un-important' for their child to watch TV/movies (68%) and play electronic games/use computer for fun when at home (65%). On average, parents reported that they and their child enjoyed sedentary activities and PA at home 'about equal' and 'strongly agreed' there was enough space for their child to play indoors in the house and outdoors in the back garden. Houses averaged 11.5 ± 2.1 rooms/areas, and over half (57%) included an open plan living area and a TV located in the primary child's bedroom (52%). On average, homes included 2.0 ± 2.1 musical instruments, 27.7 ± 18.3 PA equipment items and 11.6 ± 4.7 media equipment items. Median sizes for the house and garden were 145 m^2 and 269 m^2, respectively. Lastly, most families subscribed to digital TV (82%) and had 3-4 smartphones between them.

a. Associations between social, individual factors and weekday sitting time, sitting breaks and PA

The results for weekday sitting and PA are shown in Tables 3 and 4, respectively. After adjustment for baseline confounding factors (model 1), a greater child preference for PA was positively associated with weekday home-based MVPA (β = 0.23, p = < 0.01) and negatively associated with weekday home-based sitting (β = -0.25, p = < 0.01). Perceived importance of active play for children was also positively associated (β = 0.16, p = 0.02) with home-based weekday LPA. Additionally, a greater parental preference for PA was positively associated with home-based weekday sitting breaks (β = 0.15, p = 0.04). In the final models (model 2), children with a greater preference for PA spent more time in MVPA (β = 0.23, p = < 0.01) and less time sitting at home on weekdays (β = -0.27, p = < 0.01). On weekdays, children with parents who placed more importance on them engaging in active play at home, spent more time in LPA at home (β = 0.18, p = 0.02). Moreover, children whose parents had higher levels of perceived importance of them playing electronic games/using computer spent less

time in LPA (β = -0.14, p = 0.05) and more time sitting at home (β = 0.15, p = 0.03) on weekdays.

b. Associations between social, individual factors and weekend sitting time, sitting breaks and PA

Weekend sitting and PA results are presented in Tables 3 and 4, respectively. After adjustment for all confounding factors, the importance parents assign to active play for their child was positively associated with LPA (β = 0.16, p = < 0.03) and sitting breaks (β = 0.16, p = < 0.04) at home on weekends. Only the importance parents place on active play was included in the final models for LPA and sitting breaks, therefore the results remained unchanged from model 1.

c. Associations between social, individual factors and the physical home environment

Tables 5, 6 and 7 show results for media equipment accessibility and availability, additional physical factors and architecture/home design factors, respectively. After adjusting for the confounding factors, a greater parental preference for PA was negatively associated with overall media equipment (accessibility and availability score) (β = -0.19, p = < 0.01), fixed media equipment (β = -0.19, p = < 0.01) and media equipment in the child's bedroom (β = -0.17, p = 0.02) (model 1). While greater child preference for PA (β = 0.20, p = < 0.01) and perceived importance of children participating in active play (β = 0.21, p = < 0.01) were positively associated, perceived importance of watching TV/movies for children was negatively associated (β = -0.14, p = 0.03) with PA equipment. Perceived importance of children playing electronic games/using computer was also negatively associated with musical instruments (β = -0.18, p = $\leq$ 0.01). A maximum h/day of screen-time rule was negatively associated with portable media equipment (β = *-0.16*, p = 0.02), as well as the number of smartphones at home (β = -0.15, p = 0.03). Additionally, perceived importance of children participating in active play (β = 0.17, p = 0.02) and spending time outside (β = 0.19, p = 0.01) were both positively associated with perceived space to play in the back garden, whilst perceived importance of children spending time outside was also positively associated with objectively measured garden size (β = 0.18, p = 0.01).

In the final models (model 2), a greater parental preference for PA was associated with less accessibility and availability of overall media equipment (β = -0.16, p = < 0.03), fixed media

equipment (β = -0.19, p = 0.01) and media equipment in the child's bedroom (β = -0.15, p = 0.05) [Table 5]. Homes with a maximum h/day of screen-time rule also had less portable media equipment accessibility and availability (β = -0.16, p = 0.02) [Table 5] and fewer smartphones (β = -0.14, p = 0.04) [Table 6]. Greater perceived importance of spending time outside for children was associated with a larger garden (front and back) (β = 0.18, p = 0.01) and more perceived space to play in the back garden (β = 0.19, p = 0.01) [Table 7]. Additionally, a higher level of perceived importance of active play for child (β = 0.16, p = 0.02) and a greater child preference for PA (β = 0.15, p = 0.04) was associated with a greater PA equipment accessibility and availability [Table 6]. Lastly, greater perceived importance of playing electronic games/using computer for child was associated with less musical instrument accessibility and availability (β = -0.17, p = 0.02) [Table 6].

