Expert Working Group Working Paper

Under 5s

UK physical activity guidelines: Draft review and recommendations for the Under 5s

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Background

UK physical activity guidelines

The first UK physical activity guidelines were produced in 1996 following the 1994 Ascot Meeting of UK and international experts, who agreed recommendations for adults (1, 2). These recommendations were then extended to include new recommendations for children and young people in 1998 (3). These recommendations suggested the frequency, intensity and time of aerobic physical activity needed for each age group but also included the first recommendation, for children and young people only, for muscle strengthening, flexibility and bone health. In 2004 the English Chief Medical Officer formally endorsed these recommendations and thus began a continuing relationship with their production and dissemination that has continued to today. At the same time Scotland and Wales had adopted similar guidelines and following the publication of the 2008 USA physical activity guidelines (4), the UK CMOs harmonised and produced the current physical activity guidelines, published in 2011 (5). These included, for the first time, recommendations for Under 5s and for sedentary behaviour across all age groups (6).

Development of the evidence base for Under 5s and physical activity

There is a much larger body of evidence on the Under 5s than was available to inform 'Start Active, Stay Active' in 2011, e.g. new evidence on the benefits of physical activity ('tummy time') in infants, and the benefits of moderate-to-vigorous intensity physical activity (MVPA) in pre-schoolers. There is also a substantial amount of new evidence on the impact on health and development of sedentary behaviours (e.g. screen time, though mostly from studies of TV and DVD viewing) and time spent asleep. Moreover, this evidence has been reviewed systematically and appraised critically using the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) methodological approach in 2018[1]. The review and appraisal work was made available to the UK Under 5s Expert Working Group (EWG), permitting much better informed guidelines for the Under 5s in the UK, and facilitating international harmonisation of guidelines. UK 2018/19 guidelines can be harmonised with Canada 2017 (7); Australia 2017 (8); S. Africa 2018 and WHO 2017-2018 (guideline development processes ongoing) (9).

In addition to the new evidence referred to above, since Start Active Stay Active was published there has been a substantial shift in the way physical activity is understood – we now see it as one of an inter-dependent set of '24-hour movement behaviours' (physical activity; sedentary behaviour, including screen time; sleep; standing; (7-9)). The UK Under 5s draft recommendations were therefore developed with a '24-hour movement behaviour 'approach. Two principles underpinned the work of the Under 5s EWG. First, and in common with the other EWGs, the UK guideline update for the Under 5s was based on the best (most recent, relevant, evidence-based) existing guideline internationally. Since the best available

[1] We acknowledge the help of the WHO, both for funding an updated literature review and appraisal using GRADE methodology in February 2018, and for agreeing to share the literature search results with the Under 5s EWG.

international guidance for the Under 5s took a 24-Hour Movement Guideline approach (7, 8), that was the starting point for the UK guideline update for the Under 5s. Second, and also in common with the other EWGs, a default position was agreed (supported by a consultation summarised below) that the UK draft recommendations should be as consistent as possible with the best available international guidance, departing from it only where there was new evidence and/or compelling argument for doing so (7, 8).

Physical activity, and the other 24 -hour movement behaviours, in the Under 5s should not be seen in isolation from the behaviours in older age groups: there is a more substantial evidence base on the benefits of adequate physical activity and sleep, and risks of some sedentary behaviours in school-age children and adolescents (10-12). Levels of these behaviours in the pre-school period are closely related to later levels in school-age children, and sedentary behaviour increases from the age of school entry which displaces physical activity and/or sleep (13-16). This contextual evidence complemented the evidence on the health and developmental impact of the 24-hour movement behaviours and helped inform the draft recommendations.

The key aim/objective of this working paper is to present potential recommendations for any changes to the existing 2011 UK Chief Medical Officer Physical Activity Guidelines. This working paper presents the findings of each EWG in relation to their area. The document answers a set of questions about potential changes to current physical activity guidelines, by expert scrutiny of the most up to date scientific evidence, and other national guidelines.

Outline of CMO Process

This work was conducted in three phases (summarised in Figure 1). Phase One has seen the construction of each EWG, selection of international experts, formal purposive systematic reviews of the existing and new evidence, a website for a national consultation on the current UK CMO Guidelines and their implementation, and production of working group papers. All Chairs and Expert Panel members will complete a statement of their declarations of interest.

In Phase Two, draft working papers were developed (this being one of the six papers). The draft papers were circulated to participants attending two Scientific Consensus Meetings (SCM) in Edinburgh and London, during June and July of 2018, respectively. This document has been revised in two ways: i) to reflect the feedback received from both consensus meetings; ii) in response to the updated evidence base.

Phase Three will include a second national consultation on the draft physical activity recommendations, and a final round of review and revision. EWGs will then produce a final technical report for the UK CMOs with final recommendations for new physical activity guidelines. If the CMOs sign off the suggested recommendations, then the CMO Guidelines Writing Group will support the production of a final CMO Physical Activity Guidelines Report.

