

**Bedtime routines: a dynamic, repetitive set
of behaviours and their implications for child
wellbeing, health and development**

A thesis submitted to the University of Manchester for the degree of
Doctor of Philosophy in the Faculty of Biology, Medicine and Health

2019

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Abstract

Bedtime routines represent one of the most common family activities. Bedtime routines are comprised of different activities that families with young children undertake the hour before bed. These activities range from hygiene activities (tooth brushing, etc.) to dietary behaviours (snacks, drinks before bed, etc.) and literacy-related activities (book reading, etc.). Generally, there is little information on the mechanisms involved in the formation of bedtime routines and the implications of those different activities to child wellbeing and development. Quality of sleep is the area that has drawn the majority of research interest regarding bedtime routines and children. A mixed methods approach was used combining quantitative data collection, interviews with parents, a systematic review and Public and Patient Involvement. Additionally, an innovative method of assessing bedtime routines through the use of text surveys was developed as part of this work. Overall, the mixed methods approach and innovative bedtime routine assessment were used to develop a greater understanding of this highly recurrent, dynamic family activity and its implications for child wellbeing and development. Based on findings from each study, there were observable differences in the quality of bedtime routines across different families, with those differences affecting child wellbeing and development. More specifically, children with suboptimal bedtime routines presented with higher prevalence of dental caries, lower school readiness and lower executive function. Also, parents who implemented suboptimal bedtime routines followed more rigid parenting styles and also showed lower executive function scores when compared to parents with optimal bedtime routines. Results also highlighted the effectiveness of text surveys in assessing and enhancing our understanding around bedtime routines with minimal intrusion and high participant feedback. The qualitative piece of this research indicated that parents want and try hard to have a good bedtime routine however, factors such as cognitive tiredness, lack of support and motivation can result in problematic bedtime routines being established and maintained.

Declaration

No portion of the work referred to in the thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning

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Acknowledgments

Undertaking a PhD at the University of Manchester and especially at the Dental Health Unit has been one of the most rewarding and fulfilling experiences. My time there has exceeded all expectations and I feel incredibly privileged to have been given this opportunity. I was particularly lucky to have a strong, understanding, encouraging and always available supervisory team that helped me and pushed me when needed. Especially I want to thank...

Julia Allan who despite joining the supervisory team later has been an extremely important addition. As a health psychologist, Julia allowed me to incorporate and explore more psychology elements and thinking into my work. Moreover, through Julia's input, I was able to better link my psychology background with my current work and transform my PhD into an amalgamation of psychology, dentistry and public health with a strong behavioural component. Also, Julia helped me tremendously with my funding application to the Medical Research Council and offered guidance and support whenever necessary.

Mike Kelly who made every meeting into a challenging yet welcoming thought exercise, one that helped me to reflect on my work. Throughout my PhD, Mike was always the one with a critical eye and he helped guide, in his quiet and calm manner, my work to some new and exciting areas. His wealth of knowledge and experience provided some crucial feedback to my academic writing and overall helped me to enhance and further develop my skills.

Michaela Goodwin for her overwhelming positive support throughout this process. From the moment Michaela, alongside Mike, first interviewed me she has been the most integral part of my academic and professional development. She was always happy to help with all the little, and quite frequent at times, questions that I had. She helped me to make sense of my PhD through her own experiences and her valuable advice. She helped me when I struggled with the ever so dreadful statistical analyses and she was always willing to have a read through my work at any stage.

She was there when needed her the most with a smile. Michaela is by far the supervisor that everyone secretly wishes to have but only a few of us are actually lucky to have in our lives. For many, many reasons my PhD would not have been the same without her!

Iain Pretty for everything that he had done for me in the past three years. It is really difficult to put into words the extent of Iain's contribution not only to my work but also to my personal and professional development. Iain made himself available whenever necessary and he was always keen to help and support my ideas. My meetings with him were always an opportunity to discuss ideas and get some really useful feedback. I always admired his directness rather than going around in circles with endless discussions before reaching a point. He helped to realise my potential and never stopped me from doing something as long as there was a plan, a rationale behind it and it made sense to my overall career. He taught me valuable lessons that spanned a pure student-supervisor relationship and these are the lessons that I will hold dear in my life. He provided me with guidance but he also challenged me when needed. In essence, he did not only tell me to reach for the "stars", he also provided me with a ladder to do so!

Also, I would like to thank all current and previous Dental Health Unit colleagues especially Richard, Niki, Maureen, Kate, Laura, Pinpinut, Debs, Jo, Ishty and Brenda for creating a great working environment. I would like to thank everyone else at the University of Manchester, especially in finance, admin support and doctoral academy, and beyond for their help in these past 3 years. Finally, a really big thank you to everyone at the dental practices and the Sure Start centres from where I recruited my participants to and to the participants, both parents and children, themselves for their contribution to my research. None of this could have been achieved without you.

I want to also thank my family especially my parents, my brother and my wider family for being such big supporters and advocates of my work. Every single one of them has helped me in their own different ways. Especially to my parents I

want to say a really big thank you for everything they have been through so I can be here today.