4. Discussion

This study examined whether social and individual factors specific to the home were associated with: (i) sitting time, breaks in sitting and PA and (ii) the home physical environment. Parental importance of active play for children was significantly associated with increased LPA and sitting breaks, as well as a physical environment conducive to PA. The level of importance that parents placed on children playing electronic games/using computers for fun was associated with less LPA and more sitting on weekdays. Parental preference for being active at home and placing limits on screen-time were both associated with a physical environment less conducive to sedentary activities. Further, child activity preferences had the greatest influence on behaviour, where children who preferred being sedentary engaged in less MVPA and more sitting on weekdays. The importance parents place on their children watching TV/movies was the only factor not associated with either the physical environment or children's behaviour. In line with previous research that found parental factors to be stronger correlates of children's weekday behaviour [59], stronger associations were identified for weekday behaviour outcomes, suggesting that social and individual factors play a greater role in children's weekday behaviour at home. These findings likely reflect the increased freedom children have to make their own activity choices without parental influence on weekends.

Parental importance of active play for children at home was positively associated with home-based LPA and sitting breaks, which is consistent with studies that have shown parental importance of PA to be positively associated with PA [60] and outdoor play [61]. Parents who perceive active play as important for their child are more likely to allow or encourage active play at home, providing children with more opportunities to engage in LPA and break up their sitting. More importance placed on active play was also associated with greater accessibility and availability of PA equipment at home. Time outdoors is an important predictor of children's active play [62,63], and in this study parents who perceived it as important had larger gardens. Therefore, it appears a higher level of importance assigned to active play and time outside at home translates into a physical environment that better supports active play. However these relationships may be bidirectional, as parents consider outdoor space and PA equipment an essential factor for their children's active play at home

[22]. Nonetheless, changing parent's attitudes towards active play seems important for supporting children's PA at home.

Children's computer use, specifically for playing games among boys and social networking among girls, is sharply increasing [64]. In this study, children whose parents placed more importance on them playing electronic games/using computers for fun, accumulated less LPA and more sitting time on weekdays. This is consistent with another study that found an inverse relationship between parents' negative attitudes towards computer use and children's screen-time [65]. Two thirds of parents considered playing electronic games/using computers unimportant or very unimportant for their child. Parents who enforce fewer restrictions on their child's use of games consoles and computers, are less aware of the risks associated with excessive usage or they may perceive them as being important for education and social interaction [22]. Consequently, children's increased use of video games and computers may hinder their participation in PA at home similar to studies that have found children's screen-time [66], and specifically computer use [20], to be inversely related with PA.

Enforcing a screen-time limit was not associated with children's home-based sitting, in contrast with the only other study to objectively measure home-based sedentary time [25]. This discrepancy likely reflects the sharp increase in the use of portable electronic devices over the past decade [25]. Indeed, parents find limiting the use of such devices difficult due to their portability and because of their multi-functionality, hence rules restricting portable device usage may be harder to enforce [22]. This may also explain why homes of parents who enforced screen-time limits on their children had lower accessibility and availability of portable devices as well as fewer smartphones, which is consistent with one study that found parents who limit screen-time have less media equipment at home [67]. Similarly, parents with a preference for being active at home reported a lesser presence of media equipment at home overall and in the child's bedroom, in line with a study that found higher parental screen-time was associated with presence of at least one electronic media device in a child's bedroom [68]. These findings suggest that parental activity preferences and limits on screen-time may be indirectly associated with children's behaviour through the home physical environment, building on previous evidence that has shown direct associations with children's screen-time [13,17].

In agreement with studies that have shown activity preferences to be a strong predictor of children's PA [19,20] and screen use [21], this study found that children with a preference for PA at home engaged in more MVPA and less sitting at home, but only on weekdays. The reason for the lack of a relationship observed with weekend behaviour is unclear, and it is in contrast to another study reporting that children who preferred PA were more likely to play in the garden at home only on weekends [69]. This discrepancy may, in part, be because Veitch et al. [69] found that children played in their garden more at weekends, whereas children in this study engaged in more MVPA on weekdays. Nonetheless, these findings suggest children's activity preferences have an important influence on their PA and sedentary time at home.

This study adds to the evidence that social factors are directly associated with children's PA and sedentary time [13,17,18,70], by showing that they may also be indirectly associated through the physical environment at home. Parent's limits on screen-time and their perceived importance of active play, time outdoors or recreational video game/computer use for children were associated with either children's behaviour or predictors of children's PA and sedentary behaviour within the physical environment at home [13] or both. Therefore, strategies which change parent's attitudes towards active play/time outdoors and encourage more restrictions on electronic media use at home are warranted. Educating parents on the importance of regular PA and limiting sedentary time for health, strategies for limiting screen-time and increasing PA at home as well as how to create heathier home environment may be a promising approach. Further, parents should also be encouraged to model healthy behaviours including limiting screen-time and participating in PA themselves as well as promoting family participation in PA. Since parental and child activity preferences were shown to be significant influences on the physical environment and children's home-based behaviour, respectively, changing activity preferences or finding equally enjoyable active alternatives to sedentary activities at home will also be an important challenge for future research. Since parental rules and priorities for leisure activity are reflected in their home environments, this approach may not only be important for the child but for the entire family, given the associated physical factors are key determinants of sedentary time and PA [30].

