Exploring the feasibility of a cluster randomised control trial to improve children's 24 hour movement behaviours and dietary intake: Happy Homework.

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Co-author agreement statement

SD, DSB, GMcL and RA are aware of, and agree to this preprint submission.

- This is a pre-print manuscript that has not undergone peer-review.
- Cite this work as *Donnelly, S., Buchan, D.S. McLellan, G & Arthur, R. (2020, December 10). Exploring the feasibility of a cluster randomised control trial to improve children's 24 hour movement behaviours and dietary intake: Happy Homework.*
- Preprint DOI: 10.31236/osf.io/a2znt

Abstract

High levels of childhood obesity have been observed globally over the last three decades. Schools are promising settings to implement interventions aiming to improve health-related behaviours in children. The aim of this study was two-fold; (1) explore the feasibility of Happy Homework (HH) from qualitative investigations with teachers and pupils and (2) examine preliminary effects of the HH pilot on children's activity patterns, sleep and dietary behaviours. Four schools in Lanarkshire, UK, were randomised to either the HH intervention ($n = 2$) or usual curriculum control group ($n = 2$). The intervention ran for 8 weeks and consisted of interactive curriculum-focussed health and wellbeing homework tasks. Primary outcome measures were intervention fidelity, recruitment rates and compliance with trial procedures. Secondary outcomes were objectively measured physical activity (PA), sedentary behaviour (SB) and sleep via ActiGraph GT3X+ and activPAL4™ accelerometers, dietary intake, and screen-time (ST). Children ($n = 158$) were provided with informed consent, and subsequently, 68 of those children participated in this study. A recruitment rate of 43% and retention rate of 93% was observed. In relation to fidelity, the intervention group teachers ($n = 3$) provided children with HH each week for the full 8 weeks of the intervention. Compliance for ActiGraph GT3X+, BMI, ST and dietary intake questionnaire outcomes was high ranging from 91% to 100%, while 67% of the sample provided valid activPAL4™ data for both baseline and post-intervention. HH was found to improve measures of PA and SB in children in 8 weeks. Before progression to an effectiveness trial, additional procedures should be considered to improve recruitment rates, compliance with outcome measures, and implementation of the HH intervention long-term.

Keywords: children, 24-movement, physical activity, sedentary behaviour, diet, homework

1 **Introduction**

2 Childhood obesity has reached epidemic levels in many countries (Tremblay et al.,
3 2002). Overweight youth are at increased risk of remaining overweight into adulthood (Reilly
4 et al., 2003), with insufficient PA being shown to relate to higher weight status and poorer
5 health outcomes in children. PA guidelines suggest that children aged 5–17 years should
6 accumulate at least 60 mins of MVPA daily (Department of Health and Social Care, 2019).
7 Yet, findings from a Global Matrix comparing 15 countries indicate that children are failing
8 to meet these recommendations (Tremblay et al., 2014), particularly those with low SES
9 (Gidlow et al., 2006).

10 Recent 24 h movement guidelines were developed in Canada (Tremblay et al., 2016)
11 and Australia (Australian Government Department of Health, 2019), which represent a
12 paradigm shift in thinking about movement behaviours. Such recommendations have altered
13 from focussing on a single movement behaviour (e.g., MVPA) to an integrated movement
14 behaviour model. This model includes recommendations that children should participate in at
15 least 60 mins of daily MVPA, view no more than 2 h of recreational ST, sustain adequate
16 sleep durations of between 9-11 h per night and maintain consistent bed and wake times.
17 Children meeting all three recommendations have the lowest odds ratio for obesity in
18 comparison to those not meeting such recommendations (Carson et al., 2016).

19 Development of effective interventions that encourage children to meet the 24 h
20 movement guidelines is a key priority for public health researchers. However, the majority of
21 interventions aiming to promote healthy behaviours in children are implemented whilst
22 children are at school (Dobbins et al., 2013; Hegarty et al., 2016). Although some have
23 shown positive effects including children engaging in more MVPA and less ST (Dobbins et
24 al., 2013), new research suggests such interventions are not proving to be effective in
25 reducing childhood inactivity (Love et al., 2018). Furthermore, low levels of PA, high levels

of ST, and short sleep durations are all associated with increased food intake and poor diet quality in children (Beaulieu et al., 2016; Chaput and Dutil, 2016; Thivel et al., 2019), with poor diet being a key driver of childhood obesity (Faught et al., 2016). Therefore, future school-based interventions should consider a multidimensional intervention strategy (e.g., PA, sleep, and diet) across settings (e.g., school and home) to achieve sustained effects across the whole day (Love et al., 2018; Wyatt et al., 2018).

Whilst children spend a considerable amount of their day at school, the home is considered a fundamental environment for health promotion, with parents regarded as the most important influence on children's obesogenic health behaviours (Story et al., 2009). Home-based interventions are logistically impractical and tend to be unsustainable (Duncan et al., 2011), however using schools to communicate with children in order to encourage healthy behaviours in the home may be a feasible approach. Nevertheless, improving the health of children, including those most in need, via a school-home intervention would be challenging as parents recruited for school-based interventions tend to be the most affluent and motivated parents (Clarke et al., 2015).

Parents with low SES and low educational involvement recommend a flexible intervention approach which can be adopted at any time, and includes home activities, to improve their involvement in school-based health promotion (Donnelly et al., 2019). Within previous attempts to promote healthy lifestyles using homework components in school-based interventions, homework components assumed secondary importance to the school-based component with some studies reporting positive effects upon PA, fitness and eating habits (Christodoulos et al., 2006; Eather et al., 2013; Eyre et al., 2016; Kriemler et al., 2010; Manios et al., 2006; Marcus et al., 2009). Nonetheless, other interventions deploying homework tasks such as AFLY5 demonstrated no effect upon increasing PA, reducing SB or increasing fruit and vegetable consumption (Aadland et al., 2019; Abraham and Michie,

2008; Kipping et al., 2014; Reilly et al., 2006). Comparing the contributions of such homework interventions is difficult as studies tend to employ multiple approaches, some are limited by low statistical power (Tercedor et al., 2017), whilst others have used self- or proxy-measures to quantify PA (Fitzgibbon et al., 2005; Manios et al., 2006). Furthermore, studies deploying accelerometers use varying devices and cut-points which makes it difficult to quantify and compare the magnitude of effect (Kriemler et al., 2010; Marcus et al., 2009).

The use of novel metrics including AvAcc and IG from raw accelerometry data could enable comparisons to be drawn from studies that use different accelerometer devices (Rowlands et al., 2018). AvAcc provides a measure of the volume of activity whereas the IG describes the intensity distribution of accelerations (Rowlands et al., 2018). Together these metrics detail both the volume and intensity of activity undertaken across the monitoring period using all of the acceleration data. Both metrics could be used instead of laboratory-derived population and device-specific activity thresholds (Rowlands et al., 2018). Additionally, recently proposed activity metrics identify the minimum acceleration value above which a person's most active minutes, for example 60 mins (M60_{ACC}), 30 mins (M30_{ACC}) or 2 mins (M2_{ACC}) is accumulated (Rowlands et al., 2019). The active mins can be accumulated in any way across the day in line with PA recommendations (Department of Health and Social Care, 2019). These novel metrics may help facilitate the pooling of accelerometer data across studies employing different devices and make use of the entire data set (Rowlands et al., 2019).

Healthy Homework, to the best of our knowledge, is the only effective intervention which adopts a compulsory curriculum-based approach to health homework (e.g., family walks) alongside in-class teaching (Duncan et al., 2011, 2019). Positive intervention effects for weekday PA at home, weekend PA, BMI, and fruit consumption were found. Encouragingly, the greatest improvements in PA occurred in children from the most

socioeconomically deprived schools. Whilst these results are promising, a significant limitation of this study is that PA was measured using pedometers which have been found to be inaccurate in assessing energy expenditure and are unable to distinguish time spent in activity intensities (Ndahimana and Kim, 2017). HH, a curriculum-focussed intervention, was designed based upon recommendations from parents of low SES, in order to be flexible around the lives of parents and children, requiring no equipment or access to facilities (e.g., sports centres), and was theoretically grounded in order to increase children's motivation and adherence to the intervention (Donnelly et al., 2019; Ryan and Deci, 2000). To the best of our knowledge, this is the first school-based obesity prevention homework intervention which focusses on improving 24 h movement behaviours, including sleep, and also aims to improve diet quality in children. The aim of this study was two-fold; (1) explore the feasibility of HH from qualitative investigations with teachers and pupils and (2) examine preliminary effects of the HH pilot intervention on children's 24 h activity patterns and dietary behaviours.

Materials and Methods

Participants and Recruitment

A convenience sample of four primary schools from Lanarkshire, Scotland, who had been involved in previous studies coordinated by the primary investigator, were recruited. Once ethical approval from the University Ethics Committee was granted, the schools were approached to discuss their involvement in the study. One class per school was selected by the Head teacher based on the pupils ages (9-12 years old), and informed consent paperwork was issued to each child in the four classes ($n = 128$; 69 girls). Due to a low return-rate of consent from one school class, an additional class from this school was selected by the Head teacher and additional informed consent paperwork ($n = 30$) was issued. The reason for the low-return rate from one school was unclear. In total, 158 children across 5 classrooms were provided with informed consent paperwork. The flow of pupil participants throughout the

study can be found in The CONSORT Flow diagram (see Figure 1). Schools ($n = 4$) were randomised into intervention ($n = 3$) and a control ($n = 2$) classroom groups. As such, teachers within their respective classrooms were allocated to the intervention ($n = 3$) and control ($n = 2$) arms of the study. Schools were blinded to this information until pre-intervention measures were collected.

Pilot programme

The HH pilot intervention included homework activities which aimed to improve activity-related behaviours over the whole day (i.e., movement, sleep, yoga, dance, walking, fitness, games and competitions) and key dietary-related components (e.g., fruit and vegetables, soft drinks, sugars, snacking, energy in foods, food from around the world and kitchen hygiene). HH PA tasks were decided upon based on The WHO recommendations for activity in children aged 5-17 years which suggest that most of children's daily activity should be aerobic, and vigorous-intensity activities should be incorporated including activities which strengthen muscle and bone at least 3 times per week (WHO, n.d.). Additionally, 24 h movement guidelines were also implemented into the design of HH tasks, in that children should aim to break-up time spent sedentary by moving, with recreational screen time (ST) limited to no more than 2 h, and that children would aim to sustain adequate sleep durations of between 9-11 h per night, maintaining consistent bed and wake times (Tremblay et al., 2016). HH activities were then mapped in-line with the Scottish Curriculum for Excellence (CfE) for primary school children, taking into consideration their four developmental capacities; (1) successful learners, (2) confident individuals, (3) responsible citizens and (4) effective contributors (see Table 1). The Experiences and Outcomes of the HH intervention embody the attributes and capabilities of the four capacities, with the experiences relating to the learning experience and development of these capacities, and the outcome referring to what is to be achieved. The CfE does not provide explicit

recommendations for the choice of activities, but rather a focus on mental, emotional, social and physical wellbeing which widens knowledge about choices in life and the costs and benefits attached. Therefore, the development of the HH intervention was informed from the SDT (Deci and Ryan, 1985) which aimed to develop children's motivation to lead healthier lifestyles by meeting their three basic psychological needs: autonomy, competence and relatedness (See Table 2). Satisfying childrens basic psychological needs has been shown to be predictive of PA participation and general positive behaviours associated with wellbeing (Breslin et al., 2017).