Finally, I want to thank my partner Hannah for being there for me in the difficult and stressful as well as the relaxed and nice times. She is always the one who gives me courage and her help has been vital in the successful completion of my work. She is my rock, my safe place, and I cannot find words to describe the gratitude for everything that she has done for me.

Having thanked everyone so far, I have to say that for any inadequacies or mistakes that remain in this work the responsibility is my own.

The author

I studied for my BSc in Psychology at the Aristotle University of Thessaloniki, Greece with an interest in social and clinical psychology. During my BSc I completed a series of clinical placements mainly in substance and alcohol misuse while my undergraduate thesis focused on migrants and refugees and their access to the National Health System in Greece. Following my undergraduate studies, I completed a postgraduate degree (MSc) in Clinical Psychology at the University of Reading, UK while also completing my registration with the British Psychological Society (MBPsS) and receiving my license to practice as a psychologist in Greece. My postgraduate research focused on experimental pain and mindfulness with a clinical placement in pain management. The end of my postgraduate studies found me working as an assistant clinical psychologist at a secure forensic unit in the UK where I was involved in a variety of roles from risk assessment to individual and group therapeutic sessions with patients. Upon the commencement of my PhD, I was able to undertake a series of work experience across qualitative and teaching positions as well as working as a research assistant on a systematic review.

*Dedicated to my mum and her endless positivity for everything
that I do!*

*Αφιερωμένη στη μαμά μου και στην ατέλειωτη θετικότητα της
για ότι και αν κάνω!*

Foreword

9.620.000! That is the number of pages someone will come across when searching “Bedtime Routines” on Google. The number drops slightly to 7.870.00 when adding the word “Child” to the search. The top 10 pages of either searches, with over 200 results, contain mostly pages from newspapers, magazines and parenting forums. Moreover, just on Amazon, 218 books results are returned when searching “Bedtime Routines”. As in the case of general Google searches, the vast majority of books focus on different ways and techniques for establishing good bedtime routines.

Moreover, different national and international bodies and organizations including Public Health England, the National Health Service in the UK, the National Institute of Health in the US and the American Academy of Pediatrics are all clear on the importance of bedtime especially for younger children and for specific activities before bed (i.e. toothbrushing, reading a book before bed, etc.). However, no clear and concise information is readily available to parents, clinicians and beyond on: (a) what constitutes an optimal bedtime routine, (b) what parents currently do in regards to their bedtime routines, (c) how bedtime routines affect child wellbeing and development, (d) ways of establishing such routines, (e) how to maintain a good routine or change a poor one and finally, (e) how we can help parents with their bedtime routines. In the next 9 chapters that form this thesis, I intend to address these key questions through a stepped approach that will gradually build all necessary evidence to uncover and better understand bedtime routines as a repetitive, dynamic set of health behaviours and to investigate their relationship with child wellbeing and development.

In addressing these key questions, a wide range of projects was completed starting in July 2016 and finishing in June 2019. The chronological order of all work relating to this thesis is presented below in table 0.1.

Table 0.1. Chronological order of research projects

Period	Study	Sample	IRAS ID
October 2016 to August 2017	Pilot study	50 parents with children 3-5 years of age	219018
June 2017 to September 2017	Systematic review	N/A	N/A
October 2017 to August 2018	Larger study	200 parents with children 3-7 years of age	238552
August 2018 to October 2018	Qualitative study	Subset (n=12) of parents from larger study sample	238552
October 2018 to January 2019	Funding application	N/A	N/A
February to March 2019	Public and Patient Involvement (PPI) work	13 parents with young children	N/A

This thesis is presented in an alternative format. This allows chapters that are suitable to be submitted for publication or have already been published during the PhD to be incorporated into the thesis. The work presented in the following chapters is divided into 4 areas, each addressing a series of key issues before moving to the next. Presenting this work in the chronological order in which it was completed, despite its merits, would have resulted in a more fragmented thesis with abrupt transitions from one topic to the next. Therefore, an alternative approach was adopted when compiling the chapters of the thesis to create a better narrative and flow from one topic to the next. This order is presented in table 0.2.

Table 0.2. Order of presentation for each chapter

Chapter	Title	Focusing on	Study / Dataset
1	Literature review	Understanding existing literature and research in the area and how bedtime routines relate to specific topics on child wellbeing and development	N/A
2	Interactive text surveys in public health research: a novel assessment for bedtime routines	Description of the development stages of the bedtime routine assessments used in the rest of the thesis	Pilot & Larger study datasets combined to allow for an overview of the development of the assessment
3	Bedtime routines, child wellbeing & development	First investigation of the impact of bedtime routines on specific areas of child wellbeing and development	Pilot study (n=50)
4	Bedtime routine characteristics of families with young children living in deprived areas	First examination of bedtime routines and their characteristics in families living in deprived areas	Larger study (n=200)
5	Bedtime oral hygiene behaviours, dietary habits & children's dental health	More in-depth examination of the impact of bedtime routine activities on dental health	Same dataset as Chapter 4
6	Perceived barriers & facilitators for bedtime routines in families with young children	Qualitative piece examining factors associated with the development and establishment of bedtime routines	Subsample of larger study sample (Chapters 4 & 5) (n=12)
7	Bedtime routine interventions to improve child wellbeing & family functioning: a systematic review of the literature	A review of literature on bedtime routine interventions excluding quality of sleep given the wealth of data on that area	N/A
8	Bedtime Routines Intervention for Children (BRIC) using an automated text messaging system for behaviour change	A proposed intervention on bedtime routines for first-time parents, incorporating results and findings from all chapters above	N/A
9	Parental views on a proposed bedtime routines intervention using text messages: results from Patient & Public Involvement (PPI) focus groups	Small-scale PPI study examining parental views and feedback on the proposed intervention presented in Chapter 8	PPI (n=13)

Each chapter will include a summary box at the end. Each summary box aims to provide, in a concise, bullet-point style, key highlights of that chapter under the headings: (a) What do I know now and (b) What do I need to know next.