Parental activity preferences also had a strong influence on the physical home space, and child activity preferences had the greatest influence on their behaviour. A difficult, but important, challenge for home-based interventions is to develop strategies which reduce both parents and children's preferences for sedentary activities. Specifically, one approach for

increasing children's enjoyment of PA is to target improvements in their fundamental movement skills (FMS), since mastery of FMS may lead to increased enjoyment of PA [71]. This combined with restrictions on screen-based sedentary behaviours set by parents, will provide children with opportunities to experience alternatives to activities such as TV viewing and playing electronic games, which they may enjoy just as much. Parental activity preferences may be particularly difficult to change, as they are more ingrained. However, after receiving education on the benefits of PA and detriments of sedentary behaviour, parents may perceive PA as more valuable, which may contribute to the formation of a home environment more conducive to PA.

This study has numerous strengths, including the validated audit used to comprehensively assess the home physical environment [33], the investigation of associations between home-specific social and individual factors and home-based behaviour and the objective measurement of PA, sitting and sitting breaks. The adjustment for a multitude of important confounding factors was also a strength. Nonetheless, some limitations need to be acknowledged, including the reliance on self-report to assess the home-specific individual and social factors and for determining when the children were at home, which may have introduced some measurement error. Although the use of objective measures to assess PA and sitting should be considered a strength, they are not without limitations. Their key limitation is that they do not provide information on the context behaviours such as where the behaviour is being performed, the type of behaviour being performed and with whom [72]. On the other hand, there are currently no feasible objectives measures for collecting this information. The cross-sectional nature of the study also means that causal relationships cannot be inferred. Moreover, we did not have data from both parents. Whilst it is likely that the parent who participated is more involved in the formation of the home environment and their child's behaviour at home, it could be that the other parent has a stronger influence. However, the number of parents at home was controlled for in all analyses. Further, the overrepresentation of university educated parents living in the least deprived locations, may limit the generalisability of the findings. However, the proportion of high SES families is comparable with other studies [29,73]. Additionally, despite the use of GIS to objectively measure house and garden size being a strength, full home addresses were not obtained, therefore measures pertain to each postcode and not the specific homes. Thus, the measures only provide estimates of size, given home size is likely to differ between homes in the same

postcode. Lastly, although the magnitude of the significant associations were relatively small, they were in the hypothesized directions and in accordance with previous literature.

5. Conclusion

In conclusion, parental and child preferences and priorities, as well as parental rules for leisure activity at home, are associated with children's sitting and PA at home, particularly during weekdays. They are also associated with factors related to leisure activity in the physical environment, providing evidence to support our hypotheses. Such insight is important, given children spend more time at home than anywhere else [14,15]. The findings suggest that interventions seeking to create home environments conducive to PA, should target parental attitudes and the activity preferences of children and parents, alongside adapting the home physical environment. Future home-based interventions should provide support and education to parents on how to make home environments, through the instigation of restrictions on screen-time and physical environmental changes, that hinder engagement in sedentary activities and promote active alternatives. Additionally, changing children's and parent's preferences for home-based activities or replacing sedentary activities with acceptable active alternatives will also be key targets.

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Table 1. Participant characteristics and descriptive statistics

Variable	Mean (SD) or %	*N*
Parent Characteristics		
Parent age	41.5 (5.7)	211
Parent gender (% female)	83%	213
Parent education**		207
Secondary school or lower	12%	
Diploma/Trade	34%	
University degree or higher	54%	
Child Characteristics		
Child age	10.2 (0.7)	233
Child sex (% girl)	55%	235
Child BMI-z-score	0.6 (1.1)	233
Family Characteristics		
Number of siblings (< 18 yrs) at home	1.2 (0.9	213
Number of people at home	4.1 (1.1)	213
Family situation		213
Single parent/other	19%	
Two parent	81%	
Home ownership		213
Rent	14%	
Own	86%	
SES (based on WIMD scores) **		220
Low	14%	
Medium	27%	
High	59%	
Home Characteristics		
Objectively measured house size ($m^{2)}$	145 (52.1)	207
Objectively measured garden (i.e., front and back) size (m^2)	269.0 (166.7)	214
Space to play [1]		211
Inside the house	3.6 (0.7)	
Back garden	3.6 (0.7)	
Audit Variables		
Total no. of rooms/areas **	11.5 (2.1)	210
Presence of a TV in the child's bedroom (% yes)	52%	212
Presence of an open plan living area (% yes)	57%	211
Equipment variables		
*No. of PA equipment items **	27.7 (18.3)	210
PA equipment accessibility and availability score	86.7 (63.1)	209
*No. of media equipment items **	11.6 (4.7	210
Media equipment accessibility and availability score	44.2 (18.2)	209
*No. of bedroom media equipment items **	1.9 (1.7)	212
Bedroom electronic media accessibility and availability score	6.9 (6.3)	210
*No. of musical instrument items **	2.0 (2.1)	210
Musical instrument accessibility and availability score	7.2 (7.5)	209
Electronic Media		
TV service		213
Digital (e.g., SKY, BT etc…)	82%	
Freeview or other	18%	