It has been suggested that the limited effects of previous school-based interventions could be attributed to the use of 'top-down' approaches whereby researchers drive intervention design with limited input from school stakeholders (Rütten et al., 2019). The World Health Organisation has indicated that actions to prevent childhood obesity should be implemented across multiple settings and incorporate a wide range of stakeholders (Organization, 2012). As such, the HH intervention was developed under the guidance of local authority primary school Head teachers ($n = 4$). The Head teachers were provided with eight weeks of provisional HH activities. From these provisional HH activities, the Head teachers chose their preferred six weeks during a meeting with the lead researcher and additional classroom teachers. The HH intervention was also informed by recommendations from parents of low SES, ensuring that home-based joint parent and child activities can be implemented with flexibility and no financial burden on families, and in turn, involving families in health curriculum (Donnelly et al., 2019).

HH workbooks were provided to children on a Monday, Wednesday, and Friday to encourage habitual involvement in the activities over an 8-week period, which included 2 Easter holiday weeks. Additional activities and health promotion reminders were provided in the workbooks for the subsequent days in which the child did not receive HH (e.g.,

weekends). Parents were required to sign off each activity that they completed with their child in the parent sign off box located at the bottom of each page within the HH workbook. The teachers were provided with a logbook to record the specific days in which the children completed HH activities to measure the fidelity of HH based on parental signatures. If the child completed their weekly HH activities, they would receive a happy face sticker on their HH workbook at the end of each week. Happy face stickers were distributed as a small reward for the completion of HH activities each week to encourage pupils to complete their homework. Previous research has shown that the use of small rewards encourage adherence and is thought upon favourably by parents (Buchan et al., 2019; Donnelly et al., 2019).

Quantitative Enquiry.

Anthropometrics.

At school, mass was measured barefoot to the nearest 0.1kg with an electronic scale (Seca Digital Scales, Seca Ltd, Birmingham, UK) whilst stature was measured barefoot to the nearest 0.1cm using a portable stadiometer (Seca Stadiometer, Seca Ltd, Birmingham, UK) in accordance with standard procedures (Cole et al., 1995). BMI was then calculated as the mass in kilograms divided by the square of the stature in meters. Thereafter, the BMI z-score was determined and children were classified as healthy weight (BMI z-score <1.04, below the 85th percentile) or overweight/obese (BMI z-score $\geq$ 1.04, above the 85th percentile) relative to the UK 1990 BMI population reference data (Cole et al., 1995) and using software provided by the Child Growth Foundation (Pan and Cole, 2010).

ActiGraph GT3X+.

Each child was provided with an ActiGraph GT3X+ (ActiGraph, LLC, Pensacola, FL, USA) accelerometer and instructed to wear the device 24 h per day for 7 days, except during any water-based activities, on the non-dominant wrist (confirmed by the child). Written

instructions for care and placement of the monitors were provided to parents. All devices were synchronised with Greenwich Mean Time and initialized to capture data at 80Hz prior to distribution.

ActiGraph GT3X+ data processing.

Accelerometer data were downloaded using ActiLife v6.13.3 (ActiGraph, Pensacola, FL, USA) and saved in raw format as gt3x files. The gt3x files were subsequently converted to time-stamp free .csv files which were exported into R (R Foundation for Statistical Computing, Vienna, Austria, <https://cran.r-project.org/>) and processed using the GGIR package v1.9-2. GGIR removed abnormally high values, detected non-wear time (Hees et al., 2013) and auto-calibrated the raw accelerometer signals using local gravity as a reference (van Hees et al., 2014). Finally, GGIR calculated Euclidean Norm Minus One (ENMO) over 5 sec epochs expressed in milli-gravitational units (mg). Participant files were removed from further analysis if files had a post-calibration error greater than 0.01 g or there were less than 3 days (including 1 weekend day) of valid wear (defined as ≥ 16 h per day). The following activity outcomes reported included; AvAcc across the monitoring period (mg), the IG, M60, M30, M2, time accumulated in MVPA and time spent inactive. Time spent in MVPA was defined as the time accumulated above an acceleration of 201 mg (Hildebrand et al., 2014) whereas time spent inactive was defined as time accumulated below 50 mg (Rowlands et al., 2018).

activPAL4™.

The activPAL4™ micro (PAL Technologies Ltd., Glasgow, UK), was used to quantify SB's including sitting time, standing time, stepping time, MVPA stepping time, sit-to-stand transitions, sitting ≤ 30 mins, sitting ≤ 60 mins and sitting > 60 mins during free-living. This device has previously been shown to be a valid measure of body posture and for quantifying SB (Aminian and Hinckson, 2012). The activPAL4™ was placed in a small

flexible nitrile sleeve to waterproof the device and was attached to the children's right thigh using dressing. Children were instructed to wear the device for 24 h per day across a 7-day period.

activPAL4™ data processing.

Raw *activPAL4™* data were processed using Processing PAL software (Version 1.3) using the Events.csv files from the *activPAL4™*. To quantify sleep and non-wear time the default setting in Processing PAL was used which uses an algorithm developed and validated to detect sleep and non-wear for continuous (24 h) wear protocols (Winkler et al., 2016). The algorithm's first step finds long periods that are most likely to be sleep or non-wear. Sleep/non-wear bouts were identified as the longest bout per 24 h period (from noon-to-noon each day) that lasts ≥ 2 h, or any very long bouts lasting ≥ 5 h. As sleep can register as multiple periods of sitting/lying interspersed with real or erroneously detected posture changes and stepping, the next step iteratively examines surrounding bouts and determines whether they are more likely additional sleep/non-wear (limited movement) or waking wear (more movement). Bouts were 'surrounding' if any portion was within a 15 min window before or after a sleep/non-wear bout. All bouts in the sleep window were classed as sleep/non-wear when the window contains any of these: a sitting/lying or standing bout that is long (≥ 2 h), or moderately long (≥ 30 min) with very few (≤ 20) steps in between; a sleeping/non-wear bout; or, posture changes without intervening steps. This step repeats until no more sleep/non-wear is found. Data were included in the analyses if the child provided a minimum of 3 valid days of recording which included 1 weekend day. Valid days were defined as a day with ≥ 10 h of wear time during identified waking hours (Tudor-Locke et al., 2015).

Day in the Life Questionnaire.

The DILQ has been validated in 7-9 year old children (Edmunds and Ziebland, 2002), and has been used in 6-11 year old children (64,65). The 23-item DILQ uses words and pictures to encourage the child to recall and describe a range of activities from the previous day (24 h recall method), including everything they had to eat and drink (Edmunds and Ziebland, 2002). Write and draw questions regarding what the child had to eat are embedded within other items that take the child through a range of daily activities, providing context which helps the child to recall what they ate the day before (Edmunds and Ziebland, 2002). For analyses, the number of daily servings of fruit and vegetables were totalled; a point was awarded for each fruit and vegetable recalled by the child as part of their diet the previous day.

Screen time Questionnaire.

ST can take different forms including; TV, video games, computer and mobile device (Hale and Guan, 2015), therefore children were asked to report how many hours they engaged in ST on weekdays (before school and after school) and weekend days (morning and evening) for mobile phone/tablet use, TV, and playing computer/video games which did not require them to be active (i.e., sitting down). Self-reported methods for quantifying ST have shown acceptable reliability and validity in children (Hardy et al., 2013). Children's average self-reported ST for 'weekday' was multiplied by 5, and 'weekend' ST was multiplied by 2 to create a weekday and weekend ST outcome and added together to calculate overall weekly ST.

Family Involvement Questionnaire.

The 46-item FIQ-E version (Manz et al., 2004) is a validated multidimensional self-report scale measuring the frequency of family involvement in education (Semke et al., 2010). The FIQ-E's items are rated on a 4-point Likert-type scale ranging from 1 (rarely occurs) to 4 (always occurs), and examines three distinct factors of parent involvement: (1)

home-school communication (e.g., talk to teacher about classroom rules), (2) home-based learning (e.g., read with child), and (3) school-based involvement (e.g., volunteer in the classroom). For the purposes of the current study, only items from the home-based learning subscale (e.g., help with homework, read with child, limit TV, etc.) were completed by parents to obtain demographic information surrounding the involvement of parents who were participating in HH activities. The FIQ-E has demonstrated good factorial fit according to conventional criteria and excellent internal consistency ($\alpha = .91-.84$) (71).

Socioeconomic Status.

Home postcodes were obtained from each family involved in the study in order to calculate the SES of children via the SIMD online calculator (Scottish Government, 2016). This demographic outcome was used in subsequent analyses as a covariate. The SIMD identifies areas of deprivation across Scotland in a consistent way, ranking small areas from most deprived (ranked 1) to least deprived (ranked 6,976) which is then converted into a relative decile score between 1 and 10 (1 being the most deprived areas and 10 being the least deprived areas). Scores for each area are calculated based on objective indicators across 6 domains; (1) residents' income, (2) employment, (3) housing, (4) health education, (5) skills and training, and (6) geographic access to services and telecommunications. SIMD scores for all locations in Scotland were publicly available at the time of the research.

Qualitative Enquiry.

In order to explore the experiences of teachers involved in the HH intervention and the feasibility of HH, the teachers who delivered HH ($n = 3$) participated in individual interviews. Furthermore, to explore the experiences of pupils who participated in the HH intervention, 5 pupils from each of the 3 intervention arm classes ($n = 15$) were randomly selected by the researcher and took part in WDST groups. All interviews were conducted by the primary investigator who had previous experience collecting qualitative data of a similar

nature over a four-year period. All interviews were recorded using a digital recorder and transcribed verbatim.

Teacher participation.