Apart from chapters 1, 8 and 9, all other chapters have been either been submitted to or published in journals. A breakdown of chapters and journals where they were submitted can be found below in table 0.3.

Table 0.3. Chapters submitted or published

Chapter	Status	Reference
Chapter 2	Submitted	Kitsaras, G., Goodwin, M., Allan, J., Kelly, M. P., & Pretty, I. A. (TBC) Interactive text surveys in public health research: a novel assessment for bedtime routines. BMC Medical Research Technology, (TBC).
Chapter 3	Published	Kitsaras, G., Goodwin, M., Allan, J., Kelly, M. P., & Pretty, I. A. (2018). Bedtime routines child wellbeing & development. BMC public health, 18(1), 386.
Chapter 4	Submitted	Kitsaras, G., Goodwin, M., Allan, J., Kelly, M. P., & Pretty, I. A. (TBC). Bedtime routine characteristics of families with young children living in deprived areas. Journal of Family Psychology, (TBC).
Chapter 5	Submitted	Kitsaras, G., Goodwin, M., Allan, J., Kelly, M. P., & Pretty, I. A. (TBC). Bedtime oral hygiene behaviours, dietary habits & children's dental health. Community Dental Health, (TBC)
Chapter 6	Submitted	Kitsaras, G., Goodwin, M., Allan, J., Kelly, M. P., & Pretty, I. A. (TBC). Perceived barriers & facilitators for bedtime routines in families with young children. British Journal of Educational Psychology, (TBC).
Chapter 7	Submitted	Kitsaras, G., Romero, J.S., Goodwin, M., Allan, J., Kelly, M. P., & Pretty, I. A. (TBC). Bedtime routine interventions to improve child wellbeing & family functioning: a systematic review of the literature. Systematic Reviews, (TBC).

Chapter 1

Literature review focusing on bedtime routines and their association with specific areas of child development and wellbeing including dental disease, school readiness & executive function

Introduction

Children have slowly yet steadily become a key priority for governments, international organisations and policy bodies across the world, with legislative and policy changes reflecting this (Heywood, 2017). Now more than ever before, there is a growing push to invest in children's development and wellbeing in order to promote positive short- and, most crucially, long-term outcomes. These outcomes span health, psychological, cognitive, educational, social and behavioural boundaries, and combined can impact on an individual's opportunities and chances in life, their success, competence and health and consequently the success and health of the nation (Heckman, 2006; Mindell & Williamson, 2018; World Bank, 2016). Key bodies including the United Nations International Children's Emergency Fund (UNICEF), the National Health Service (NHS) in the United Kingdom and more recently the Lancet Early Childhood Series Steering Committee have emphasised the: *"need for nurturing care that includes adequate health, nutrition, security and safety, responsive caregiving, early learning opportunities and early childhood investments to help young children to reach their full potential and build a strong foundation for subsequent development, health, and wellbeing."* (Black et al., 2017, page 7).

In the spirit of these fundamental changes in how children are prioritised across the world there is a renewed and growing interest in repetitive family activities especially those that have implications for wellbeing and development. Family and childhood routines more broadly refer to observable, predictable, and repetitive behaviours that occur daily or weekly in the context of caregiver child interactions in the home environment (Mindell & Williamson, 2018). Routines in general, have shown positive effects on a variety of factors including the promotion of a general sense of security, emotional stability, fewer behavioural problems especially during landmark transition periods (e.g. starting school, moving schools etc.) and promotion of a general sense of wellbeing (Greenman, 2005; Handler, 1997). Routines also have important associations with parent-child dynamics and overall family functioning (Henderson & Jordan, 2009). Based on the behavioural theory approach, it could be

assumed that improving the consistency of routines may lead to better overall child compliance, this could subsequently result in a more predictable sequence of daily activities which could further increase compliance with parental instructions and improve general family functioning (Plaud & Plaud 1998; Sytsma et al. 2001). Despite their importance, routines in general are rarely researched, nevertheless with advancements in routine assessments more supporting evidence is emerging (Henderson & Jordan, 2009). One of the most common, recurrent family routines are bedtime routines (Mindell & Williamson, 2018).