Number of smartphones (mode)	3-4	213
Social and Individual Factors		207
Child activity preferences at home [2]	3.3 (0.8)	
Parent activity preferences at home [2]	3.3 (0.7)	
Parent perceived importance of active play at home for child [3]	4.0 (0.8)	
Parent perceived importance of time outside at home for child [3]	4.3 (7.3)	
Parent perceived importance of watching TV/movies at home for child [3]	2.2 (0.7)	
Parent perceived importance of playing electronic games or using the computer for fun at home for child [3]	2.3 (0.8)	
Maximum h/day of screen-time rule (% yes)	69%	206
Additional variables		
Daylength (h/day)	13 (3.4)	

[1]1=strongly disagree; 5=strongly agree
[2] 1=almost always - sedentary; 5=almost always – PA
** = Displayed for descriptive purposes only.

Table 2. Participant's home-based behavioural data

Variable	Mean (SD) or %	N
Home-based activPAL outcomes		207
Full days of activPAL wear time at home	5.3 (1.1)	
h/full day of activPAL wear at home	5.8 (1.6)	207
Min/h spent sitting, % of time at home*		
Overall	40.3 (5.9), 67%	207
Weekday	39.4 (6.4), 66%	206
Weekend day	41.4 (6.5), 69%	180
Number of sitting breaks/h		
Overall	7.0 (1.9)	207
Weekday	7.2 (2.0)	206
Weekend day	6.6 (2.1)	180
Home-based ActiGraph outcomes		214
Full days of ActiGraph wear at home	5.5 (0.9)	
h/full day of ActiGraph wear at home	5.8 (1.6)	
Min/h spent in MVPA, % of time at home		
Overall	6.7 (2.3), 11%	214
Weekday	7.0 (2.4), 12%	212
Weekend	6.2 (2.6), 10%	194
Min/hr spent in LPA, % of time at home		
Overall	14.9 (2.9), 25%	214
Weekday	15.3 (3.0), 26%	212
Weekend	14.2 (3.3), 24%	194

*%=proportion of time at home

Table 3. Associations between social and individual factors and children's sitting time and breaks per hour at home

	Weekday				***Weekend***			
Home-based sitting time	**Model 1**		**Model 2**		**Model 1**		**Model 2**	
	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β
Parental activity preferences	-0.66 (0.67)	-0.08	–	–	-0.47 (0.76)	-0.05	–	–
Child activity preferences	-1.94 (0.58)	-0.25***	-2.04 (0.58)	-0.27***	-0.83 (0.64)	-0.11	–	–
Max h/day of screen-time	0.03 (1.03)	0.00	–	–	-0.68 (1.12)	-0.05	–	–
Importance of active play [1]	-0.35 (0.60)	-0.04	–	–	0.07 (0.64)	0.01	–	–
Importance of time outside [1]	0.13 (0.71)	0.02	–	–	0.02 (0.74)	0.00	–	–
Importance of watching TV/movies [1]	-0.43 (0.72)	-0.04	–	–	- 1.05 (0.77)	-0.11	–	–
Importance of using E-games/computer [1]	1.13 (0.64)	0.13*	1.33 (0.62)	0.15**	0.33 (0.67)	0.04	–	–
Model 2 R^2 (adjusted R^2)			0.17 (0.11)				–	
Home-based sitting breaks	**Model 1**		**Model 2**		**Model 1**		**Model 2**	
	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β
Parental activity preferences	0.39 (0.19)	0.15**	0.30 (0.20)	0.11	0.05 (0.23)	0.02	–	–
Child activity preferences	0.28 (0.17)	0.12*	0.14 (0.18)	0.06	-0.08 (0.20)	-0.03	–	–
Max h/day of screen-time	-0.08 (0.29)	-0.02	–	–	0.36 (0.34)	0.08	–	–
Importance of active play [1]	0.28 (0.17)	0.11*	–	–	0.39 (0.19)	0.16*	0.39 (0.19)	0.16**
Importance of time outside [1]	0.37 (0.20)	0.14*	0.32 (0.20)	0.12*	0.24 (0.22)	0.09	–	–
Importance of watching TV/movies [1]	-0.22 (0.20)	-0.07	–	–	0.04 (0.24)	0.01	–	–
Importance of using E-games/computer [1]	-0.07 (0.18)	-0.03	–	–	-0.25 (0.20)	-0.10	–	–
Model 2 R^2 (adjusted R^2)			0.28 (0.22)				0.18 (0.12)	

* $p = \leq 0.10$, ** $p = \leq 0.05$, *** $p = \leq 0.01$. [1] Parent perceived importance of activities for their child. Model 1: Model for each social and individual factor adjusting for home ownership, family situation, WIMD, parent age and sex, season, daylength, no. of siblings, as well as the child's BMI, age and sex. Model 2; Model including all significant social and individual factors from model 1, adjusting for home ownership, family situation, WIMD, parent age and sex, season, daylength, no. of siblings, as well as the child's BMI, age and sex.