Individual interviews were conducted with the teachers who delivered HH ($n = 3$), which were arranged at their convenience. A semi-structured interview guide with open-ended questions were used to ensure consistency across interviews. The interview guide (see supplementary file A) covered the following topics; implementation of general homework and previous health and wellbeing homework, completion of HH tasks, perceptions of HH tasks and recommendations to improve HH. Prior to data collection, the interview guide was assessed and discussed between the primary investigator and the director of studies, in which collective consensus was agreed that the guide would enable the researcher. The interviews took place in a private area of the school and lasted 25.59 ± 5.60 min. All three teachers within the two intervention schools handed out all eight weeks of HH (6 curriculum-time weeks and 2 Easter holiday weeks). Given the sensitivity of observing teacher practice within the classroom, it was not feasible to observe whether the HH workbooks were being handed out by the teachers. Therefore, teachers were asked to complete fidelity forms, which also detailed pupil's completion of HH.

WDST Groups.

Prior to data collection, the WDST group interview guide was assessed and discussed between the primary investigator and the director of studies, in which collective consensus was agreed that the guide was age appropriate, aligned with SDT outcomes and therefore supported the study aims (see Suplimentary file B). The WDST method provides children with alternative ways of expression and enables a deeper exploration of children's thoughts and perceptions by not limiting children to verbal communication (Noonan et al., 2016). WDST group interviews were informed by Noonan and colleagues procedures practical

300 checklist (Noonan et al., 2016). At the beginning of WDST interview, children were asked to
301 introduce themselves and share their favourite topic to learn in class as an ice breaker task.
302 This was used to provide children with the opportunity to experience talking aloud to the
303 group, and to establish an environment in which sharing and listening was valued (Gibson,
304 2012). Children were then provided with post-it note© paper and a pencil and asked to write
305 down ‘5 words to best describe PA to someone else’. Children were then asked to explain the
306 meaning of their responses and place their responses post-it notes© on to the marker board
307 and discuss these as a group. Following this, children were asked to draw an environment
308 where they were most likely to participate in PA. By doing this, children could express their
309 perceptions of PA visually, and subsequently, the research team could determine whether HH
310 activities were included in such drawings. The drawing took the focus away from direct
311 questioning and consensus, to that of a more child-centred approach that better allowed for
312 the lived experience to be shared (Horstman et al., 2008). During the write and draw activity
313 the primary investigator separately engaged children in informal conversations to allow them
314 to articulate what they were drawing and why. Once children had completed their drawings
315 the WDST group continued with more challenging open-ended questioning concerning the
316 three basic psychological needs; relatedness, autonomy, and competence. These questions
317 aimed to elicit perspective from children to determine whether HH satisfied their basic
318 psychological needs (see Suplimentary file B). By adopting this interactive and dual method
319 approach (i.e., WDST), we hoped to prompt detailed perceptions of childrens PA and HH
320 that may not have been identified if singular methods based approaches (e.g., focus groups)
321 has been used (Dockett and Perry, 2005). Each WDST group ($n = 3$) consisted of 5 children
322 from the same school, selected randomly from the consenting children by the primary
323 investigator. The interviews took place in a quiet area in the school where the pupils could be
324 overlooked but could not be overheard and lasted on average 40.84 ± 10.43 min.

Data Analysis

Quantitative Data.

All analyses were conducted using IBM SPSS Statistics v.23 (IBM, Armonk, NY). Independent sample *t* tests and one-ways analysis of covariance (ANCOVA) examined the differences in mean; BMI z-score, AvAcc, IG, MVPA, M60, M30, M2, sitting time, standing time, stepping time, MVPA stepping time, number of sit-to-stand transitions, sitting (≤ 30 mins), sitting (≤ 60 mins), sitting (>60 mins), sleep duration, ST, and total fruit and vegetable consumption score between intervention and control groups at baseline and post-intervention time points. Statistical significance was set at 0.05. The 95% confidence intervals (CI) for the mean differences for each group are presented with the partial eta squared values (η_p^2) reported as effect size estimates. In accordance with Green and colleagues (Green et al., 1996), 0.01, 0.06 and 0.14 were interpreted as small, medium and large effect sizes, respectively.

Qualitative Data.

Deductive-inductive thematic analysis allowed for themes to be identified and extracted from the teacher and child qualitative data driven by the research aims, as described by Braun and Clarke (Braun and Clarke, 2006). To ensure credibility in the analyses, the director of studies, who was not present during data collection, independently reviewed the data at several stages of the analyses.

Individual interviews.

Thematic analysis was used in order to systematically represent teacher's experiences of the HH pilot programme (Braun and Clarke, 2006). We followed the 6 steps of thematic analyses which include: (1) Familiarisation with the data, (2) Generating initial codes, (3) Searching for themes, (4) Reviewing themes, (5) Defining and naming themes, and (6) Producing the report (Braun and Clarke, 2006). The primary investigator conducted the

interviews and then listened to the audio files of the interviews and transcribed these. In doing so, the primary investigator became intimately familiar with the data. In generating initial codes, it is important to consider the research aims as coding will depend on whether the themes are data- or theory-driven (Braun and Clarke, 2006). Teacher interviews were conducted in order to answer specific questions regarding the HH pilot programme including teacher perspectives of implementing HH, their preferred weeks, and recommendations to improve HH. As such, when analysing teacher data a deductive approach was applied to our thematic analysis in order to explore teacher perceptions of HH, however the researcher was open to additional emergent themes. Data from these sessions included the nature of their PA, the active ingredients associated with their PA and social interactions facilitated due to their engagement in PA. Following this, commonalities were sought in the themes generated. A review of these themes was then conducted and from this, themes were pooled together and defined. This process was conducted between the primary investigator and the director of studies. Upon agreement of the final themes, such themes were produced as detailed in our results.

WDST groups.

This approach generated three separate sources of data; (1) a frequency count (show activity), (2) visual data (write and draw activity) and (3) verbatim data (tell activity and children's write and draw narratives). One stage did not inform the next, rather a mixed analysis approach was taken. For the 'show' data, children's responses were totalled. Narratives were transcribed verbatim, classified as a written 'report', and subsequently attached to each individual drawing. 'Tell' data was analysed through an inductive-deductive process which was framed by the three basic psychological needs as per SDT, using these as a thematic framework, with researchers also open to emergent themes surrounding HH. The reports and drawings were then used in combination to categorise 'marks' on paper in

relation to specific themes. For example, a drawing containing a child participating in a game of football with friends would require marks for more than 1 theme (both activity and social interaction). The three data sources were triangulated and pooled together, in which thematic analysis was conducted, drawing and narratives presented, and pen profile analysis conducted. This method has been shown as an effective way of presenting data to researchers that have an affinity with both quantitative and qualitative enquiry (Knowles et al., 2013; Ridgers et al., 2012).

Results

All four schools contacted agreed to participate. A total of five classrooms and their classroom teachers and pupils were recruited for this study. From the 158 children recruited for this study, 71 children ($n = 31$ girls) and their parents returned consent documents, and by being present on the day of pre-testing, 68 children and their families were included in the study. Of the parents who completed FIQ-E ($n = 69$), 58% ($n = 40$) were classified as 'involved' and 42% ($n = 29$) were classified as 'less involved' using the median split of the FIQ-E scores. A significant difference between the intervention and control groups regarding parent involvement ($p < 0.05$) was observed. In the intervention group, the average parent involvement score was 2.80 ± 0.35 ($n = 38$), whereas for the control group, the average FIQ-E score was 3.04 ± 0.40 ($n = 30$) meaning that families within the control group were more involved in home-based learning. The average SIMD score of the families recruited to this study was 5.38 ± 2.76 . No significant differences were observed for SIMD when comparing children involved in the control and intervention groups. Analyses was undertaken to split families into low SIMD based on residing in an area with an SIMD decile score of ≤ 2 ($n = 16$; 23%) and high SIMD based on residing in an area with an SIMD decile score of ≥ 3 ($n = 55$; 78%) groups.

Of the children who participated in this study, 28 (41%) met the wear-time criteria of a minimum of 3 days (including 1 weekend day) of valid wear (defined as ≥ 16 h of wear-time per day) for ActiGraph devices ($n = 18$ intervention arm). Furthermore, 49 (72%) met the wear-time criteria of a minimum of 3 days of recording (including 1 weekend day) of valid days (defined as a day with ≥ 10 h of wear-time during identified waking hours) for activPAL4™ devices ($n = 28$ intervention arm) at baseline. The descriptive characteristics of the study sample at baseline and post-intervention are shown in Table 3.

Changes in outcome measures

Differences found between the control group and intervention groups with between group differences always compared to the control group can be found in Table 4. Objective observations found significant intervention effects on PA including; stepping time and MVPA stepping time as well as less time (0-30mins) sitting when compared to the control group. Interestingly, a positive intervention effect for sleep duration was approaching significance ($p = 0.05$). Significant improvements were observed for the control group including IG and sit-to-stand transitions. The effect size for each outcome was large (≥ 0.14).

Pupils perceptions of their PA

Pupils were asked to provide general information surrounding their PA through the Write and Draw activity in order to explore whether HH was perceived to be embedded in their perceptions of PA. Data from these sessions included the nature of their PA, the active ingredients associated with their PA and social interactions facilitated due to their engagement in PA (see Figure 2). From their drawings, they discussed the nature of their PA being either structured such as attending clubs, or unstructured such as playing in their garden. HH was not highlighted as an environment in which they are likely to engage in HH within their drawings. Pupils discussed various active ingredients associated with their participation in PA including enjoyment and choosing their favourite activity as well as

limiting technology. During the write and draw activity, pupils discussed numerous social interactions with key individuals as a result of their participation in PA including their siblings, coach and team mates.

HH fidelity and acceptability

We asked teachers to complete HH fidelity forms during the eight weeks of the intervention which detailed pupil completion of the tasks (see Table 5). Whilst two of these teachers from one school completed fidelity forms for their classes in full, the third teacher forgot to do so from week two and thereon, however based on our qualitative data, we are confident that all three teachers provided the full 8 weeks of HH intervention. Nevertheless, it is important to note we have missing data ($n = 19$; 47.50%) when examining pupil acceptability from week 2 of HH and thereon. From the completed logbooks, completion rates ranged from 58% in week 1 to 33% in week 8. Whilst the teachers suggested that there was higher completion rates in earlier weeks, they believed the novelty of the activities may have worn off, with lower completion rates over the later stages of the programme. Analysis of homework completion rates confirms that completion of HH activities decreased as the weeks progressed.

Positive outcomes associated with HH

Teachers and pupils provided information surrounding the positive outcomes associated with HH (Table 6). Teachers suggested that they enjoyed implementing HH activities into their classroom, and believed that this practice got the class into a routine, which was easy to implement as weekly HH and ran alongside other key areas of the curriculum as it was well-matched to the CfE. Teachers also discussed additional positives associated with HH including strengthened teacher-pupil and parent-child relationships, encouraging children to be more active, and engaging school-based activities with home-life.