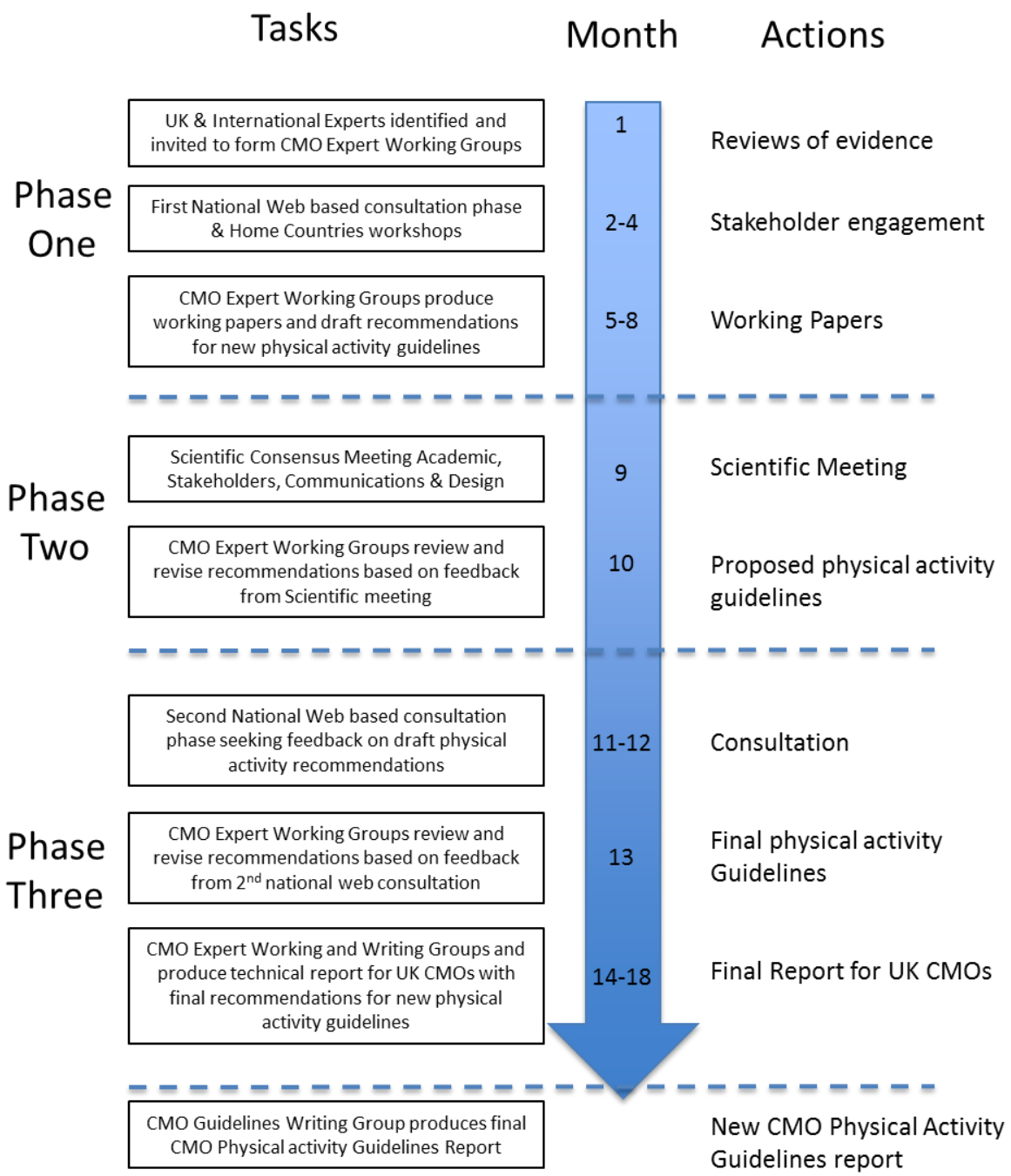

Figure 1. UK Physical activity guidelines review process

Methods for CMO Physical Activity Guidelines Update

The process to update the 2011 CMO physical activity guidelines draws upon three types of evidence: (A) recent published evidence reviews used to construct or update international physical activity guidelines; (B) the most recent pooled analyses, meta-analyses and systematic reviews from prospective and RCT research published since the most recent reviews used to update international guidelines; and (C) any additional relevant papers identified by each EWG. In addition, comments and suggestions about the current 2011 CMO Physical Activity recommendations were identified for each EWG from our first round of National Consultation.

Extensive guideline development work for 24-hour movement behaviours for the Under 5s has occurred internationally over the past 24 months (7-9). In order to develop draft recommendations for the 24-hour movement behaviours for the UK, the Under 5s EWG used the GRADE-ADOLOPMENT (adoption and/or adaptation of an existing guideline, plus *de novo* development) approach (8, 17). This approach has been used to adopt/adapt the 2017 Canadian Society for Exercise Physiology 24-Hour Movement Guidelines for the Early Years (0-4 years) to produce guidelines for Australia in 2017 (8), and is currently being used to produce international (WHO) guidelines, and guidelines for South Africa (9).