1.1. Bedtime routines

Bedtime routines contain a range of activities across different areas that families undertake in a consistent manner starting the hour or so before the child is put to bed to sleep (Mindell et al., 2015). The timeframe (“hour before bed”) to categorise activities as part of a bedtime routine has been consistent across available literature (Mindell & Williamson, 2018; Fiese, 2001). These activities reflect child and parent interactions and they exclude activities that occur as the child is falling asleep (Mindell & Williamson, 2018). A recent systematic review identified a series of common activities that families undertake around bedtime including: dietary habits, bath, massage/relaxation/quieting down, reading books/sharing books, rocking, watching TV/using-playing with electronic devices, praying, singing/listening to music, brushing teeth and playing/running around (Mindell & Williamson, 2018). There is no universal categorisation or classification system for these bedtime routines activities. Mindell and Williamson (2018) categorised these activities under 4 areas: (a) nutrition/diet, (b) hygiene, (c) communication and (d) physical contact. Hale et al. (2009) categorised bedtime routine activities into five categories including (a) interactive activities, non-interactive activities, television-related activities, eating and hygiene-related activities while Henderson and Jordan (2010) used two categories for bedtime routine activities, adaptive and maladaptive. Table 1.1 summarises the categorisation of key bedtime routine activities.

Bedtime routines are common in families with young children however, limited research hinders an in-depth understanding of the exact prevalence and characteristics of bedtime routines (Mindell & Williamson, 2018). The majority of research studies into bedtime routines has been carried out in the United States (US) where it was found that around 81% to 95% of families with young children implement a bedtime routine (Hale et al., 2006; Mindell et al., 2009). However, and as Mindell and Williamson (2018) note: *“despite the high prevalence of young children with bedtime routines, there is variation in the extent to which bedtime routines are actually implemented on a nightly basis... Socio-demographic factors including race/ethnicity and socioeconomic status (SES) are also associated with variation in the presence and implementation of a bedtime routine in United States (US) samples.”* More specifically, and in the case of the US, children from minority ethnic families including African American and Hispanic families were significantly less likely to follow a recurrent and stable bedtime routine when compared to their ethnic White counterparts (Hale et al., 2009). Globally, there is a high degree of variation in the implementation of regular bedtime routines from a low of 40% of families with young children in India to a high of 80% of families in the United Kingdom (Mindell et al., 2010).

Table 1.1. Bedtime routine activities and corresponding categories based on author

Activity	Mindell & Williamson (2018)	Hale et al. (2009)	Henderson & Jordan (2010)
Dietary habits (snacking, bottle feeding, drinks before bed)	Nutrition	Eating	Adaptive or Maladaptive (depending on context)
Rocking	Physical contact	Interactive	Adaptive

Watching TV / using electronic devices	Communication	Television-related activities	Maladaptive
Pray	Communication	Interactive	Adaptive
Singing / listening to music	Communication	Interactive	Adaptive
Bath	Hygiene	Hygiene	Adaptive
Brushing teeth	Hygiene	Hygiene	Adaptive
Playing / running around	Physical contact	Interactive	Adaptive
Massage / relaxation / winding down	Physical contact	Interactive	Adaptive
Reading / sharing books	Communication	Interactive	Adaptive

Despite observed differences in the prevalence of bedtime routines across different sociodemographic groups and countries it is worth noting some limitations around the specific measures used to quantify and examine bedtime routines. In a large global study with a sample of almost 30,000 infants by Mindell et al. (2010) the assessment used to determine presence or absence of bedtime routines was the Brief Infant Sleep Questionnaire BISQ (Sadeh, 2004). The BISQ is a validated and extensively used measure of infant sleep, using parental retrospective questions to identify issues with their infants sleeping patterns and commonly occurring problems such as night wakings. Despite its merits, the BISQ does not include specific bedtime routine questions on specific bedtime routine activities therefore limiting its overall applicability in determining exact differences regarding bedtime routines. Moreover, the only currently available standardised questionnaire of bedtime routines by Henderson and Jordan (2010), the Bedtime Routine Questionnaire (BRQ) also takes a highly retrospective approach with parents being asked to recall bedtime routine activities over a period of a month. This approach risks missing out specific and easy

to forget details on a nightly basis due to the dynamic and recurrent nature of bedtime routines.

1.1.a. Formation of bedtime routines

Little is known about the exact factors influencing the initial development and formation of bedtime routines. Mindell and Williamson (2018) proposed a hypothesised model focusing on three broad factors: child, family and other contextual factors that potentially influence the formation of bedtime routines. When focusing on family routines more broadly, child, parental, social and environmental factors are key in the formation of routines (Spagnola & Fiese, 2007). Since bedtime routines are in essence family routines it is possible that the same factors, i.e. ethnicity, socioeconomic status, educational level, parent-child interaction, parental confidence, locus of control, etc., play a crucial role. In the context of family routines and rituals, there are different models and theories that have been used to describe the process of ritual and routine development in families (Spagnola & Fiese, 2007). One of the most commonly used models is the transactional model (Sameroff & Chandler, 1975; Samerof & Fiese, 2000). Based on this model, development of rituals and routines in general are *“neither predictable by the state of the child alone nor the environment in which he or she is being raised; it is a result of a series of transactions that evolve over time with the child responding to and altering the environment”* (Spagnola & Fiese, 2007). Based on this model, some routines will form effortlessly while others will be a struggle. Overall, it is *“neither a single characteristic of the child, the parent, or the singular formation of a routine that leads to children’s health and wellbeing. Rather, it is the dynamic interplay of the individual characteristics of children and parents that come to form the collective routines of family life”* (Spagnola & Fiese, 2007). The transactional model has not been applied to specific family routines including bedtime routines but it provides a framework for hypothesis building with regards to family rituals and routines. A more in-depth examination of specific factors from parents, children and the environment

alike is vital in order to uncover mechanisms involved in the creation and establishment of bedtime routines in families.