Negative outcomes associated with HH

Teachers and pupils outlined negatives and barriers associated with HH including; parental attitudes to homework completion, additional commitments and parent employment (see Table 7). Pupils discussed specific additional commitments in which they associated with barriers to completion of HH activities including parent employment and being involved in extra-curricular clubs.

In relation to Health and Well being homework the teachers said that prior to HH they either did not hand out any at all, had not ever considered it, or did not hand out a ‘huge amount.’ And each teacher suggested that as a result of HH they recognised the importance of health and wellbeing homework. Nonetheless, potential barriers to the effectiveness of HH emerged as the teachers suggested that health and wellbeing homework was not given the same importance as other areas of the curriculum and more broadly they did not consider the completion of homework to be a high priority to the school or the teachers (see Table 7).

Application of SDT in HH

During the ‘tell’ phase of WDST component, verbatim data was collected regarding the effectiveness of the application of SDT in HH. Specifically, pupils provided feedback surrounding the three basic psychological needs; (1) autonomy in HH (see Table 8), (2) Competence in HH (see Table 9), (3) Relatedness within PA participation and interaction during HH (see Table 10) and (4) Relatedness regarding pupils perceived level of support during HH and parent-child relationships after HH (see Table 11). From our qualitative enquiry, HH was found to satisfy these basic psychological needs. Regarding autonomy, children indicated that they experienced having choice over the activities to do in HH, however they faced pressure from their teachers at times to complete their HH. In relation to competence, children indicated that they felt capable and motivated by the activities set in HH, but did not feel the tasks were overly challenging. Regarding relatedness, children highlighted that it was positive to see their parents being active and participating in some

exercises for the first time. Furthermore, children indicated that HH activities brought their families together, especially those whose parents do not engage in activities with their children and spend time on their mobile phone. Therefore SDT was found to meet childrens three basic psychological needs whilst exposed to HH.

Key recommendations to improve HH

Ultimately, teachers and pupils seemed keen to have HH continue, with teachers suggesting that, despite their previous involvement in the design of HH, we could work more closely with them on the content of HH in the future. Additionally, pupils suggested that they would like it continue receiving HH in order to remain active. Nevertheless, teachers and pupils provided us with key recommendations in order to improve HH (see Table 12). Specifically, teachers suggested that it should be handed out once a week and pupils recommended that HH should have less-structure and could therefore be completed on any day during the week.

Discussion

The primary aim of this study was to explore the feasibility of HH, a randomised control trial to improve children's 24 h movement behaviours and dietary intake. The intervention was implemented by all three intervention teachers. From the 158 children who were provided with informed consent, a recruitment rate of 43% and retention rate of 93% was observed (Barber et al., 2016). Within those children that were retained from baseline to follow-up, the collection of valid measures varied by the outcome, compliance was highest for ActiGraph GT3X+ data (100%). Thereafter, high compliance for BMI (93%) and ST (92%), closely followed by the completion of the dietary intake questionnaire (91%) was observed. Theron, 67% compliance of valid activPAL4™ accelerometer data was observed.

From the fidelity logbook, it was apparent that completion of the Yoga, Fitness and Nutrition, and Dance homework activities were greater than the Holiday Games, Walking

and Play homework activities. From our qualitative enquiry with teachers and pupils, it was clear that adherence of HH activities reduced as the intervention progressed and that activity-related activities were preferred. Previous research in compulsory homework-based interventions have found similar outcomes (Duncan et al., 2019). Incentives have been used to encourage participation in school-based interventions including rewards as employed in this study, but also financial incentives (Martin et al., 2014) and donations to charity (Hunter et al., 2015). Previous research has demonstrated good adherence to the intervention when participants have been provided with incentives such as monetary gifts to their school upon meeting intervention goals (e.g., achieving a 2% weight loss goal) (Yoo et al., 2017). Future school-based interventions should therefore consider the use of incentives where possible to enhance compliance to their study aims.

We also had missing data within our fidelity logbooks ($n = 19$; 48%) when examining pupil acceptability of HH due to one teacher failing to complete their logbook from week 2 onwards. Incomplete logbooks has been noted as a limitation in examining acceptability of the AFLY5 intervention which included a homework element (Campbell et al., 2015). A recent systematic review of measuring implementation fidelity of school-based obesity prevention programmes suggests that logbooks, amongst other methods (e.g., observations, questionnaires) were the most common methods of measuring fidelity (Schaap et al., 2018). However, there is no agreed consensus on the operationalisation of concepts and methods used for assessing fidelity in such programmes (Schaap et al., 2018).

The home environment is known to be one of the more challenging settings to implement interventions aiming to improve children's health outcomes, particularly in low SES groups (Knowlden and Sharma, 2012). This finding is echoed by Malden and colleagues (2019) who found a low level of implementation in the home environment (41%) and a low post-intervention survey response of only 15% in a feasibility cluster randomised control trial

of an obesity prevention intervention. (Malden et al., 2019). Thus, HH was informed by research with less involved parents of low SES indicating that low-cost home-based activities including parent and child joint activities in the home environment can increase involvement (Donnelly et al., 2019). Families recruited to this study included families of low SES (23%) and less-involved parents (49%). Therefore, future interventions aiming to involve parents should take heed to the recommendations provided by less-involved parents of low SES to encourage their involvement alongside more affluent and more motivated parents.

From our qualitative investigation with teachers, it was suggested that being involved in the HH intervention strengthened teacher-pupil and parent-child relationships. Indeed, HH was found to have a substantial effect on family life by bringing parents and children together, and feeling more connected than before they participated in HH. Additionally, it was suggested that HH promoted the importance of healthy lifestyles, with its activities well-matched to the CfE. Teachers suggested HH improved their relationship with the pupils and allowed them to engage with home-life through home-based HH challenges. However, parent attitudes and employment, as well as children's additional commitments (i.e., clubs and extra-curricular activities) were viewed by children as key barriers to completion of HH activities. Teachers indicated that whilst pupils are strongly advised to complete their homework, nothing can be made compulsory, and suggested that not enough importance was emphasized on health and wellbeing homework when compared to homework focussing on literacy and mathematics. Therefore, in order to gain the benefits associated with HH structural changes may be required to ensure that health-related homework tasks as seen by teachers, parents and children as a key area of learning.

The secondary aim of this study was to examine preliminary effects of the HH pilot on children's activity patterns, sleep and dietary behaviours. The preliminary effects of the HH intervention found significant increases in activity including stepping time, MVPA

stepping time as well as significantly less time spent in SB (i.e., less time in sitting bouts (0-30mins)). Healthy Homework, to the best of our knowledge, is the only other compulsory school-based obesity prevention intervention which also observed significant intervention effects for weekday PA at home and weekend (PA) (Buchan et al., 2019). However, studies which included homework within their intervention, however did not promote this as compulsory (e.g., Active Smarter Kids (ASK) intervention and AFLY5), showed no significant effects on executive functions affected by PA (e.g., cognitive flexibility), SB, or fruit and vegetable consumption (Aadland et al., 2019; Kipping et al., 2014). As such, both our qualitative and quantitative data indicate that future school-based interventions employing homework activities should work closely with school personnel to align the intervention with the curriculum and thus, promote such homework's as compulsory in order to achieve significant positive intervention effects.

The difference between the control and intervention group for sleep was negligible with the intervention group having longer durations of sleep than the control group. To the best of our knowledge, HH is the first school-based obesity prevention homework intervention which focusses on 24 h movement behaviours, including sleep. To this end, we cannot compare our findings regarding sleep with previous school-based obesity prevention homework intervention studies. Nonetheless, findings from a systematic literature review of interventions aiming to stimulate healthy sleep in school-aged children suggest that the lack of high quality studies in this field indicates that evidence for the effectiveness of any particular intervention strategy to stimulate healthy sleep in children remains inconclusive (Busch et al., 2017). Given the importance of sleep for health (i.e., activity and diet), future studies may wish to capture sleep data in order to strengthen the evidence surrounding the most effective strategy for improving this behaviour.

Similar to the findings reported in previous compulsory homework interventions aimed at improving health-related behaviours in children, we did not observe any meaningful intervention effects of HH on ST (Duncan et al., 2011, 2019). The AFLY5 intervention appeared to have a beneficial effect on ST (Kipping et al., 2008) and included one lesson about screen viewing entitled ‘Freeze my TV’ which involved analysing leisure time to identify ST and making a list of alternative activities. Currently, the CfE does not include a ST component and therefore, we would assume the children in our intervention did not receive a classroom lesson on ST. Furthermore, whilst we did not observe any significant intervention effects on fruit and vegetable consumption, effects have been observed in fruit and vegetable consumption in other compulsory health homework studies (Duncan et al., 2011, 2019). We believe that the intensity of the nutritional components within these studies were greater than HH, as children were encouraged to participate in one nutrition component each week. This may explain the lack of effect on children’s fruit and vegetable consumption in our study. Future studies interested in improving children’s fruit and vegetable consumption may need to incorporate more frequent and intense nutritional components.

Strengths and limitations

There are several strengths associated with this study, particularly in relation to it being randomised at school-level to avoid class contamination effects. Additionally, the development of HH should be highlighted as a key strength. HH was developed with headteachers, and underpinned by a theoretical model of behaviour change, was multicomponent in nature, involved schools, families and involved compulsory homework activities. In doing so, our intervention has proven to be appropriate in the recruitment and retainment of parents of the lowest 20% area-SES, would typically be classified as ‘less-involved’; an accomplishment in which many researchers struggle to achieve (Robinson, Adair, Coffey, Harris, & Burnside, 2016). Such methodological and theoretical decisions

have shown to be most effective in school-based health improvement interventions (Day et al., 2019). Indeed, recent research from Daly-Smith and colleagues (2020) using a multi-stakeholder experience-based design process to co-develop the ‘Creating Active Schools’ Framework presents a paradigm shift in order to guide experts of PA interventions to work ‘with’ schools, abandoning outdated and traditional approaches which simply implement such interventions ‘on’ schools (Daly-Smith et al., 2020). Whilst HH was feasible and acceptable for teachers to implement into the curriculum, teachers and pupils provided key recommendations to improve such acceptability for pupils and parents in future trials. Furthermore, in-depth, qualitative and quantitative data was collected across a number of outcomes from pupils, parents and teachers. Overall, HH satisfied children’s competence, relatedness and autonomy by providing choice in enjoyable and challenging tasks which brought families together, who typically didn’t engage in PA together prior to HH.