The Under 5s EWG used the Canadian Society for Exercise Physiology 24-Hour Movement Guideline for the Early Years (0-4 years) (7) as the basis of the UK draft recommendations. The Canadian guidelines were chosen because (in contrast to other candidate guidelines): they met a number of essential/desirable criteria (8, 17): recently published**;** followed GRADE methodology; addressed clear questions; had an assessment of benefit/harms; had been assessed using the International Approach to Guidelines, Research, and Evaluation (AGREE) (18); could be updated; had risk of bias assessment; took a 24 –hour movement behaviour approach and provided access to evidence tables/summaries for consideration by the UK Under 5s EWG. The results of the literature searches (Summary of Findings and GRADE tables) were made available by the Canadian Society for Exercise Physiology and the Australian Guideline Development Group in 2017. It was desirable to update and extend these searches for the UK process which took place in 2018: the 'WHO Guidelines Development Group for integrated 24-hour movement in young children: physical activity, sedentary behaviour and sleep time in children under 5 years of age' kindly shared the results of their updated literature searches with the UK EWG in 2018. The EWG draft recommendations are based on the updated and extended evidence synthesis where possible.

The detailed process of adoption/adaptation of the Canadian guideline to produce draft recommendations for the Under 5s in the UK will be described elsewhere, but a brief summary is provided here. The Under 5s EWG considered evidence for 3 distinct populations: infants (up to age 1 year); toddlers (age 1-2 years); pre-schoolers (age 3-4 years). A large number of exposures were considered, under the general headings of physical activity, sedentary behaviour, and sleep duration. We included the following outcomes: adiposity, motor development, emotional-behavioural regulation; psychosocial health (e.g. wellbeing, quality of life), cognitive development, cardiovascular and musculoskeletal fitness, harms (i.e. injuries), skeletal health, cardiometabolic health; growth, physical activity/TV viewing (outcomes with sleep as the exposure variable).

A new review and evidence synthesis was undertaken by a sub-group of the Under 5s EWG- the aim of this work was to examine the possibility of making a new draft recommendation (not in the 2017 Canadian or Australian guidelines) in relation to the impact of physical activity and sedentary behaviour on sleep outcomes (e.g. sleep duration, delayed onset of sleep, and sleep disruption).This new review and synthesis therefore considered physical activity and sedentary behaviour as exposures and sleep variables as outcomes.

Key questions & suggestions from end 2017 national consultation

There were eight specific questions that the EWG members were asked to consider in relation to Under 5s. These questions arose from a combination of the first national consultation at the end of 2017, and questions carried forward from the previous update of the UK guidelines in 2011. For each of these questions, a summary statement of the expert response and a commentary of the evidence that underpinned that response is outlined below.

Question 1: Does the scientific evidence continue to support the current PA guidelines for the Under 5s / Early Years population?

Commentary 1: There was partial support for the 2011 physical activity guideline for the early years, but new evidence suggested updating was required, as well as an extension of the guidelines beyond physical activity into sedentary behaviour and sleep behaviour. As summarised on p.2 and Appendix 1a-1c the new recommendations take a '24-hour movement behaviour' approach, in common with guidelines for the Under 5s from Canada and Australia in 2017 and South Africa and WHO in 2018.

Question 2: Based on the current evidence what, if any, modifications to the current physical activity guidelines should be considered? In particular, please make recommendations on any modifications to the stated characteristics of how physical activity can be undertaken and accumulated for optimal prevention of chronic disease?

Commentary 2: See p2 above- and Appendix 1a-1c. The evidence (and recent international guidelines) now provides a compelling case for updating the 2011 UK guideline, and for extending it beyond physical activity to include 24-Hour Movement Behaviours (physical activity, sedentary behaviour and sleep).

Question 3: Should fundamental movement skills (FMS) be stressed as well as physical activity?

Commentary 3: Associations between the 24-hour movement behaviours and FMS have been captured in the searches (motor development was a critical outcome in searches). If there is a good deal of interest in FMS from stakeholders then it may be worth emphasising FMS as an outcome in 'messaging' of the final UK guideline.

Question 4: Please comment specifically on the available evidence related to the accumulation of physical activity in multiple short periods. Please comment on i) whether this is relevant for the optimal health message and ii) whether it is or is not appropriate for any specific health conditions.

Commentary 4: The issue of the accumulation of physical activity in bouts versus longer periods of sustained movement is much less relevant for the Under 5s than the other age groups since in the Under 5's physical activity tends to be accumulated in short bouts.

Question 5: Is there sufficient evidence to review the positive and negative effects of sleep and screen time among Under 5s? Based on current evidence what, if any modifications to current sedentary guidelines should be considered?

Commentary 5: Yes. Sleep and sedentary behaviour should be incorporated into the updated UK recommendations for several reasons: the new paradigm of '24-hour movement behaviours' recognises that these movement behaviours are inter-dependent (9); there is demand to include these behaviours as evidenced by the first national consultation responses; inclusion of all of the movement behaviours also facilitates harmonisation of UK guidelines with other recent national and international guidelines for the early years (9).

Question 6: What are the combinations of physical activity in terms of types, intensity, frequency and duration that contributes towards achieving a recommended level?