1.1.b. Effects of bedtime routines on child wellbeing and development

Due to the series and wide range of activities that constitute bedtime routines their effect on child wellbeing and development is linked to the specific activities that families undertake. One area has attracted the majority of research interest regarding bedtime routines; quality of sleep (Mindell & Williamson, 2018). A wealth of data including longitudinal, cross-sectional and intervention studies have supported the importance of bedtime routines with the American Academy of Pediatrics (AAP) recommending consistent and stable bedtime routines in order to achieve better sleep outcomes for young children (Hagan et al., 2008). High quality data on the effect of bedtime routines and quality of sleep are also available on a global scale with consistent and stable bedtime routines associated with better parental-reported quality of sleep (Allen et al., 2016; Mindell et al., 2009), longer sleep duration (Koulouglioti et al., 2014; Sadeh et al., 2009), fewer night wakings and less sleep disruptions in general (Fiese et al., 2007; Mindell et al., 2009, 2010).

When examining the research previously conducted on bedtime routines, the majority has concentrated on quality of sleep. While this connection is logical, in terms of child development and wellbeing other key areas need further investigation. Fewer studies have highlighted the effect of bedtime routines and their various activities on an array of areas including: child and parental mood (Field et al., 2001), parental confidence (Mindell et al., 2011), lower body mass index (BMI) (Chen et al., 2009; Evans et al., 2015), better school performance, school attainment and school readiness (Hale et al., 2009, 2011; High et al., 1998), child behaviour and self-regulation with lower incidence of tantrums and bedtime resistant (Burke et al., 2004; Reid et al., 2001), improved overall family functioning and marital satisfaction (Leiferman et al., 2005; Spagnola & Fiese, 2007), better oral health for children with less incidence of dental caries (Baghlafl et al., 2018; Goodwin et al., 2017; Levine,

2001; Segura et al., 2014) and increased child-parent bonding with enhanced prosocial relationships (Adams & Rickert, 1989). Despite some evidence on the importance of bedtime routines beyond quality of sleep, a lot of these effects have not yet fully been studied in longitudinal, intervention studies with the inclusion of larger and more diverse samples, while some of the current literature suffers from methodological issues that hinder the overall quality of the data (Mindell & Williamson, 2018).

With quality of sleep extensively researched there is an opportunity to uncover more information on some of the areas that have shown initial yet limited associations with bedtime routines and the activities that families undertake as part of their routines. From the wealth of different areas, school readiness, executive function and dental disease are three key areas of interest due to their important associations with short- and long-term implications for child wellbeing and development. All three are also particularly important given either a renewed interest from policy bodies and the public alike (i.e. school readiness and executive function) or the burden of disease that the condition causes to public finances, the health service and daily life (i.e. dental disease).

1.2. Dental disease

Dental caries is the most common preventable dental disease and the most prevalent disease overall across the world (Pitts et al., 2017; Selwitz, Ismail & Pitts, 2007). It is estimated that 60 per cent of children worldwide have dental caries while in 2013 in England, nearly half (46%) of 15-year olds and a third (34 per cent) of 12-year-olds had obvious decay experience in their permanent teeth (Child Dental Health Survey, 2013). In 2013, nearly a third (31 per cent) of 5-year olds and nearly a half (46 per cent) of 8-year-olds had obvious decay experience in their primary teeth with important regional differences across the country (Child Dental Health Survey, 2013; RCS Faculty of Dental Surgery, 2015). In the early stages, dental caries can be

reversed but with no proper care, caries can progress until the tooth is destroyed (Selwitz, Ismail & Pitts, 2007). Dental caries is a multifactorial disease that starts with microbiological shifts within a complex biofilm (dental plaque) and is affected by salivary flow and composition, exposure to fluoride, consumption of dietary sugars and by preventive behaviours (e.g. cleaning teeth) (Selwitz, Ismail & Pitts, 2007).

Historically, research on the development of dental caries in both children and adults has focused on biological and dietary factors (Fisher-Owens et al., 2007). In recent years, interest has grown in exploring oral health outcomes using a broader framework, incorporating psychosocial and environmental predictors with biological measures (Fisher-Owens et al., 2007). With dental disease, as with every physiological and pathological phenomenon, it is important to consider wider determinants. It is understood that personal, social and environmental factors interact with one another in a non-linear, dynamic model under constant change which can impact on an individual's health.

Physical, biological and genetic factors. Factors influencing the development of enamel or root caries include: inadequate salivary flow and composition, high numbers of cariogenic bacteria, insufficient fluoride exposure, gingival recession and immunological components (Pitts et al., 2017). Regarding social, personal and environmental factors those range from: poor oral hygiene practises, poor dietary habits and socio-demographic status among others (Fisher-Owens et al., 2007). In the case of children's oral health, the latter group of factors also includes family-related aspects such as: parents attributes, parenting styles, parental behaviours/beliefs and parental socio-demographic status. In the context of preschool age children, oral hygiene practices, dietary habits and other personal related factors should always be examined in conjunction with parental influences since children are still in their early developmental stages.