We applied novel accelerometry metrics and strict wear-time criteria for both ActiGraph and ActivPAL outcomes, aiming to capture the participant’s activity over a 24 h period to determine the preliminary effectiveness of the HH in improving PA and sleep behaviours. Limitations of this study include the small sample size, although it must be stated that this feasibility study was not intended to be adequately powered to make statistical inferences. Of the children who participated in this study, 28 (41%) met the wear-time criteria for ActiGraph devices ($n = 18$ intervention arm) whereas 49 (72%) met the wear-time criteria for activPAL4™ devices ($n = 28$ intervention arm) at baseline. Additionally, we did not obtain data from parents regarding their health outcomes. Furthermore, as we were not provided with fidelity information regarding completion of HH from one of our intervention classes, we were unable to adequately interpret the most completed weeks/activities.

Conclusion

In summary, HH activities were implemented into the curriculum successfully over the 8-week intervention period, and involved families of low SES with parents who would typically be categorised as ‘less-involved’. Acceptability decreased throughout the course of the intervention, with qualitative investigations providing recommendations to improve HH acceptability. This feasibility study provides detailed information and insight, particularly surrounding the barriers to implementing HH, and key recommendations to improve its future development. HH activities which targeted the 24 h movement behaviours whilst satisfying children’s basic needs during PA can result in improvements in stepping time, MVPA stepping time and time spent sitting. Few studies have implemented interventions in which homework activities play a significant role, yet such interventions may elevate pressure on schools. The implementation and exploration of such interventions aiming to improve children’s 24 h movement behaviours is warranted to evaluate their effectiveness and sustainability long-term.

Acknowledgements

This study was partly funded by The University of the West of Scotland VP Research Fund and NHS Lanarkshire. The authors would like to thank the children, parents and school staff who participated in this study.

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Figure 1. CONSORT flow diagram of the recruitment, adherence and analysis process of pupils.

Note. SIMD = Scottish Index of Multiple Deprivation; FIQ-E = Family Involvement Questionnaire-Elementary; BMI = body mass index; ST = screen time; DILQ = Day in the Life Questionnaire.

Table 1. HH provisional 8 week plan with curriculum underpinning.

Week	Activity	CfE Experiences and Outcomes
1	Yoga / Fruit & Vegetables	Cooperation and competition HWB 2-23a: While working and learning with others, I improve my range of skills, demonstrate tactics and achieve identified goals.
2	Fun Fitness/ Energy in foods	Evaluating and appreciating HWB 2-24a: By reflecting on my own and others' work and evaluating it against shared criteria, I can recognise improvement and achievement and use this to progress further Movement skills, competencies and concepts HWB 2-22a: I practise, consolidate and refine my skills to improve my performance. I am developing and sustaining my levels of fitness.
3	Dance / Soft Drinks	Physical activity and sport HWB 2-25a: I am experiencing enjoyment and achievement on a daily basis by taking part in different kinds of energetic physical activities of my choosing, including sport and opportunities for outdoor learning, available at my place of learning and in the wider community. Physical activity and sport HWB 2-26a: I have investigated the role of sport and the opportunities it may offer me. I am able to access opportunities for participation in sport and the development of my performance in my place of learning and beyond. Social wellbeing HWB 2-11a: I make full use of and value the opportunities I am given to improve and manage my learning and, in turn, I can help to encourage learning and confidence in others.
4	Walking / Snacks	Food and the consumer HWB 2-37a: I can understand how advertising and the media are used to influence consumers.
5	Games/ Sugar	Food and the consumer HWB 2-36a: By investigating food labelling systems, I can begin to understand how to use them to make healthy food choices. Physical activity and sport HWB 2-25a: I am experiencing enjoyment and achievement on a daily basis by taking part in different kinds of energetic physical activities of my choosing, including sport and opportunities for outdoor learning, available at my place of learning and in the wider community.
6	Competition/ Cooking & kitchen hygiene	Cooperation and competition HWB 2-23a: While working and learning with others, I improve my range of skills, demonstrate tactics and achieve identified goals.
7	Movement/ Food from around the world	Food and the consumer: HWB 2-34a: Through exploration and discussion, I can understand that food practices and preferences are influenced by factors such as food sources, finance, culture and religion.
8	All together now!	Physical activity and health HWB 2-27a: I can explain why I need to be active on a daily basis to maintain good health and try to achieve a good balance of sleep, rest and physical activity. Physical activity and health HWB 2-28a: I can explain the links between the energy I use while being physically active, the food I eat, and my HWB

Note. CfE = Curriculum for Excellence; HWB = health and wellbeing.

Table 2. HH provisional 8 week plan with theoretically underpinning.

Week	Activity	Monday	Wednesday	Friday
1	Yoga / Fruit & Vegetables HWB 2-23a	Theory: SDT – Autonomy and relatedness Goal: Provide parents and children with the opportunity to invent a short game together which allows them to stretch off (understanding the importance of this prior to activity) and pick Yoga poses to try. This session aims to intrinsically motivate the pupils by involving their parent, providing a game situation, and allowing them to choose poses.	Theory: SDT – Autonomy, relatedness and competence Goal: For parents a children to challenge themselves to execute the movement effectively, and possibly increase the intensity to a Yoga pose of their choice. This session aims to align with the pupil and parents integrated regulation by promoting participation in the activity at a time which fits into their daily routine/lifestyle.	Theory: SDT – Autonomy and relatedness Goal: Increase identified regulation in pupils and parents by providing them with the opportunity to learn about some of the benefits of participating in activities to reduce anxiety and help with sleep.
2	Fun Fitness/ Energy in foods HWB 2-24a HWB 2-22a	Theory: SDT – Autonomy Goal: Encourage children to participate in a fitness session by making it fun and relevant to what they are doing in class. This session aim to intrinsically motivate the pupils by encouraging them to pick out words and note them down and involving their parents. Through this we aimed to have the children and parents enjoy the tasks, and aim to relate them back to the EatWell Guide.	Theory: SDT – Autonomy, relatedness and competence Goal: This session aims to align with the pupil and parents integrated regulation by promoting participation in the activity at a time which fits into their daily routine/lifestyle – and encourages habitual activity by proving prompts to continue the activities on days which are not prescribed by the sessions and refer to the EatWell Guide for inspiration of healthy choices.	Theory: SDT – Autonomy, relatedness and competence Goal: This session continues with the themes of enjoyment. It incorporates aspects from session 1 and 2 this week, by furthering a competitive element and encouraging activity promotion over the weekend. Through encouraging enjoyment, these sessions ultimately aim to instil intrinsic motivation in both the parents and pupils to encourage habitual physical activity.
3	Dance / Soft Drinks HWB 2-25a HWB 2-26a HWB 2-11a	Theory: SDT – Autonomy Goal: This session aims to encourage integrated regulation in both the parents and children by providing them with information on the need for activity and healthy nutrition which can easily be instilled into their lifestyles following simple everyday steps.	Theory: Autonomy and relatedness. Goal: This session aims to offer the intervention a wider family context and allows children and parents to choose some dances they feel they may enjoy, promoting internal motivation.	Theory: Autonomy, relatedness and competence. Goal: This session encourages the family to work together to learn dances the parents will not be familiar with. This also allows the children to feel competent in their tasks.
4	Walking / Snacks HWB 2-37a	Theory: SDT – Relatedness Goal: The aim of this session was to focus on increasing identified regulation in pupils and parents by providing them with the opportunity to learn about some of the benefits walking and opting for healthier snack options as opposed to high-sugar snacks.	Theory: SDT – Autonomy Goal: This session aims to encourage integrated regulation in both the parents and children by providing them with options to increase their activity which can easily be instilled into their lifestyles following simple everyday steps.	Theory: SDT - Competence Goal: This session promotes internal regulation by not only highlighting the simple steps pupils can take to be more active, but also the simple steps families can take to make healthier choices overall.
5	Games/ Sugar HWB 2-36a HWB 2-25a	Theory: SDT – Relatedness Goal: The aim of this session is to encourage Identified regulation i in the pupils and parents by emphasizing the importance of splitting up sitting time and providing ways to do so.	Theory: SDT – Autonomy and competence Goal: This session focuses on the participant's intrinsic motivation by making a day-to-day tasks fun and a way to break up sitting time.	Theory: SDT – Autonomy and relatedness Goal: The aim of this sessions work on participants integrated regulation allowing them to see the values and need of unstructured daily activity and how they can integrating it into their lifestyle.
6	Competition/ Cooking & kitchen hygiene HWV 2-33a HWB 2-36a	Theory: SDT – Autonomy, competence and relatedness Goal: This session focuses on the participant's intrinsic motivation by splitting up sitting time or screen time with fun and exciting activities.	Theory: SDT – Relatedness and competence Goal: The aim of this session is to encourage identified regulation in the participants by emphasizing the importance of splitting up sitting time and providing ways to do so.	Theory: SDT – Autonomy, competence and relatedness Goal: The aim of this sessions work on participants integrated regulation allowing them to see the values and need of keeping active throughout the day and ways of encouraging the whole family/friends to do so also.
7	Movement/ Food from around the world HWB 2-34a	Theory: SDT – Autonomy and relatedness Goal: Focus on participants identified regulation by providing knowledge of the importance of the sleep and activity.	Theory: SDT – Autonomy, competence and relatedness Goal: This sessions aims to increase intrinsic motivation by uses games as a fun way to stay active and brings in fun aspects from week 1.	Theory: SDT – Autonomy, competence and relatedness Goal: The session continues working on the intrinsic motivation of parents to encourage more fun activity over the weekend and with as many people as possible.
8	All together now! HWB 2-27a HWB 2-28a	Theory: SDT – Autonomy and relatedness Goal: Increasing identified regulation by increasing individual's knowledge of the importance of the activity – especially when outdoors.	Theory: SDT – Competence and relatedness Goal: Increasing intrinsic motivation by incorporating fun aspects from Week 2 that they feel competent in.	Theory: SDT – Autonomy, competence and relatedness Goal: Zoning in on integrated regulation – seeing the values and need of the activity and integrating it into your lifestyle (trying to encourage this after the intervention itself ends).

Note. HWB = Health and wellbeing; SDT = Self-determination theory.

Table 7-3. Descriptive characteristics for anthropometric, ActiGraph, ActivPAL and questionnaire data of children' by arm group at baseline and post-measure.