Commentary 6: The evidence available did not refute the current recommendations on total volume of physical activity, but did permit new guidance on the type and duration of physical activity in infants (tummy time) and on moderate-to-vigorous-intensity physical activity (MVPA) for pre-schoolers.

Question 7: Is there sufficient evidence / knowledge of the risks associated with physical activity to inform an analysis of the risks versus benefits of the physical activity guidelines?

Commentary 7: There was a lack of evidence on the risks (harms such as injuries) of meeting the draft recommendations, but the EWG felt that doing so should be low risk and that the benefits outweighed the risk substantially. The EWG draft recommendations were made with potential harms in mind, and the EWG noted that there were short-term and long-term risks associated with not complying with the recommendations.

Question 8: If the evidence points to a revision of the current guidelines, are the advantages of making such a change likely to outweigh the disadvantages (for example confusion amongst practitioners still relatively unfamiliar with the 2011 Guidelines)?

Commentary 8: The EWG considered that evidence from Canada and Australia on the high degree of stakeholder acceptability of 24-hour movement guidelines for this age group (19, 20) suggest that there should be a relatively smooth transition from the current physical activity guideline to new 24-hour movement guidelines for the UK.

Question 9: What are the data limitations and implications for surveillance for this age group?

Commentary 9: Surveillance of the 24-hour movement behaviours in the UK is currently very limited. Very recent evidence from Australia and Canada (21-23) suggests that compliance with 24-hour movement recommendations is low among the Under 5s, and this is likely to be the case in the UK too. The publication of the WHO 24-hour movement guideline for the Under 5s in 2018, and the recommendations on monitoring these behaviours in the WHO Ending Childhood Obesity (ECHO) Report 2016 and ECHO Implementation Report 2017 (24,

25) should help provide momentum for new and improved surveillance of the 24-hour movement behaviours in the Under 5s in the UK which is based on objective measurements, using the best methods available in surveillance internationally.

Comments regarding the additional suggestions from the first national consultation are as follows. Standard Text= The suggestions from the national consultation. **Bold text summarises the response of the Under 5s EWG**

- There was support for the distinctions by age group (infants, toddlers, pre-schoolers), as in the Canadian & Australian guidelines. **Accepted for the new guidelines, and used in the Canadian/Australian/S. African and WHO guidelines.**

- There was support for an integrated guideline (i.e. one which would go beyond physical activity to incorporate sedentary behaviour and sleep). **Accepted, also see point 5 above.**

- Many stakeholder suggestions were about messaging so beyond our remit, but Under 5s **EWG recommends that these helpful suggestions provided in the first stage of national consultation are passed to those responsible for messaging in stage 3 of the guideline development process**.

- There was support for a 'methodology publication' explaining the process by which the new guidelines was produced (e.g. *support for a manuscript).* **The Under 5s EWG intends to write a manuscript for publication which would deal with this. Further detail will also be provided later in the process (e.g. accessible via the project website)**

- Harmonisation with other countries was considered important. **This was also considered important by the EWG and reflected in the draft recommendations. As noted above the work of the EWG was informed by guidelines published in 2017 from Canada and Australia, and by the ongoing work in the WHO and S Africa. The EWG had representation from Australia (external expert Prof Okely) and S. Africa (Dr Draper) and is represented in the ongoing guideline development processes (WHO and S. Africa).**

- Some respondents felt that increased PA in the early years would have co-benefits (e.g. environmental benefits, social benefits of being more physically active) which should be stressed. **Co-benefits (e.g. environmental benefits of more active lifestyles) are important, but beyond our remit in the EWG. The EWG recommends that such benefits could be mentioned in messaging /as contextual info in the UK guidelines. A number of other outcomes which might be regarded by some as 'co-benefits' or less obvious benefits are already captured by the Under 5s EWG given our fairly comprehensive list of search outcomes summarised in the Methodology section above (e.g. which encompassed outcomes such as psychosocial health and well-being, and social and emotional development).**

Limitations of findings

Main limitations of the process:

- The EWG has followed the 'GRADE-ADOLOPMENT' process (8, 17) but a number of important steps in this process were beyond the remit of the EWG. The EWG recommends that these steps should be considered at future stages of guideline development in the UK, as follows: **Consideration of the cost of implementation and feasibility of implementation; assessment of health inequalities of the guideline; stakeholder acceptance of the guideline.**

- More time and resource for the process would have permitted a more detailed and in-depth evaluation of the evidence in certain areas e.g. a quantitative analysis of the basis of the recommendations for total physical activity and MVPA.

Main limitations of the *evidence base* (see also research recommendations below)

- Recommending precise amounts of the 24-hour movement behaviours was problematic in some cases because of gaps and limitations in the evidence. Precise amounts/durations were recommended where possible, but, expert opinion and other factors influenced these where appropriate (e.g. consistency with previous UK and international guidelines; need for a time-specific guideline so that surveillance can take place; putting the behaviours on the public health agenda for obesity and NCD prevention as recommended by WHO (25, 26); the need to provide a foundation for future guidelines).