Table 4. Associations between social and individual factors and children's PA per hour at home

	Weekday				***Weekend***			
Home-based LPA	**Model 1**		**Model 2**		**Model 1**		**Model 2**	
	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β
Parental activity preferences	0.24 (0.30)	0.06		–	-0.00 (0.35)	0.00		–
Child activity preferences	0.35 (0.27)	0.10		–	-0.22 (0.31)	-0.06		–
Max h/day of screen-time	-0.30 (0.47)	-0.05		–	0.77 (0.53)	0.11		–
Importance of active play [1]	0.62 (0.27)	0.16**	0.67 (0.27)	0.18***	0.65 (0.31)	0.16**	0.65 (0.31)	0.16**
Importance of time outside [1]	0.40 (0.32)	0.09		–	0.43 (0.36)	0.10		–
Importance of watching TV/movies [1]	-0.17 (0.33)	-0.04		–	-0.04 (0.37)	-0.01		–
Importance of using E-games/computer [1]	-0.50 (0.29)	-0.12*	-0.57 (0.29)	-0.14**	-0.26 (0.32)	-0.06		–
Model 2 R^2 (adjusted R^2)			0.21 (0.15)				0.18 (0.12)	
Home-based MVPA	**Model 1**		**Model 2**		**Model 1**		**Model 2**	
	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β
Parental activity preferences	0.20 (0.23)	0.04	–	–	-0.20 (0.27)	-0.06	–	–
Child activity preferences	0.65 (0.20)	0.23***	0.65 (0.20)	0.23***	0.30 (0.24)	0.10	–	–
Max h/day of screen-time	0.33 (0.36)	0.07		–	0.47 (0.42)	0.08	–	–
Importance of active play [1]	0.27 (0.21)	0.09		–	0.20 (0.24)	0.06	–	–
Importance of time outside [1]	0.01 (0.25)	0.00		–	-0.06 (0.28)	-0.02	–	–
Importance of watching TV/movies [1]	-0.10 (0.25)	-0.03		–	-0.07 (0.29)	-0.02	–	–
Importance of using E-games/computer [1]	-0.25 (0.23)	-0.08		–	-0.35 (0.25)	-0.10	–	–
Model 2 R^2 (adjusted R^2)			0.24 (0.19)				–	

* $p = \leq 0.10$, ** $p = \leq 0.05$, *** $p = \leq 0.01$. [1] Parent perceived importance of activities for their child. Model 1: Model for each social and individual factor adjusting for home ownership, family situation, WIMD, parent age and sex, season, daylength, no. of siblings, as well as the child's BMI, age and sex. Model 2; Model including all significant social and individual factors from model 1, adjusting for home ownership, family situation, WIMD, parent age and sex, season, daylength, no. of siblings, as well as the child's BMI, age and sex.

Table 5. Associations between social and individual factors and the media equipment accessibility and availability summary scores

Variable	Overall media equipment [1]				Portable media equipment [1]				Fixed media equipment [1]				Bedroom media equipment [1]			
	Model 1		Model 2		Model 1		Model 2		Model 1		Model 2		Model 1		Model 2	
	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β
Parental activity preferences	-4.67 (1.77)	-0.19***	-3.89 (1.82)	-0.16**	-0.75 (0.87)	-0.06		–	-3.66 (1.38)	-0.19***	-3.66 (1.38)	-0.19***	-1.44 (0.61)	-0.17**	-1.28 (0.63)	-0.15**
Child activity preferences	-0.76 (1.64)	-0.04		–	-0.62 (0.80)	-0.06		–	-0.19 (1.28)	-0.01		–	-0.04 (0.56)	-0.01		–
Max h/day of screen-time	-5.07 (-0.13)	-0.13*	-3.60 (2.84)	-0.09	-3.08 (1.34)	-0.16**	-3.08	-0.16**	-1.40 (2.18)	-0.05		–	1.54 (0.95)	-0.11*	-1.07 (0.97)	–0.08
Importance of active play [2]	0.19 (1.66)	0.01		–	-0.97 (0.80)	-0.09		–	0.65 (1.29)	0.04		–	0.06 (0.57)	0.01		–
Importance of time outside [2]	-0.85 (1.90)	-0.03		–	-1.38 (0.92)	-0.12		–	0.10 (1.48)	0.01		–	0.14 (0.65)	0.02		–
Importance of watching TV/ movies [2]	-2.28 (0.94)	-0.08		–	-0.84 (0.94)	-0.06		–	-1.89 (1.51)	-0.09		–	-0.40 (0.66)	-0.04		–
Importance of using E-games/computer [2]	2.20 (1.70)	0.09		–	-0.09 (0.83)	-0.01		–	1.83 (1.33)	0.10		–	0.31 (0.58)	0.04		–
Model 2 R^2 (adjusted R^2)			0.13 (0.07)				0.10 (0.05)				0.12 (0.06)				0.17 (0.11)	

* $p = \leq 0.10$, ** $p = \leq 0.05$, *** $p = \leq 0.01$. [1] Accessibility and availability equipment summary score. [2] Parent perceived importance of activities for their child. Model 1: Model for each social and individual factor adjusting for home ownership, family situation, WIMD, parent age and sex, season, daylength, no. of siblings, as well as the child's BMI, age and sex. Model 2: Model including all significant social and individual factors from model 1, adjusting for home ownership, family situation, WIMD, parent age and sex, season, daylength, no. of siblings, as well as the child's BMI, age and sex.