Variable	<u>Intervention</u>		<u>Control</u>	
	Baseline Mean $\pm$ SD (n)	Post-Measure Mean $\pm$ SD (n)	Baseline Mean $\pm$ SD (n)	Post-Measure Mean $\pm$ SD (n)
Anthropometrics				
BMI (kg/m ²)	18.13 $\pm$ 3.80 (38)	18.17 $\pm$ 3.95 (36)	18.89 $\pm$ 3.02 (30)	18.78 $\pm$ 3.10 (27)
Stature (cm)	143.84 $\pm$ 9.47 (38)	145.74 $\pm$ 9.42 (36)	141.91 $\pm$ 6.25 (30)	142.73 $\pm$ 6.09 (27)
Mass (kg)	37.81 $\pm$ 10.05 (38)	38.89 $\pm$ 10.30 (36)	38.15 $\pm$ 7.59 (30)	38.48 $\pm$ 8.23 (27)
ActiGraph				
SED time (min.d ⁻¹)	1188.99 $\pm$ 35.77 (18)	1178.77 $\pm$ 44.14 (18)	1163.97 $\pm$ 47.57 (10)	1154.68 $\pm$ 57.99 (10)
AvAcc (mg)	41.04 $\pm$ 10.61 (18)	42.47 $\pm$ 13.34 (18)	44.19 $\pm$ 9.54(10)	43.35 $\pm$ 13.38 (10)
IG	-1.98 $\pm$ 0.13 (18)	-1.98 $\pm$ 0.16 (18)	-1.97 $\pm$ 0.13 (10)	-2.07 $\pm$ 0.14 (10)
MVPA (min.d ⁻¹)	130.96 $\pm$ 29.59 (18)	137.44 $\pm$ 35.73 (18)	147.31 $\pm$ 30.07 (10)	149.96 $\pm$ 48.13 (10)
M60 (mg)	196.79 $\pm$ 68.82 (18)	201.78 $\pm$ 89.12 (18)	205.55 $\pm$ 43.65 (10)	202.65 $\pm$ 69.27 (10)
M30 (mg)	324.74 $\pm$ 120.92 (18)	335.42 $\pm$ 150.97 (18)	337.61 $\pm$ 94.14 (10)	325.32 $\pm$ 142.21 (10)
M2 (mg)	1401.65 $\pm$ 412.21 (18)	1443.73 $\pm$ 484.86 (18)	1450.99 $\pm$ 361.25 (10)	1247.05 $\pm$ 455.29 (10)
ActivPAL				
Valid days	6.61 $\pm$ 0.50 (28)	7.91 $\pm$ 1.27 (22)	6.62 $\pm$ 2.09 (21)	7.36 $\pm$ 1.96 (11)
Waking time (hrs/day)	13.81 $\pm$ 0.82 (28)	13.95 $\pm$ 1.05 (22)	13.86 $\pm$ 0.91 (21)	13.98 $\pm$ 0.56 (11)
Sitting time (hrs/day)	9.08 $\pm$ 0.82 (28)	8.67 $\pm$ 1.05 (22)	8.68 $\pm$ 0.88(21)	8.59 $\pm$ 0.78 (11)
Standing time (hrs/day)	2.56 $\pm$ 0.55 (28)	2.79 $\pm$ 0.59 (22)	2.83 $\pm$ 0.65(21)	2.99 $\pm$ 0.70 (11)
Stepping time (hrs/day)	2.17 $\pm$ 0.46 (28)	2.49 $\pm$ 0.49 (22)	2.35 $\pm$ 0.60 (21)	2.40 $\pm$ 0.46 (11)
MVPA Stepping time (hrs/day)	1.11 $\pm$ 0.26 (28)	1.30 $\pm$ 0.30 (22)	1.16 $\pm$ 0.34 (21)	1.22 $\pm$ 0.26 (11)
Sit-to-stand transitions	86.82 $\pm$ 16.89 (28)	81.55 $\pm$ 13.76 (22)	86.57 $\pm$ 20.91 (21)	93.00 $\pm$ 13.89 (11)
Sit 0-30 mins (hrs/day)	5.74 $\pm$ 0.81 (28)	5.61 $\pm$ 0.55 (22)	5.83 $\pm$ 0.68 (21)	6.11 $\pm$ 0.51 (11)
Sit 30-60 mins (hrs/day)	2.08 $\pm$ 0.67(28)	1.83 $\pm$ 0.70 (22)	1.70 $\pm$ 0.49 (21)	1.63 $\pm$ 0.45 (11)
Sit 60 mins plus (hrs/day)	1.26 $\pm$ 0.68(28)	1.22 $\pm$ 0.60 (22)	1.14 $\pm$ 0.85 (21)	0.85 $\pm$ 0.53 (11)
Sleep Duration (hrs/day)	10.01 $\pm$ 0.67 (28)	10.03 $\pm$ 0.59 (20)	10.13 $\pm$ 0.77(20)	9.86 $\pm$ 0.43 (11)
Questionnaires				
Weekly Screen time (hrs.min)	38.19 $\pm$ 32.99 (36)	34.51 $\pm$ 20.36 (33)	28.26 $\pm$ 18.97 (29)	31.54 $\pm$ 17.48 (27)
Fruit and vegetable consumption	1.54 $\pm$ 1.46 (37)	1.50 $\pm$ 1.50 (34)	2.43 $\pm$ 3.63 (30)	1.30 $\pm$ 1.54 (27)

Note. BMI = Body Mass Index; SED = Sedentary; AvAcc = Average Acceleration; IG = Intensity Gradient; MVPA = Moderate-to-vigorous physical activity.

Table 7-4. Changes in outcome measures from baseline to post-intervention in the control and intervention groups.

Variable	Adjusted C-I Difference (95% CI)	Effect size Partial eta squared
Anthropometrics		
BMI-z score	0.02	0.004
ActiGraph		
SED time (min.d ⁻¹)	-11.62 (-50.74, 27.50)	0.02
AvAcc (mg)	-1.76 (-10.30, 6.77)	0.007
IG	-0.11 (-0.20, -0.02)	0.19
MVPA (min.d ⁻¹)	1.07 (-28.70, 30.85)	0.000
M60 (mg)	-8.13 (-52.85, 36.60)	0.006
M30 (mg)	-21.72 (-111.07, 87.62)	0.010
M2 (mg)	-236.06 (-530.60, 58.48)	0.10
ActivPAL		
Sitting time (hrs/day)	0.29 (-0.46, 1.03)	0.02
Standing time (hrs/day)	-0.07 (-0.47, 0.33)	0.004
Stepping time (hrs/day)	-0.38 (-0.63, -0.13)*	0.25
MVPA Stepping time (hrs/day)	-0.22 (-0.37, -0.07)*	0.24
Sit-to-stand transitions	10.76 (2.60, 18.91)	0.20
Sit 0-30 mins (hrs/day)	0.50 (0.09, 0.91)	0.17
Sit 30-60 mins (hrs/day)	-0.11 (-0.47, 0.26)**	0.01
Sit 60 mins plus (hrs/day)	-0.30 (-0.76, 0.16)	0.06
Sleep Duration (hrs/day)	-0.33 (-0.66, 0.00)**	0.13
Questionnaires		
Weekly Screen time (hr.min)	-1.21 (-11.27, 8.85)	0.001
Fruit and vegetable consumption	-0.54 (-1.19, 0.12)	0.04

Note. BMI = Body Mass Index; SED = Sedentary; AvAcc = Average Acceleration; IG = Intensity Gradient; MVPA = Moderate-to-vigorous physical activity.

* = SIMD as covariate; ** = baseline BMI z-score as covariate; bold indicates significance.

Table 7-5. Completion of HH activities based on teachers fidelity logbooks.

Weekly HH activities	Completion of weekly HH activities
	<i>n</i> (%)
Week 1 – Yoga	23 (58)
<i>Missing</i>	2 (5)
Week 2 – Fitness and nutrition	16 (40)
<i>Missing</i>	19 (48)
Week 3 – Dance and nutrition	16 (40)
<i>Missing</i>	19 (48)
Week 4 – Walking	11 (28)
<i>Missing</i>	19 (48)
Week 5 (Holiday week) – Games and colouring	11 (28)
<i>Missing</i>	19 (48)
Week 6 (Holiday week) – Games and colouring	11 (28)
<i>Missing</i>	19 (48)
Week 7 – Play	11 (28)
<i>Missing</i>	19 (48)
Week 8 – Games and nutrition	13 (33)
<i>Missing</i>	19 (48)

Note. Total no. of intervention pupils (*n* = 38)

Table 7-6. Teacher and pupils positive perceptions of Happy Homework

Theme	Subtheme	Example quote
Teacher perceptions		
Content	Useful and appropriate content	<i>I was really keen to take part because when I looked at what the sort of activities... I thought they well-matched the curriculum and the age and stage of the children so I thought they would enjoy doing it – Teacher 1</i>
	Activities well-matched to curriculum	
	Links HWB messages from school to home	<i>I quite like the idea of setting them active challenges or maybe trying to get them to be asleep by a certain time... So I quite liked that idea and its maybe something I took from it the most was that actually setting them challenges to do at home might be quite useful - Teacher 2</i>
	Challenges	
Preferred activities	Enjoyable for the children	<i>And the activities I thought were appropriate and enjoyable for the children - Teacher 1</i>
	Yoga	<i>I actually liked all of them for different reasons. I'd say the week 1 yoga, that ties into things I was saying before that I was trying to do about more mindfulness or maybe more relaxing... - Teacher 1</i>
	Dance	
	Walking	
Encouraging habitual activity	Workout week – spelling workout	<i>They really quite liked the colouring in and that seemed to be quite well done... well some of them weren't but you could tell most of them weren't rushed. So you could tell they maybe had a wee proper go at it instead of just rushing it - Teacher 2</i>
	Liked the idea of puzzles instead of work over the Easter Holiday period.	
	Hoped HH kept the children thinking of HWB whilst on Holiday	
	Completed well over the Easter Holiday period.	
Implementation	Could have been made optional for children who go on holiday over the Easter Holiday period	<i>They would bring that in the following Monday and when they brought that in they'd get their sticker and get the new one out so the actual implementing it and routine wasn't a bother we kinda worked that in with our usual homework and it was quite good just having that as my fourth task every week and the kids knew what was coming up Teacher 1.</i>
	Class got into routine	
	Teacher enjoyed implementation	
	Explained well for the children	
Teacher-pupil relationship	Homework was provided for the teacher	<i>Part of me was like great, that's homework I don't need to worry about. I didn't really, to be honest, didn't have a big opinion on it – Teacher 3</i>
	Making relationships stronger	<i>And to be able to have a chat with them on a Monday when I gave it out about what they were going to be doing and they were telling me 'well I've got dance club' or 'I'm doing this...' so I may be found out more about what they did outside of school [that] would've kept them active.... so, I was maybe finding more about how they stayed active outside of school which is a benefit and things they enjoyed doing - Teacher 1</i>
	Encouraging pupils to be more active	
		<i>I felt myself I probably made more of a point of trying to encourage the children to do it which is obviously a good thing to be encouraging them to be as active as possible so maybe bringing it into my mind more to encourage them to do it - Teacher 1</i>

Table 7-6. Teacher and pupils positive perceptions of Happy Homework (continued).