- One component of the 24-hour day not measured/recognised by recent studies is standing. Standing is neither physical activity (movement) nor sedentary behaviour, though a recent consensus process suggested that it should be considered as physical activity (27). Young children may spend several hours per day standing. Since standing is unmeasured it does not appear in the literature and standing may be being misclassified in studies as sedentary behaviour and/or physical activity. This misclassification may be obscuring associations with health outcomes, and producing biases in estimates of the levels of these behaviours.

- There is a need for more evidence on the health and developmental impact of contemporary screen technology. The evidence for the current draft recommendations was largely from studies of time spent viewing TV and DVDs. More modern screen-based technology can be interactive (involving social engagement e.g. with family members) and is potentially less harmful than the kinds of sedentary behaviour used to inform the draft recommendations. There is also a need for an evidence synthesis on the health and developmental influences of the content of what is viewed on screen, and the extent to which children are actually sedentary during screen time.

Draft recommendations August 2018 update

Infants (less than 1 year) For infants, a healthy 24 hours includes:

- Being physically active several times in a variety of ways, including interactive floor-based activity *e.g. crawling. For infants not yet mobile, this includes at least 30 minutes of tummy time*[Footnote1] *spread throughout the day while awake (and other movements such as reaching and grasping, pushing and pulling themselves independently, or rolling over)*; more is better.
- Minimising the amount of time restrained (e.g. in a pram or high chair). Screen time is not recommended. When sedentary, engaging in pursuits such as reading and storytelling with a caregiver is encouraged.
- 14 to 17 hours (for those aged 0-3 months) or 12 to 15 hours (for those aged 4-11 months) of sleep, including naps.

Toddlers (1-2 years) For toddlers, a healthy 24 hours includes:

- At least 180 minutes spent in a variety of physical activities at any intensity, including active and outdoor play, spread throughout the day—more is better.
- Not being restrained (e.g., in a pram, buggy, or high chair) or sitting for extended periods. Sedentary screen time should be no more than 1 hour; less is better[Footnote2]. When sedentary, engaging in pursuits such as reading and storytelling with a caregiver is encouraged.
- 11 to 14 hours of good-quality sleep[Footnote3], including naps, with consistent bedtimes and wake-up times, avoiding use of screens for at least one hour before bed-time.

Pre-schoolers (3-4 years) For pre-schoolers, a healthy 24 hours includes:

- At least 180 minutes spent in a variety of physical activities spread throughout the day, including active and outdoor play,—more is better; the 180 minutes should include at least 60 minutes of moderate-vigorous intensity physical activity (MVPA).
- Not being restrained (e.g. in a buggy or car seat) or sitting for extended periods. Sedentary screen time should be no more than 1 hour; less is better[Footnote2]. When sedentary, engaging in pursuits such as reading and storytelling with a caregiver is encouraged.
- 10 to 13 hours of good-quality sleep[Footonote3], which may include a nap, with consistent bedtimes and wake-up times, avoiding use of screens for at least one hour before bed-time.

Footnote 1. Tummy time may be unfamiliar to babies at first, but can be increased gradually-starting from a minute or two at a time-as the baby becomes used to it. Babies should not sleep on their tummies.

Footnote 2 The historical evidence on screen time was largely from studies of the duration of screen time exposure to TV and DVD screens. These studies tend not to measure the type of content, nor the nature of the child's engagement with it. While it is generally assumed

that the child is sedentary during screen time, some research suggests this is not always the case. There was a lack of evidence on the health and developmental impact of more recent screen-based technology, especially that which involves or requires interaction with other individuals (e.g. family members). The Expert Working Group felt that accompanied/interactive screen-time had less potential for harm and greater potential for benefit than solitary or sedentary screen time

Footnote 3 Good quality sleep is not excessively restless or broken by long periods of wake. Note children normally have brief wakings during the night but learn to settle themselves back to sleep within a few minutes.

Table 1. Summary of Evidence Quality, Quantity, and Generalisability Under 5s EWG[2]

Behaviour	**Type of Evidence**	**Generalisability & Directions of Associations with Outcomes**	**Comments on Evidence**
Physical Activity (PA)	**Experimental/quasi experimental studies**: 14 RCT (n 4,199) 3 cross-over trials (n 182) 11 non randomised controlled trials (n 1,654) **Observational studies**: 9 case control (n 2,404) 16 longitudinal (n 18,354) 63 cross-sectional (n 77,452)	High generalisability to UK-evidence largely from high-income western countries **More PA is associated with improved**: **adiposity** (infants); **motor development** (infants, toddlers, pre-schoolers); **cognitive development** (infants, pre-schoolers); **fitness** (pre- schoolers); **bone/skeletal health** (pre-schoolers); **cardiometabolic health** (pre-schoolers).	Evidence for specific amounts/types of PA not clear /conclusive for all populations, but clear that 'more is better'. New evidence for benefits of higher intensity (MVPA) in pre-schoolers, and 'dose' of tummy-time in infants, and active/outdoor play.
Sedentary Behaviour (SB)	**Experimental/quasi experimental studies**: 2 RCT (n 482)	High generalisability to UK-as noted above for PA.	Most of the evidence is on screen time