Social and Environmental factors. There is a well-established relationship between social and environmental factors leading to health inequalities and their impact on physical, dental and psychological health (Levin et al., 2009; Marmot &

Bell, 2011; Mattila et al., 2005). With regards to dental disease, socio-demographic inequalities contribute to poorer oral health with different socio-demographic groups associated with higher rates of decay and other oral health problems (Blas & Kurup, 2010; Marmot & Bell, 2011). Other factors related to elevated risk of caries include poverty, social status, number of years in education, access to dental services and insurance coverage for dental services (Marmot & Bell, 2011). The impact of socio-demographic and socio-economic factors is diverse with higher income associated with improved living conditions, such as safe housing and ability to buy sufficient, healthy food (Fisher-Owens et al., 2007). Finally, there is evidence in support of associations between individual socio-economic experience and adverse health events in economically disadvantaged children including biochemical and physiological manifestations such as higher cortisol levels (Stansfeld, 1999).

Parental attitudes, attributes, beliefs and behaviours. Oral hygiene habits are developed early in life (Blinkhorn, 1978; Eskyte et al., 2018; Peres et al., 2005;). Therefore, focusing on parental attributes, attitudes, beliefs and behaviours is essential to better understanding the complex mechanisms underlying dental disease. It is widely acknowledged that parental beliefs regarding oral health and parental oral health-related behaviours play a fundamental role in establishing preventive behaviours that will subsequently mediate the development of childhood dental caries (Duijster et al., 2013). Parent attributes are characteristics of the parent that may influence the environment the child develops in; with age, mental health and locus of control playing an important role (Hooley et al., 2012). Regarding the age of the parents, and especially the age of the mother, several studies found no clear effect (Adeniyi et al., 2009; Ohsuka et al., 2009; Zhou et al., 2011).

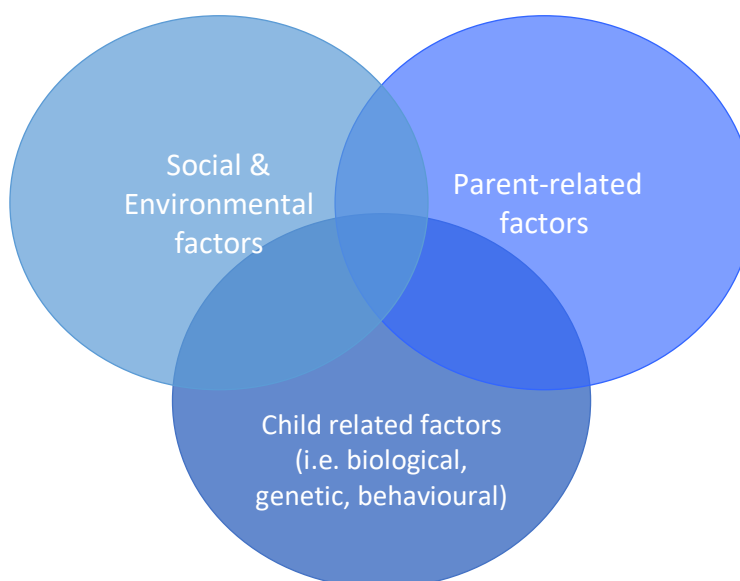
Parental mental health can influence the extent to which parents engage in proactive behaviours and therefore impact different areas of child development including his/her dental health (Hooley et al., 2012). In families where parents presented with an external locus of control (i.e., belief that they and their children are vulnerable and have no control over external events) children had a higher risk of caries (Lencova et al., 2008). However, Seow et al., (2009) found no correlation

between dental caries and parent's sense of competency, parenting style or locus of control. Interestingly, studies have found that smoking in parents is associated with higher rates of caries in children, with that evidence potentially reflecting the impact of poor parental health behaviours in children (Aida et al., 2008; Leroy et al., 2008). Additionally, limited or no parental knowledge around oral health and poor or no knowledge regarding the benefits of fluoride were also associated with increased risk of caries in children (Adeniyi et al., 2009; Skeie et al., 2006). Children, whose parents have established a successful pre-bedtime routine that involves tooth brushing, show better oral health outcomes highlighting another important area of parental involvement in children's oral health (Segura et al., 2014). Ohsuka et al. (2009) found that having a grandparent, as a daytime caregiver, was associated with elevated risk of dental caries suggesting that these may be due to the differences in education and/or perception in nurturing a child between parents and grandparents.

According to Hooley et al. (2012): *“parental attitudes, knowledge, and beliefs influence the choices parents made for their children, the behaviours they model to their children, and the tastes and preferences that children develop throughout their childhood.”* An example of that influence is with regards to diet and level of physical activity available to children (Skouteris et al., 2010). The dietary choices that children are exposed to during their early years influence the development of their food-drink preferences in later life (e.g. preference for food-drinks high in sugar content, especially sugared drinks) (Birch, 1999). Given the direct association between diet and dental caries parental selection of habitual diet is critical to children's long-term dietary behaviours, oral and physical health (Astrom & Kiwanuka, 2006). Parents who requested sugar-free alternatives and who spend less money per month on sugary food and drinks had higher levels of knowledge and well-informed beliefs about the impact of dental disease (Hallet & O'Rourke, 2006; Postma et al., 2008). Also, children whose parents allowed them to consume products rich in sugars during bedtime routines showed higher levels of caries compared to children whose parents had a more robust routine in place (Levine, 2001). Finally, parental attitudes (indulgent or permissive) especially with regards to their child's diet also predisposed children to develop caries (Wigen & Wang, 2010).