Pupil perceptions		
Activities	Well planned	No, it was quite well planned out. Like it was once every 2 days. So, you still had 2 days on the weekend if you weren't able to do it – Girl 7
	Amount of homework given	
	Preferred active homework tasks	I agree with everyone else the active ones make you more, want to go and be more active. The written ones, you're just sitting down writing... - Girl 8

Note. HH = Happy Homework; HWB = health and wellbeing.

Table 7-7. Negative perceptions and barriers teachers and pupils perceived regarding Happy Homework.

Theme	Subtheme	Example quote
Teacher perceptions		
General homework	Completion of general homework is not a priority to the school or teachers Unsure of the benefits of homework Completion of homework is dependent upon children's circumstances	
	Health and wellbeing homework isn't given the same importance as other curriculum areas.	<i>I probably don't think as much importance is put on HWB in terms of the homework and then parents who don't want a lot of homework aren't really bothered either way. So, no, I would say they put more importance on their traditional homework they would get like your spelling words, your maths... your calculations' - Teacher 1</i>
Completion of HH activities	Higher completion rates in early weeks	<i>Whereas before, prior to the break, I did feel, it wasn't 100% bringing it back, but I did think I got a lot back as to post-Easter time - Teacher 1</i>
	Novelty wore off	<i>I feel like the participation kinda tailed off. They were quite enthusiastic at the start but its similar with most things, they get used to it and the novelty wears off - Teacher 2</i>
	A lot of paper – environmentally friendly	<i>Initially I looked at them and thought it was a lot of paper. And with my wee eco-head on I thought oh my goodness that's a lot of paper - Teacher 3</i>
Barriers to completion of HH	Parent attitudes	<i>Yeah a couple [of parents] saying we couldn't get it done because were very busy or some of them, as I've said there are some who are super fit and super active. So... that kinda would've been a piece of cake to them and possibly their parents might be thinking they already do like 5 clubs a week we don't need to be looking at this - Teacher 3.</i>
	Clubs	<i>In this class, I do have a lot of children... go to the after-school clubs like the netball and the football. In fact, I have one girl who, on a Thursday night, goes to three different things so she's very busy. So, some of them, when I was coming back saying 'have you got it? Have you handed it in?' some of them were saying 'I was at this club this night and I couldn't do it, or..' - Teacher 1</i>
	Holidays Home-life	
HH was not age-appropriate	Games	<i>Em some of the games I think were maybe a wee bit young. Obviously you weren't meant to know that but they were maybe a bit young for the kids we had. The treasure hunt, I think a lot of them were a bit... some of them had done a treasure hunt in the school a week before, obviously again you weren't to know that - Teacher 2</i>
HH provided extra work	Extra work for teachers	
	Time consuming for parents	<i>I think it's quite time consuming for the parents as well because they're just looking to make their life easy... a lot of them are working full-time, you know both parents, so it's all about making it quite easy for them. - Teacher 2</i>

Table 7-7. Negative perceptions and barriers teachers and pupils perceived regarding Happy Homework (continued).

Theme	Subtheme	Example quote
Teacher perceptions		
HH Stickers	Clashing views (class-by-class basis) Enthusiastic initially	<i>Initially they seemed quite enthusiastic about the stickers but then it kinda tailed off. But then, maybe the aged range they're at, the stickers aren't the same novelty for them - Teacher 2</i>
	Not an enticement Collecting back in Happy Homework workbooks was time-consuming	<i>I found it, the handing out of them fine. Em, the collecting in of it was more of a challenge I felt because em, we were collecting it in at the end of the week, and then I was having to check through them all and put the stickers on. It's maybe my issues and I could've planned it better but, I wanted to be the one to check them in order to check if they had the stickers. I found that I was getting myself quite flustered at the end of the week and trying to tick off who had handed it in and who hadn't handed it in and then checking to see that they had done all the activities. Yeah I found that aspect quite time consuming. - Teacher 2</i>
Pupil perceptions		
Barriers	Lifestyle	<i>Cause some people would be like aw it's very good for my child because they don't do anything. So, I guess it's for like some people but not for others. Like some people might have like a really serious sport they do and they're training like every day of the week for like 4 hours or something so like when you come back it's like 'right I have to do it now' – Girl 6</i>
	Clubs Time-consuming Parent employment Celebrations	<i>It's just sometimes sports get in the way. So, it was a good amount but it's just like sometimes stuff gets in the way... - Girl 7</i> <i>I think it was due the happy homework, I had my auntie and uncles wedding because I had to go out and get stuff for it a lot – Girl 1</i>

Table 7-8. Pupils perceived Autonomy in Happy Homework

Theme	Sub-theme	Example quote
Options in Happy Homework	Days	<i>I don't know if this makes sense but one night I got in really late and I had to do Happy Homework and I was like to my mum 'I have to do it' and she was like 'don't do it just now' and I was like 'no I have to'. And when I thought about it more I thought I'd just leave it till tomorrow and my mum was fine with that... – Girl 1</i>
	Time	<i>I like the ones that provided you with an option because if there was one you didn't really want to do at the time they you could have like the option to do another one so then if you, then when you want to do the other one you can do the other one as well – Boy 6</i>
	Activities – choice	<i>I prefer the ones like options. Em, so you have like more options you don't just need to do that it gives you like more opportunity to do that... if you had one option and you didn't like it you have one option you have to do but you might not like it a lot or as much. But if you have 2 options then you've got that one option you can go to say I really like that, or I don't like that. So, if you do more than 2 options, maybe like 4 or 5 options, you could do, it would make... if you liked all of them you might decide 'aw I want to do all of them' so you might be more active that night if you've got, if you don't do as much sports you could be like aw ill just do this one. It might not be as much but its more active you could do all of them if you wanted to be more active – Girl 6</i>
	Activities – prescriptive	<i>I think in some of the activities there is a choice between some and then in others like, it will tell you to go do this or that, like it was a set activities for some of them you had to do which would be good in some ways. Like some of them would be really good but some would be like not challenging but like made you have to go out your way to do it, and not like quick... - Girl 6</i>
Pressure to complete Happy Homework	No pressure	
	Pressure from teacher	<i>When the teacher didn't get a lot in she got quite annoyed and we felt pressured to do it – Boy 1</i>
	Competing interests/activities	<i>After sport... like if you have a club on. If it's like late on like 7 or 8 your mum or dads like it's a school night get to bed. And you're like having to do it. So, if there's more options you could be like that one's going to be quicker I could do that one – Boy 7</i>

Table 7-9. Pupils perceived Competence in Happy Homework

Theme	Subtheme	Example quote
Capability	Capable	<i>Em, I felt quite capable. Like your mum and dad might say aw you done that wrong but you're kinda in a smaller group so I felt more capable – Girl 3</i>
	Balanced level of difficulty	<i>Yeah. I don't want to say it was easy. Sometimes it was challenging but sometimes it was easy... I found the written ones easy, like relatively easy, but the like most of the active ones like the em, the alphabet exercise like I have quite a, like 7 letters in my name so that's a lot of exercise – Boy 6</i>
Happy Homework challenges	Fun	<i>I mean it wasn't, it didn't have to be that challenging like cause you kinda wanna win. The plank one was quite, it was like a fun challenge if you know what I mean – Girl 6</i>
	Aimed at younger population	
Overcome Happy Homework challenges	Good idea	<i>Cause the one that was like the sugar one, like the teaspoon. At first we didn't really understand how much it was and what it was and sometimes some packets might not say like the certain amount on it. So, it's hard to like, it was like your favourite snacks to have, but some of your favourite snacks might not have it so it's good to see you're looking to see what ones are good for you. At first we didn't really get it but after you done it, after you thought about it and read the question more it was getting more clear – Girl 6</i>
	Competitiveness	
Sense of accomplishment	Determined to try my best	<i>I have like accomplished some skills that I wasn't able to do before like... – Girl 6</i>
	Proud	
	Special occasions	<i>I wasn't really calm before and I wasn't really into yoga. But now I've tried it I actually quite like it – Girl 3</i>
	Completed all 8 weeks	
	New skills	<i>That I had finished them. I missed one week because I wasn't in school I was away somewhere but obviously I couldn't hand it in but after the last week I just did that because I would've felt like I just left that one – Boy 6</i>
	Interest in new activities	
	Fun to complete compared to maths	
	Made sure went back to compete all activities	

Table 7-10. Pupils perceived Relatedness: physical activity participation and interactions during Happy Homework

Theme	Subtheme	Example quote
Participate in PA with most	Siblings Cousins	<i>Most of the time I'll just do it with... em, my cousins, and em, I don't go to any clubs anymore. I used to go to loads but now I don't – Girl 1</i>
	Pet	<i>This sounds really really strange, but em, my aunties dog... he loves to chase after his ball and he loves to have a race because he's really really fast because he's a cocker spaniel and its really fun because you'll just run with him and he will give you this wee grin when you run past and he's got the ball and he will look up at you – Girl 2</i>
	Friends Dad	<i>Eh my dad... he's quite active and he's the only person in my family that comes cycling or running... I'm not entirely sure [why]... probably because we can go a lot longer distance that if I was just with my friends – Boy 1</i>
	Mum	<i>My mum because usually she drags me out of bed to go a run... because usually my friends don't want to come out to play. They just video-chat me. They are more social – Girl 4</i>
Parent/family participant in Happy Homework	Mum (majority)	<i>Yeah... usually my mum would work from home but my dad doesn't work from home at all... [Inaudible] – Boy 3</i>
	Dad	<i>My mum helped me with the last couple but my dad did the yoga one but he couldn't do it and he fell flat on his face [laughing] – Girl 3</i>
	Siblings Gran Cousins	
Experience of family participation in Happy Homework	Seeing parents active	<i>It was good, it was the first time I've ever saw either of my parents do the plank... I liked doing it – Boy</i>
	Competitiveness	<i>With your parents it's making you more competitive to beat them. Em, and then it's like fun because you're having that time with them. So, it's fun to have more time doing stuff – Girl 6</i>
	Fun Sometimes not enough people to play games Took parent away from technology	<i>Yeah because my dad's always on his phone. He practically doesn't do anything with me so... he does the homework with me. Usually, daily he's on his phone and never really speaks to me. So, with the happy homework he actually does it with me and its better – Girl 4</i>
	Brought family together	<i>It was kinda like fun and happy cause like, my parents are like divorced and he came to do the homework with me because I asked him so I was kinda happy... yeah... happy because I like finally saw my mum and dad like together so like it was nice – Girl 4</i>

Table 7-11. Pupil perceived Relatedness: perceived level of support during Happy Homework and parent-child relationship after Happy Homework