[2] More detailed summary evidence tables will be available by the time of the scientific consensus meetings

	Observational studies: 7 case-control (n 2,374) 34 longitudinal (n 78,100) 79 cross-sectional (n 167,946)	**More SB is associated with: higher adiposity** (infants, toddlers, pre-schoolers); poorer **motor development** (toddlers), poorer **cognitive development** (infants, toddlers, pre-schoolers); poorer **psychosocial health** (pre-schoolers).	(duration), mainly TV/DVD viewing. Evidence for specific amounts inconclusive, but clear that 'less is better'.
Sleep	**Experimental/quasi-experimental studies**: 2 RCT/controlled trials (n 67) 3 cross-over trials (n 45) **Observational studies** 3 case-control (n 810); 27 longitudinal (n 98,340); 48 cross-sectional (n 90,834)	High generalisability to UK-as noted above for PA. **Shorter sleep duration is associated with: higher adiposity** (pre-schoolers); **poorer emotional regulation** (infants, toddlers, pre-schoolers**); poorer cognitive development** (pre-schoolers).	Increased sleep duration within a currently recommended range seems to have little evidence of harm. Evidence largely on duration of sleep rather than related behaviours (e.g. sleep environment and routine). Evidence for specific amounts inconclusive

Table 2. Summary of Evidence – Sleep Systematic Reviews (UK Under 5s EWG)

Exposure	Type of Evidence	Associations with Sleep Outcomes	Comments
Outdoor play time	**Observational studies** 1 longitudinal (n 369) 1 cross-sectional (n 497)	**More play associated with longer sleep duration** (pre-schoolers), **earlier bedtime** (pre-schoolers), **less night wakening** (toddlers). No association with sleep latency (toddlers, pre-schoolers)	No evidence available for infants. Included studies assess both toddlers and pre-schoolers
Total PA	**Observational studies** 1 cross-sectional (n 216)	**More TPA associated with shorter sleep duration and more time awake at night** (pre-schoolers)	No evidence available for infants and toddlers Scarce evidence assesses associations in pre-schoolers only. A range of sleep outcomes assessed
MVPA	**Experimental** 1 RCT (n 826) **Observational studies** 1 longitudinal (n 183) 2 cross-sectional (n 243)	**More MVPA associated with better sleep stability;** no association with sleep quality or sleep duration at night (preschoolers)	
VPA	**Observational studies** 1 cross-sectional (n 131)	No association with sufficient sleep (pre-schoolers)	
Screen time	**Observational studies** 6 longitudinal studies (n 6648) 18 cross-sectional studies (n 51 697)	No association between screen time and sleep outcomes for infants. **More TV time associated with shorter sleep duration; more screen time**	No clear associations evident for other types of screen viewing (computer etc.) and sleep duration/ outcomes.

		associated with night wakening; longer sleep onset latency (toddlers and pre-schoolers); **later bedtime and worse sleep habits** (pre-schoolers)	
Evening Screen time	**Observational studies** 2 longitudinal (n 416) 7 cross-sectional (n 4 340)	No association between evening screen time and sleep outcomes for infants and toddlers. **More TV time associated with shorter sleep duration; more screen time associated with later bedtime and sleep problems** (pre-schoolers)	No clear associations evident for other types of screen viewing (computer etc.) and sleep duration/ outcomes.
Objective Sedentary	**Experimental studies** 1 RCT (n 826) **Observational studies** 2 cross-sectional (n 365)	No clear association between sedentary time and sleep outcomes for pre-schoolers.	No evidence for infants and toddlers Scarce evidence for objectively measured sedentary behaviour

Research recommendations

1. **Research questions related to communication, implementation and surveillance of the guidelines in the UK from 2019**

    - What is the scope for using the four UK countries' Health Surveys to carry out surveillance of the recommendations in all three populations (infants, toddlers, pre-schoolers);
    - To what extent do Under 5s in the UK comply with the recommendations; how does this vary by age, SES, ethnicity and geographical area?
    - How should compliance be improved?
    - How should the 24-hour movement behaviours be quantified?
    - What are the determinants of the movement behaviours?
    - What are parents' and other stakeholders' (e.g. Early Year's education and health staff) perceptions of the new guidelines in the UK? e.g. What are the main barriers to acceptance? (28)
    - What are the health and developmental consequences of compliance/non-compliance with the guidelines?
    - Are distinct guidelines required for special populations in future ? e.g. those with chronic disease or disability ?
    - How best to present this message to parents and Under 5 professionals?

2. **Major research questions which should be answered in order to ensure improved guidelines in future**

    All 24-Hour Movement Behaviours

    - What are the optimal amounts, intensities (for physical activity), and frequencies of the behaviours in all age groups?

    Physical Activity (PA)

    - Are there benefits of active outdoor play over active indoor play?
    - Are there any harms to increasing PA to levels recommended?
    - Is there evidence that the ratio of children to outdoor and indoor space is related to frequency, duration and level of physical activity in infants, toddlers and pre-schoolers?