Table 6. Associations between social and individual factors and the additional physical environment factors

Variable	PA equipment [1]				Musical instruments [1]				Smart phones				TV in child's bedroom			
	Model 1		Model 2		Model 1		Model 2		Model 1		Model 2		Model 1		Model 2	
	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β
Parental activity preferences	8.80 (5.89)	0.10		–	0.03 (0.74)	0.00		–	-0.03 (0.06)	-0.04		–	-0.09 (0.05)	-0.13*	-0.09 (0.05)	-0.13*
Child activity preferences	15.37 (5.30)	0.20***	11.19 (5.38)	0.15**	-1.21 (0.66)	-0.14*	-1.05 (0.65)	-0.12	0.04 (0.05)	0.06		–	-0.02 (0.04)	-0.03		–
Max h/day of screen-time	13.94 (9.21)	0.10		–	0.10 (1.13)	0.01		–	-0.19 (0.09)	-0.15**	-0.18 (0.09)	-0.14**	-0.09 (0.07)	-0.08		–
Importance of active play [2]	16.64 (5.34)	0.21***	13.02 (4.42)	0.16**	0.45 (0.67)	0.05		–	-0.07 (0.05)	-0.09		–	-0.03 (0.04)	0.05		–
Importance of time outside [2]	11.98 (6.22)	0.14*		–	1.24 (0.76)	0.12		–	-0.10 (0.06)	-0.12*	-0.09 (0.06)	-0.11	-0.01 (0.05)	0.02		–
Importance of watching TV/ movies [2]	-13.85 (6.34)	-0.14**	-10.38 (6.24)	-0.11*	-0.99 (0.78)	-0.09		–	-0.08 (0.06)	-0.08		–	-0.05 (0.05)	-0.07		–
Importance of using E-games/computer [2]	-1.95 (5.64)	-0.02		–	-1.76 (0.68)	-0.18***	-1.65 (0.68)	-0.17**	0.03 (0.06)	0.04		–	-0.01 (0.05)	0.01		–
Model 2 R^2 (adjusted R^2)	0.28 (0.22)				0.16 (0.10)				0.19 (0.13)				0.20 (0.15)			

* $p = \leq 0.10$, ** $p = \leq 0.05$, *** $p = \leq 0.01$. [1] Accessibility and availability equipment summary score. [2] Parent perceived importance of activities for their child. Model 1: Model for each social and individual factor adjusting for home ownership, family situation, WIMD, parent age and sex, season, daylength, no. of siblings, as well as the child's BMI, age and sex. Model 2: Model including all significant social and individual factors from model 1, adjusting for home ownership, family situation, WIMD, parent age and sex, season, daylength, no. of siblings, as well as the child's BMI, age and sex.

Table 7. Associations between social and individual factors and architecture/home design physical environmental factors

Variable	Garden size				Space to play inside the house				Space to play in the back garden				Open plan living area			
	Model 1		Model 2		Model 1		Model 2		Model 1		Model 2		Model 1		Model 2	
	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β	B (SE)	β
Parental activity preferences	10.76 (16.02)	0.05	–	–	-0.09 (0.07)	-0.09	–	–	-0.11 (0.07)	-0.11	–	–	0.08 (0.05)	0.13*	0.08 (0.05)	0.13*
Child activity preferences	5.30 (14.56)	0.03	–	–	0.04 (0.06)	0.04	–	–	0.04 (0.07	0.04	–	–	0.03 (0.05)	0.06	–	–
Max h/day of screen-time	20.45 (24.47)	0.06	–	–	0.02 (0.11)	0.01	–	–	-0.08 (0.11)	-0.05	–	–	0.06 (0.08)	0.06	–	–
Importance of active play [2]	13.51 (14.47)	0.07	–	–	0.11 (0.06)	0.13*	–	0.13*	0.15 (0.07)	0.17**	–	–	0.05 (0.05)	0.09	–	–
Importance of time outside [2]	40.47 (16.31)	0.18***	40.47 (16.31)	0.18***	0.09 (0.07)	0.10	–	–	0.19 (0.08)	0.19***	0.19 (0.08	0.19***	0.01 (0.05)	0.02	–	–
Importance of watching TV/ movies [2]	-11.64 (17.07)	-0.05	–	–	0.04 (0.07)	0.04	–	–	-0.01 (0.08)	-0.01	–	–	0.02 (0.05)	0.03	–	–
Importance of using E-games/computer [2]	-3.50 (14.94)	-0.12	–	–	0.09 (0.06)	0.10	–	–	-0.01 (0.07)	-0.01	–	–	0.01 (0.05)	0.02	–	–
R_2 (adjusted R^2)			0.20 (0.15)				0.13 (0.07)				0.16 (0.11)				0.09 (0.04)	