Theme	Subtheme	Example quote
Supported/cared for	Encouraged to complete activities	<i>Yeah I felt supported. When they did have the time to come over and help me they were telling me like, say it was the plank one, they would tell me that I could do it and I was able to do it – Girl 8</i>
	Parent wanted to join in Usually hates homework – felt happy spending time with family	<i>Yeah, because like they support you on your homework. Usually I don't want to do homework but when I had to do that, when I was doing it with them, I felt happy... because usually I hate homework.... because I spent time with my family and stuff like that – Girl 4</i>
	Helping to complete activities Boost of confidence	<i>I remember like for a couple of weeks id just be doing it myself because my mum and dad had to work but then they had like time to do one with me so I wasn't by myself doing it. My mum and dad were doing it. So, it wasn't just me doing it this time. And they helped me do it... and then like when you're doing a plank and them supporting you yeah like that. It boosts your confidence – Boy 6</i>
Relationship after Happy Homework	The same	
	Spend more time together now	<i>We got closer... because we were spending more time together... my dad comes out the back with me to play football... yeah, because he used to say he didn't have any time – Boy 4</i>
	Participate in sports together now	<i>Em, yeah because when it was all done and stuff like that, they wanted to do more sports with me and stuff like that – Girl 4</i>
	Fall out over losing Get along better	<i>It makes you angry when you lose to your parents. It makes you fall out [laughing] – Boy 7</i> <i>Well me and my dad kinda get competitive with each other. So, if I won against him he would always want to have a re-match or something like that. But yeah in the end if he won he'd be happy. But like it kinda depends how it goes. Like if he wins he will be really happy but he won't let go of it. But then it would kinda improve after it because we became like... just like we kinda got along a wee bit better – Girl 7</i>

Table 7-12. Key recommendations to improve Happy Homework

Theme	Subtheme	Example quote
Teacher recommendations		
Every day approach – normal		<i>The only thing I can really think of is... trying to make it a bit more, as part of their normal day. Things they might be doing kinda anyway. Em, I know that would probably be really hard to think of things like that. But the walking one was a really good example of that because they would be building that into their day anyway. And if they weren't, they might not see it as too onerous to try and to try and do. - Teacher 1</i>
Streamline implementation	Signing in one place	<i>You had them signing it Monday, Wednesday, Friday. I get that, but maybe just one day for the parents to sign it like on a Thursday just to say this is when it's done... obviously, with health and wellbeing you're trying to get them to do it on a daily basis but even if that is the case they're still only getting it signed on the Thursday night - Teacher 3</i>
	Hand out once a week	<i>Em, based on what we do with homework, we would give it out once a week and it would be expected, say you hand it out on Monday and collect in on Friday. Because generally speaking the homework we do is out on Monday in on a Friday. Um, so with the wee kinda activities Monday, Wednesday, Friday, rather than on Friday morning like 'you need to sign, you need to sign' like, wee things... - Teacher 3</i>
	Holiday challenges instead of homework	<i>Even a challenge instead of actual homework. You know so, 'your challenge this holiday weekend is to...' and then a generic be active for 15 mins and get it signed off - Teacher 3</i>
Teachers	Research team could work more closely with classroom teachers on content planning	<i>The only thing I would say is it might be worth em, depending on what age range your targeting at, so maybe you could discuss with us, with teachers or whatever, think about the level of certain things so like the games and things like that. Upper school and lower school will be interested in completely different things. Em, so that's an option if it's going to be games they want to play, we could maybe have some ideas of the activities they could do - Teacher 2.</i>
	Rewards specific to school	<i>So yeah probably finding on a school-by-school basis what they're reward systems like and behaviour systems - Teacher 1</i>
Continue promoting it		<i>Gee-wiz... em... I don't know. Em... I think it is just constantly flogging at it. I don't know. I think nowadays everyone just accepts everything to be done for them. So how will you manage to get people to recognise they need to take responsibility for their own development and their own health and wellbeing? Rather than it being something that is handed out to them. But I think you're kinda battling against the tide with it - Teacher 3</i>
Incorporate equipment		<i>I know that in P6 we do 'bikeability' so I don't know if anything involving bikes but then you have the whole equity thing if not everyone has a bike so there's issues like that - Teacher 1</i>
Pupil recommendations		
Increase autonomy support	Some activities – go out and play (less structured)	
	Any days (less structured)	<i>I just feel like if we didn't have days when we had to do it, em, it would be a little bit better – Girl 1</i>
	More options – activities	<i>After sport... like if you have a club on. If it's like late on like 7 or 8 your mum or dads like it's a school night get to bed. And you're like having to do it. So, if there's more options you could be like that one's going to be quicker I could do that one – Boy 7</i>
Increase autonomy in ways to completion Happy Homework activities	Ways to prove you have completed the activities	<i>I think we should have to like do something to show that we've done it. I know that like, I only got my mum to sign it once I done it but some people just go their mum to sign it so oh yeah I've done it... yeah to make people want to do it because they're so to their electronics or like if they've got a phone you could say like call a friend or text a friend to go out and play for 15 minutes. So, say you called, say I called Anna, you could write like who did you go out with, who did you call, and then at school the next day, when you've told to prove you could ask Anna, did Zara actually call you – Girl 7</i>
	Digitally (computer-based)	

Figure 7-2. Write and draw data.

Supplementary files

Supplementary File A

Interview guide for qualitative data collection with teachers.

Just to re-introduce myself, I am Samantha and I am a PhD Student from the University of the West of Scotland. I am talking with you today to discuss the Happy Homework intervention in detail and gain feedback on this intervention. This intervention is in its early stages; therefore, I encourage you to be as honest as possible as the feedback you provide us with in this interview will allow us to improve upon the intervention and highlight any positive areas of the intervention. To make you aware, this interview will be recorded for the purposes of our study, which will allow us to have the interview transcribed and then analysed as part of a PhD study which we hope to have published as a journal article and add to research on school-based interventions. Anything you say today will remain confidential with the research team and your identity will remain anonymous. We expect the interview to last around 30 minutes. Please feel free to skip any questions should you not want to answer any. You can also end the interview at any point. If you are ready, let's get started.

So, can you tell me a little about yourself and the class you teach?

Tell me about your teaching of health and wellbeing?

Previous to the Happy Homework activities, what if any homework did you hand out to your class for health and wellbeing?

Can you tell me a little about the completion rates of these homework's?

What was your initial thoughts regarding the Happy Homework activities?

How did you find implementing the Happy Homework activities?

Were there any weeks you preferred over others? (Will provide list of weeks)

Can you tell me what you thought of the Easter activities?

What, if anything, were some positives you took from the Happy Homework activities?

What, if anything, were some negatives you took from the Happy Homework activities?

Whilst we have collected completion information of the activities, overall as a class, how would you describe the completion of the activities?

If anything, what feedback did you receive from the pupils?

If anything, what feedback did you receive from parents?

Could you provide us with some feedback regarding the happy face stickers to encourage the pupils to complete the activities?

If we asked you to provide us with some key recommendations to improve the Happy Homework activities, what comes to mind?

Is there anything you feel you would like to add that we have not covered regarding the Happy Homework activities?

Ok, if you're happy we will end the interview here. Thank you again for your participation in this study. Please feel free to contact me if you have any questions or anything else you'd like to add at a later date. We will be in contact with you at a later date with an overview of the interview in which you can review to assure your perceptions were captured. I'll stop the recording now, thank you again.

Supplementary File B

Interview guide for qualitative data collection with pupils.

Write, Draw, Show and Tell Group. School: _____ Date: _____

Setting:

Area where children can be seen but not overheard

Circular seating arrangement with researcher sat with children

Researcher and children address each other by first name

Introduction:

“Hi everyone! I would first of all like to thank you for being here and I hope we can make this session as fun as possible. For anyone who doesn’t know, my name is Samantha and I am a scientist from the University of the West of Scotland.”

Assent: Verbal explanation of research purpose, processes involved and data uses:

“We are here today to talk to you about physical activity and learn a little bit about your experiences of being physically active. We will collect information here today and we will then put this information together with other boys and girls experiences from other schools. This will then provide my team at the university with a good understanding of boys and girls experiences of physical activity and this will then be written up into different types of reports.”

Verbal explanation of structure and context of WDST group:

“So, in this group, we will start off by introducing ourselves to get familiar with each other. Once we do this, I will ask everyone to write down ‘5 words to best describe physical activity to someone else.’ You will also be asked to draw an environment where you were most likely to participate in physical activity. After this, we will all have a conversation about our experiences of physical activity. Is everyone here happy to take part? Just to double check, if anyone here does not want to participate you can say now.”

Obtain verbal child assent: ☐ (tick if provided)

Show:

Interactive ice breaker activity

“Let’s go around the table and say your name and your favourite topic to learn about in class. Before we do this, it is very important that we make sure we listen to everyone and be respectful when other people are talking. So, let’s get started...”

Write and Draw:

Provide children with post-it note paper and a pencil and ask them to:

“Write down 5 words to best describe physical activity to someone else.”

Ask the children to provide a verbal explanation of the meaning being their written responses then have the children place these on a board in front of them and discuss the responses as a group.

Invite the children to independently draw an environment where they were most likely to participate in physical activity.

Throughout this activity, separately engage children in informal conversation for them to articulate what there are drawing and why (e.g., 'and what about you Joe? Can you tell me what's going on in your picture?')

Tell: Person-centred (encourage child to talk about themselves).

Challenging open-ended questioning surrounding the children's experiences of physical activity (Autonomous or controlled), providing children with various opportunities to speak about individual PA interests and experiences.

Need-supportive versus controlling contexts (3 basic psychological needs):

Relatedness

Over the past week, what sorts of physical activities have you done outside of school?

Can you tell me where you did the activity and who it was with?

Can you tell me who you like to participate in physical activities with most?

Why do you like to participate in physical activities with this group more than others?

What sorts of things do your parents or carers do, if anything, which encourages you be more active?

Did your parents/carers participate in the Happy Homework activities with you?

If so, tell me about your experience of participating in the Happy Homework Activities with your parents/cares?

- *Supported by parents/carers when participating in the Happy Homework Activities?*
- *Cared for by parents/carers participating in the Happy Homework Activities?*

How would you describe your relationship with you parents/carers after participating in the Happy Homework Activities together?

Autonomy/choice

Can you tell me a little bit about whether or not you got any opportunities to make choices in the activities you carried out for the Happy Homework Activities?

Was there times when you felt you didn't have options in the Happy Homework activities you completed?

Was there times when you felt pressure to complete the Happy Homework Activities?

Competence

Can you tell me about your experience of participating in the Happy Homework activities?

How capable did you feel you were when performing the Happy Homework activities?

Did you find anything challenging in the Happy Homework Activities?

Were you able to overcome challenges in the Happy Homework Activities over time?

Once you completed the Happy Homework weeks, did anyone feel a sense of accomplishment?

Before we finish, does anyone have anything they would like to add to our conversation about the Happy Homework activities or about being active in general?

Thank you for participating in our discussion today! You can all head back into class now.