    Sedentary Behaviour (SB)

    - Is there evidence for non-reading-related sedentary activities on cognitive development which should be promoted (e.g. puzzles, music, craft) with infants, toddlers, pre-schoolers
    - What are the benefits/harms of modern more interactive/less passive forms of screen time for the Under 5s?

    Sleep

- What are the causal contributions of healthy sleep practices (ABC of sleeping) to the onset and maintenance of children's sleep problems for infants, toddlers and pre-schoolers?
- What is the impact (from higher quality experimental/ longitudinal studies) of sleep on outcomes considered here, particularly for infants and toddlers?
- Does compliance with National Sleep Foundation (NSF) recommended levels of sleep relate to positive health and wellbeing outcomes in Under 5s?
- For infants and toddlers, what are the associations between sleep duration and growth; motor development; PA; SB; Quality of Life; wellbeing and risk/ harms such as injuries?
- For pre-schoolers, what are the associations between sleep and emotional regulation; motor development; Quality of Life; wellbeing and risks/harms such as injuries?
- What is the impact of a regular sleep routine on sleep and other outcomes?

Integration of the 24-Hour Movement Behaviours

- What is the impact of PA on sleep and impact of sleep on PA (see above)?
- What is the impact of screen-time on sleep and the timing of screen-time exposure before sleeping?
- Are there analytical approaches to analysing multiple behaviours other than compositional analysis?

Scientific Consultations (Edinburgh and London meetings June & July 2018, plus online comments and submissions)

Comments on the first version of the current technical report were received at two national scientific consensus meetings in June and July 2018. Meeting delegates were stakeholders from universities, government and NGOs, and other interested parties. Comments were submitted online and made at the national meetings. These comments fell into two broad categories: feedback on the scientific content of the work; suggestions in relation to 'messaging' of the work. The Under 5s EWG reflected on these comments in July and August 2018 and a detailed response to the feedback was provided and is available from the University of Bristol Co-ordinating Centre website (www.bristol.ac.uk/uk-physical-activity-guidelines/). Feedback was largely positive, and a number of changes to the current technical report and the draft recommendations have been made.

Next steps

A second national consultation on the draft physical activity recommendations will be undertaken. This report will then be reviewed and edited where appropriate. A final technical report will then be produced for the UK CMOs with final recommendations for new physical activity guidelines. If the CMOs sign off the suggested recommendations, then the CMO Guidelines Writing Group will support the production of a final CMO Physical Activity Guidelines Report.

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Appendices Under 5s EWG

Appendix 1a

Evidence review: Summary rationale for changes to current UK guidance

Physical Activity: All Under 5 populations (infants, toddlers, pre-schoolers)

Title of paper	Canadian 24-Hour Movement Guidelines for the Early Years (0–4 years): An Integration of Physical Activity, Sedentary Behaviour, and Sleep
Year	2017
Journal	BMC Public Health2017; 17 (Suppl 5): 1874 also see published guideline and supporting systematic reviews on Canadian Society for Exercise Physiology Website: http://csepguidelines.ca/early-years-0-4/-
Authors	MS Tremblay et al[1]
Ways in which findings disagree with current UK or Dutch CYP recommendations	Canadian findings go beyond the current UK recommendations, based on additional physical activity evidence for infants (with specific 'tummy time' recommendations) and for pre-schoolers (e.g. new intensity of PA recommendation for pre-schoolers) , and by 'integrating' physical activity with the other '24 hour movement behaviours' (Physical Activity, Sedentary Behaviour, Sleep) as described below. Canadian findings based on searches up to Nov. 2016 were updated further, based on new searches , in Australia in 2017 and by the WHO in Feb. 2018.
Potential implications of disagreement	UK 2011 Guidance for the Under 5s requires an update, taking into account not just new evidence on physical activity in this age group, but also the new paradigm of 24-hour movement behaviours.
Other comments	There is a much larger body of evidence than was available to inform 'Start Active Stay Active 2011' and this has not only been reviewed systematically (search updated to Feb 2018*) but also appraised critically using GRADE methodology. The work has been made available to us in the form of GRADE tables/ Summaries of Findings/ Evidence to Decision Summaries. This permits a much better informed physical activity recommendation for the Under 5's in the UK, and facilitates international harmonisation of recommendations (UK 2018/19-Canada 2017-Australia 2017- S. Africa 2018 – WHO 2018).In addition, there is now a formal method for adapting/adopting highly relevant recommendations from one nation to another .This methodology was used to adapt/adopt the Canadian 24 hour movement guidelines for the Under 5s to Australia in 2017 and has been used by the UK Under 5s EWG in 2018. Note that physical activity in the Under 5s should not be seen in isolation from older age groups: there is a substantial evidence base on the impact of physical activity in school-age children and adolescents; physical activity declines from the age of school entry & is related to physical activity in school-age children and adolescents.