* $p = \leq 0.10$, ** $p = \leq 0.05$, *** $p = \leq 0.01$. [1] Accessibility and availability equipment summary score. [2] Parent perceived importance of activities for their child. Model 1: Model for each social and individual factor adjusting for home ownership, family situation, WIMD, parent age and sex, season, daylength, no. of siblings, as well as the child's BMI, age and sex. Model 2: Model including all significant social and individual factors from model 1, adjusting for home ownership, family situation, WIMD, parent age and sex, season, daylength, no. of siblings, as well as the child's BMI, age and sex.

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7. Appendix – univariate regression associations

Table 7. Univariate associations between social and individual factors and children's home–based sitting time and breaks

Variable	Home-based sitting						Home-based sitting breaks					
	Overall		***Weekday***		***Weekend***		***Overall***		***Weekday***		***Weekend***	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Parental activity preferences	-0.11	-2.05, 0.27	-0.12	-2.33, 0.16	-0.09	-2.27, 0.59	0.19*	0.13, 0.85	0.21*	0.20, 0.95	0.11	-0.11, 0.79
Child activity preferences	-0.23*	-2.62, -0.63	-0.27*	-3.14, -1.03	-0.01	-1.93, 0.42	0.10	-0.10, 0.54	0.15*	0.01, 0.69	-0.03	-0.45, 0.30
Max h/day of screen-time	-0.06	-2.60, 1.04	-0.04	-2.56, 1.37	-0.07	-3.07, 1.20	0.11	-0.12, 1.03	0.05	-0.38, 0.84	0.16*	0.04, 1.40
Importance of active play [1]	-0.08	-1.63, 0.47	-0.09	-1.83, 0.44	-0.05	-1.59, 0.83	0.18*	0.10, 0.76	0.15*	0.02, 0.72	0.20*	0.12, 0.88
Importance of time outside [1]	-0.06	-1.59, 0.70	-0.05	-1.67, 0.83	-0.05	-1.77, 0.94	0.18*	0.10, 0.82	0.18*	0.10, 0.86	0.11	-0.11, 0.75
Importance of watching TV/movies [1]	-0.09	-1.96, 0.46	-0.08	-1.99, 0.62	-0.14	-2.65, 0.14	-0.08	-0.60, 0.17	-0.09	-0.67, 0.14	0.00	-0.44, 0.46
Importance of using E-games/computer [1]	0.10	-0.35, 1.87	0.12	-0.19, 2.23	0.04	-0.93, 1.65	-0.08	-0.54, 0.16	-0.04	-0.50, 0.26	-0.10	-0.68, 0.15

Table 8. Univariate associations between social and individual factors and children's home–based PA

Variable	Home-based LPA						Home-based MVPA					
	Overall		***Weekday***		***Weekend***		***Overall***		***Weekday***		***Weekend***	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Parental activity preferences	0.10	-0.18, 0.93	0.10	-0.17, 1.01	0.04	-0.50, 0.85	0.08	-0.18, 0.69	0.10	-0.12, 0.79	0.03	-0.45, 0.63
Child activity preferences	0.01	-0.46, 0.53	0.09	-0.20, 0.84	-0.10	-0.96, 0.20	0.15*	0.04, 0.81	0.20*	0.18, 0.97	0.04	-0.35, 0.58
Max h/day of screen-time	0.07	-0.45, 1.34	0.00	-0.95, 0.95	0.13	-0.14, 1.96	0.14*	0.01,1.40	0.13	-0.08, 1.38	0.15*	0.01, 1.70
Importance of active play [1]	0.14	-0.02, 1.01	0.17*	0.11, 1.18	0.11	-0.15, 1.06	0.09	-0.13, 0.67	0.10	-0.12, 0.73	0.05	-0.32, 0.66
Importance of time outside [1]	0.07	-0.28, 0.85	0.10	-0.19, 1.01	0.04	-0.50, 0.84	0.01	-0.41, 0.48	0.03	-0.37, 0.56	-0.04	-0.67, 0.41
Importance of watching TV/movies [1]	-0.05	-0.79, 0.41	-0.05	-0.84, 0.43	-0.01	-0.77,0.64	-0.01	-0.50, 0.44	-0.02	-0.56, 0.42	-0.01	-0.59, 0.55
Importance of using E-games/ computer [1]	-0.13	-1.04, 0.04	-0.12	-1.06, 0.11	-0.08	-0.98, 0.29	-0.14*	-0.84, 0.00	-0.11	-0.81, 0.09	-0.15*	-1.01, 0.00

* p =<0.05. [1] Parent perceived importance of activities for their child.