In conclusion, children's oral health and caries development is heavily influenced by a highly inter-correlated set of factors ranging from social, environmental to family, with biological and genetic factors also implicated. Figure 1.1 represents those inter-correlated connections where social and family factors both influence the child's oral health and dietary habits and how all three factors contribute to caries development and poor oral health in general. Despite the fact that research has long highlighted the importance of parent-related factors in caries development social and environmental factors have attracted substantially more attention than parenting (Hooley et al., 2012). Nevertheless, it is important, whenever possible, to examine all factors associated with caries development given their high level of inter-correlation.

Figure 1.1. Schematic representation of the inter-correlation between factors that influence caries development in children.



1.2.a. Impact of dental disease on quality of life

Oral diseases during childhood can have a negative impact on the life of preschool children and their parents (Abanto et al., 2011). The negative impact of dental caries at an early age includes chewing difficulties, decreased appetite, weight

loss, sleeping difficulties, changes in behaviour (such as irritability), implications for psychological development (with low self-esteem having been suggested) and decrease in school performance (Abanto et al., 2011; Feitosa et al., 2005; Filstrup et al., 2003).

With regards to school performance, the World Health Organization (2003) highlighted the social impact of oral diseases resulting in restricted school access, absences from school and the loss of millions of school hours annually around the world. Jackson et al. (2011) found positive correlations between oral health status and school performance with poorer oral health status resulting in higher likelihood of school absences. Additionally, a child with fair or poor oral health was almost 3 times more likely than a child with very good or excellent oral health to miss school due to dental pain or infection (Jackson et al., 2011). Even when children are present at school, dental pain and discomfort due to dental disease may impact upon their educational experience leading to lower school performance (Blumenshine et al., 2008; Jackson et al., 2011).

Apart from school performance, dental disease affects various areas of life such as self-esteem, confidence and psychosocial development. A healthy smile affects social interactions and has an essential role in the way children start building up interpersonal relationships and self-esteem (Rebok et al., 2001). Self-esteem is an important psychological factor contributing to health and quality of life and it has been found to be the most dominant and powerful predictor of happiness with low self-esteem and problematic inter-personal relationships leading to poor mood, social anxiety and eventually generally impaired mental health (Feitosa et al., 2005). Additionally, smiling has a vital role in other important areas of life with parent-child bonding and interaction being one of the most important (Rossi, 1990). Healthy bonding and secure attachment have a series of positive effects on child development (Bowlby, 2005).

Pain and infection, direct consequences of dental caries, often affect a child's ability to eat (Sheiham, 2006). Studies have shown that children with dental caries

are at risk of weighing less than 80% of their ideal weight, fitting into the criteria of “failure to thrive” (Acs et al., 1992; Acs et al., 1999). Impaired diet and nutritional deficiencies in a growing child can result in lifelong and potentially life-changing impacts on neural development and somatic growth while normal growth and development may also be delayed due to pain and sleep disturbances (disturbed sleep may affect glucocorticoid production and growth) (Sheiham, 2006). Acs et al. (1999) showed that following treatment, children with dental caries achieved “catch-up” weight gain. “Catch-up” growth has been reported in children whose growth was slowed down due to illness and/or malnutrition (Prader et al., 1963). Upon receiving treatment, those children go through a phase of rapid growth until they reach their normal growth curve (Acs et al., 1999).

Finally, treatment of dental caries in children often possesses a significant financial expense for families with high direct and indirect costs (Sheiham, 2006). Additionally, in some cases dental caries can require hospitalization and visits to emergency departments that can be extremely stressful for parents and frightening for children (Sheiham, 2006). Untreated dental disease in children increases their risk for dental extraction under general anaesthetic a process that has significant impact on children and their families and can increase the risk of dental anxiety (Brigman et al., 1999; Tickle et al., 2009). Apart from child and family related implications dental caries also impacts upon public finances and function of healthcare systems around the globe. In England, emergency hospital tooth extraction for children and adolescents up to 18 years old cost the National Health Service £30 million in 2012-2013 while treatment of tooth decay cost the NHS about £2.3 billion in 2011-2012 (RCS Faculty of Dental Surgery, 2015).

1.2.b.Prevention of dental disease in children

Given the implications of dental caries on quality of life, public finances and society it is extremely important to successfully deploy preventive measures to secure lower levels of caries. There are generally three streams of preventive measures with regards to dental caries (Ismail, 1998). Those focus on the community, personal and professional levels. These measures relate to primary (preventive

measures), secondary (screening and early detection of disease) and tertiary (treatment of disease) public health measures.