	***We acknowledge the help of the WHO, both for funding an updated literature review and appraisal using GRADE methodology in Feb 2018, and for agreeing to share it with us.**

Appendix 1b

Summary rationale for changes to current UK guidance

***Sedentary behaviour**: All Under 5 populations (infants, toddlers, pre-schoolers)*

Title of paper	Canadian 24-Hour Movement Guidelines for the Early Years (0–4 years): An Integration of Physical Activity, Sedentary Behaviour, and Sleep
Year	2017
Journal	BMC Public Health (Supporting systematic reviews- see also http://csepguidelines.ca/early-years-0-4/-)
Authors	Tremblay et al[1]
Ways in which findings disagree with current UK or Dutch CYP recommendations	Canadian findings go beyond the current UK recommendations for the Under 5s based on additional evidence-on sedentary behaviour, and by 'integrating' sedentary behaviour with the other '24 hour movement behaviours' (Physical Activity &, Sleep).
Potential implications of disagreement	UK 2011 Guidance for the Under 5s requires an update, taking into account not just new evidence on sedentary behaviour in this age group, but also the new paradigm of 24-hour movement behaviours.
Other comments	
Title of paper	
Year	2017
Journal	BMC Public Health
Authors	Tremblay et al[1]
Ways in which findings disagree with current UK or Dutch CYP recommendations	The synthesis of new findings for the Canadian/Australian/WHO guidelines permits specific recommendations in relation to sedentary screen-time which were not possible before.-
Potential implications of disagreement	UK 2011 Guidance for the Under 5s requires an update, taking into account not just new evidence on sedentary behaviour in this age group, but also the new paradigm of 24-hour movement behaviours.
Other comments	There is a much larger body of evidence on health impact of sedentary behaviour in the Under 5s than was available to inform 'Start Active Stay Active 2011' and this has been reviewed systematically (search updated to Feb 2018*) and appraised critically using GRADE methodology this year. The updated work has been made available to us* in the form of GRADE Tables, Summaries of Findings, and Evidence to Decision Summaries. This permits evidence-based sedentary behaviour recommendations for the Under 5's in the UK, and facilitates international harmonisation of recommendations (UK-Canada-Australia- S. Africa- WHO) as noted above. In addition, the formal method for adapting/adopting highly relevant recommendations from one nation to another was used to adapt/adopt the Canadian 24 hour movement guidelines for the Under 5s to Australia in 2017[2] and has been used by the UK Under 5s EWG in 2018.

	Note that sedentary behaviour in the Under 5s should not be seen in isolation: it tends to increase from around the time of school-entry, and in school-age children and adolescents has health impact. ***We acknowledge the help of the WHO, both for funding an updated literature review and appraisal using GRADE methodology in Feb 2018, and for agreeing to share it with us.**

Appendix 1c

Summary rationale for changes to current UK guidance

Sleep: *All Under 5 populations (infants, toddlers, pre-schoolers)*

Title of paper	Canadian 24-Hour Movement Guidelines for the Early Years (0–4 years): An Integration of Physical Activity, Sedentary Behaviour, and Sleep
Year	2017
Journal	BMC Public Health (Supporting systematic reviews, and see alsohttp://csepguidelines.ca/early-years-0-4/-)
Authors	Tremblay et al[1]
Ways in which findings disagree with current UK or Dutch CYP recommendations	Canadian findings go beyond the current UK recommendations by synthesising evidence on sleep (not included in Start Active Stay Active 2011), and by 'integrating' physical activity with the other '24 hour movement behaviours' (Physical Activity, Sedentary Behaviour, Sleep).
Potential implications of disagreement	UK 2011 Guidance for the Under 5s requires an update, taking into account not just new evidence on physical activity in this age group, but also the new paradigm of 24-hour movement behaviours.
Other comments	
Title of paper	
Year	2017
Journal	BMC Public Health
Authors	Tremblay et al[1]
Ways in which findings disagree with current UK or Dutch CYP recommendations	Current UK recommendations do not include sleep. The new findings permit recommendations on sleep duration and the conceptual integration of the '24 hour movement behaviours' (Physical Activity, Sedentary Behaviour, Sleep) as noted above.
Potential implications of disagreement	UK 2011 Guidance for the Under 5s requires an update, taking into account not just evidence on sleep in this age group, but also the new paradigm of 24-hour movement behaviours.
Other comments	Evidence on the impact of sleep duration in the Under 5s has been reviewed systematically (search updated to Feb 2018*) and appraised critically using GRADE methodology this year. The updated work has been made available to us* in the form of GRADE Tables, Summaries of Findings, and Evidence to Decision Summaries. This permits evidence-based sleep duration recommendations for the Under 5's in the UK, and facilitates international harmonisation of recommendations (UK-Canada-Australia- S. Africa- WHO) as noted above. In addition, the formal method for adapting/adopting highly relevant recommendations from one nation to another was used to adapt/adopt the Canadian 24 hour movement guidelines for the Under 5s to Australia in 2017 and has been used by the UK Under 5s EWG in 2018.

	The UK EWG has undertaken a new literature search on behaviours related to sleep duration and sleep quality in the hope of being able to go beyond the Canadian recommendations Note also that in school-age children and adolescents longer sleep duration, up to a point, is associated with a range of health and non-health benefits. ***We acknowledge the help of the WHO, both for funding an updated literature review and appraisal using GRADE methodology in Feb 2018, and for agreeing to share it with us.**