Table 9. Univariate associations between social and individual factors and the media equipment accessibility and availability summary scores

Variable	Overall media equipment [1]		Portable media equipment [1]		Fixed media equipment [1]		Bedroom media equipment [1]	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Parental activity preferences	-0.19*	-7.85, -1.20	-0.08	-2.60, 0.66	-0.18	-5.99, -0.86	-0.16*	-2.53, -0.18
Child activity preferences	-0.03	-3.64, 2.42	-0.08	-2.26, 0.68	0.00	-2.29, 2.38	-0.04	-1.32, 0.79
Max h/day of screen-time	-0.12	-10.12, 0.74	-0.14*	-5.33, -0.11	-0.05	-5.57, 2.80	-0.10	-3.23, 0.57
Importance of active play [2]	0.01	-2.97, 3.39	-0.09	-2.57, 0.50	0.04	-1.72, 3.16	0.04	-0.82, 1.40
Importance of time outside [2]	-0.03	-4.24, 2.73	-0.10	-2.85, 0.52	0.00	-2.68, 2.69	0.02	-1.06, 1.38
Importance of watching TV/ movies [2]	-0.05	-5.14, 2.45	-0.03	-2.18, 1.49	-0.07	-4.31, 1.51	-0.03	-1.57, 1.09
Importance of using E-games/computer [2]	0.11	-0.65, 5.97	0.02	-1.34, 1.89	0.11	-0.57, 4.52	0.06	-0.68, 1.64

Table 10. Univariate associations between social and individual factors and the additional physical environment factors

Variable	PA equipment [1]		Musical instruments [1]		Smartphones		TV in child's bedroom		Digital TV	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Parental activity preferences	0.10	-3.34, 20.01	-0.04	-1.76, 1.04	-0.06	-0.16, 0.07	-0.13	-0.18, 0.01	-0.12	-0.13, 0.01
Child activity preferences	0.24*	7.94, 28.56	-0.13	-2.36, 0.08	0.06	-0.06, 0.15	-0.01	-0.09, 0.08	0.02	-0.06, 0.07
Max h/day of screen-time	0.12	-2.83, 35.19	-0.00	-2.25, 2.18	-0.16*	-0.38, -0.02	-0.09	-0.25, 0.05	-0.09	-0.19, 0.04
Importance of active play [2]	0.22*	6.57, 28.31	0.02	-1.13, 1.45	-0.11	-0.19, 0.02	-0.01	-0.10, 0.08	-0.09	-0.11, 0.02
Importance of time outside [2]	0.12	-1.39, 22.87	0.06	-0.85, 1.98	-0.13	-0.22, 0.01	-0.02	-0.11, 0.09	-0.12	-0.14, 0.01
Importance of watching TV/movies [2]	-0.15*	-27.10, -0.78	-0.12	-2.82, 0.24	-0.04	-0.16, 0.09	-0.04	-0.14, 0.07	0.06	-0.05, 0.12
Importance of using E-games/ computer [2]	-0.02	-12.99, 10.31	-0.15*	-2.82, -0.16	0.06	-0.07, 0.15	0.00	-0.09, 0.09	0.07	-0.04, 0.10

* p =<0.05. [1] Accessibility and availability equipment summary score. [2] Parent perceived importance of activities for their child.

Table 11. Univariate associations between social and individual factors and architecture/home design physical environmental factors

Variable	House size		Garden size		Space to play inside house		Space to play in back garden		Open plan living area	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Parental activity preferences	0.04	-7.32, 12.50	0.05	-19.87, 43.04	-0.08	-0.20, 0.05	-0.06	-0.19, 0.08	0.10	-0.02, 0.16
Child activity preferences	-0.00	-8.74, 8.42	0.07	-14.50, 40.64	0.03	-0.09, 0.14	0.02	-0.10, 0.14	0.05	-0.06, 0.11
Max h/day of screen-time	0.10	-4.18, 26.18	0.06	-28.73, 70.61	0.01	-0.19,0.22	-0.04	-0.28, 0.16	0.05	-0.10, 0.20
Importance of active play [2]	-0.03	-10.89, 6.93	0.06	-17.30, 40.45	0.12	-0.01, 0.22	0.17*	0.03, 0.28	0.07	-0.04, 0.13
Importance of time outside [2]	-0.04	-12.21, 7.31	0.17*	5.66, 67.99	0.06	-0.07, 0.19	0.17*	0.03, 0.30	0.05	-0.06, 0.13
Importance of watching TV/movies [2]	-0.07	-15.92, 5.65	-0.07	-52.47, 17.49	0.03	-0.10, 0.17	0.01	-0.13, 0.16	-0.00	-0.11, 0.10
Importance of using E-games/computer [2]	-0.08	-14.89, 3.92	-0.03	-36.90, 24.47	0.11	-0.03, 0.22	-0.00	-0.13, 0.13	-0.01	-010, 0.09

* p =<0.05. [1] Objectively measured house and garden size. [2] Parent perceived importance of activities for their child.