In the case of caries in children the main focus is on the home environment and parent's responsibility in following those recommendations in order to shape a positive and pro-active attitude towards oral health for their children (de Castilho et al., 2013; O'Malley et al., 2017; Poutanen et al., 2006). Those recommendations include: a well-structured bedtime routine that involves supervised tooth brushing using fluoride toothpaste, balanced diet that controls sugar intake, regular visits to a dentist and raising awareness & education practices for the importance of good oral health (Davies & Bridgman, 2011; Ismail, 1998). As Zeedyk et al. (2005) showed despite parents' best effort and involvement in one of those preventive measures (tooth brushing) most of them fell short in effectively following the recommendations.

Given the possible limitations of measures that require the input of parents, alternatives are needed in relation to caries prevention in children. Water fluoridation as well as tax-related policies (i.e. sugar tax) are the only preventive measures that does not require input of a professional or parental involvement (Colchero et al., 2017; Ismail, 1998). Evidence in support of water fluoridation as a preventive practice in dental caries is extensive (Horowitz, 2003; Iheozor-Ejiofor et al., 2015; Public Health England, 2013; Lewis & Ismail, 1993; Rugg-Gunn et al., 2016; Selwitz, Ismail & Pitts, 2007). In England, on average, five-year and 12-year olds living in fluoridated areas are 15% and 11% less likely respectively to have had tooth decay than those in non-fluoridated areas (Public Health England, 2013). Despite some success, these measures face opposition and criticism in places where they have been implemented including the UK and Nordic Countries (Rugg-Gunn et al., 2016; Stafford, 2012).

In conclusion, early childhood caries is a public health problem with social, behavioural, environmental and genetic factors that can only be controlled through understanding the dynamic inter-relationships between them. All these factors present a complex, dynamic and inter-changeable network of interactions.

Furthermore, the impact of early childhood caries in life and the difficulties in successfully preventing them signals the need for more in-depth analysis of those inter-correlated relationships.

1.3. School readiness

Defining school readiness has been a challenging topic and historically researchers in the field have been reluctant to provide a definition of school readiness (Saluja, Scott-Little & Clifford 2000). The context of school readiness has undergone major changes during the past four decades (Gesell, Ilg & Ames 1974; Graue 1992; Meisels 1995; Murphy & Burns 2002; Pandis 2001; UNICEF, 2011). By the simplest definition, a child who is ready for school will have the basic minimum skills and knowledge in a variety of domains. According to Lara-Cinisomo et al. (2004) these minimum standards set the threshold for what children should know and be able to do in order to enter school ready and eager to learn, thereby enabling a successful transition into a primary school learning environment. Nowadays, most school readiness assessments emphasise children's competencies when they enter school including: academic and cognitive skills, language and literacy abilities, and social-emotional functioning (Heaviside & Farris, 1993; Rimm-Kaufman & Pianta, 2000; Zill, Collins, West, & Hausken, 1995).

Despite focusing on children's competencies, one major limitation of those definitions is the failure to consider the full range of inputs and processes that explain how children acquire these competencies (Bronfenbrenner & Morris, 1998; Sameroff, 1995). Therefore, a more comprehensive framework for understanding school readiness is needed, a framework that will better integrate the complex environmental, social and individual factors that impact upon development (Bronfenbrenner & Morris, 1998; Sameroff, 1995). Pianta & Walsh (1996) noted that: *"School readiness may be more broadly understood as a property or product of the ecologies within which children are embedded that support their developmental and educational progress: a set of interactions and transactions among people (children,*

teachers, parents, and other caregivers), settings (home, school, and child care), and institutions (communities, neighbourhoods, and governments)." Based on this perspective, school readiness can be better understood as the product of a series of direct and indirect interactions with all those elements and it is through those social interactions that children acquire academic, language and social-emotional competencies (Belsky & MacKinnon, 1994; Meisels, 1999; Rimm-Kaufman & Pianta, 2000; Shonkoff & Phillips, 2000).

The existence of various and in some cases contradictory and diverse definitions of school readiness is also clearly illustrated in the issue that official government bodies in England have in defining school readiness. The Office for Standards in Education (OFSTED) (2014) in its review on school readiness found no consensus in defining school readiness across England. That review also showed that the most common definition of school readiness derived from the Early Learning Goals (ELG) by the Standards and Testing Agency (STA) in its Early Years Foundation Stage Profile (EYFSP) (OFSTED, 2014). The ELGs described in the EYFSP include 17 goals arranged into three primary (communication, personal/emotional/social development and physical development) and four specific (mathematics, expressive arts and design, understanding the world and literacy) areas (STA, 2015). Recent attempts by the government of the United Kingdom to implement a baseline school readiness assessment sparked, once again, debate over the definition and utility of school readiness and due to high level of opposition no specific school readiness assessment was implemented with the entire issue postponed for the near, or far, future. As a result, the EYFSP remains the instrument of choice with regards to school readiness in England (OFSTED, 2014).

1.3.a. Factors that influence the development of school readiness

A wide set of inter-correlated factors impacts upon school readiness development in children. These factors can be broadly categorised into three areas: child-focused factors, parental factors and social/environmental factors. These three

areas interact with each other and they can ultimately hinder or promote school readiness.

Socio-economic and demographic factors. Poverty has been shown to be particularly detrimental in early childhood to subsequent educational and other life course outcomes. Children from lower income households score significantly lower than children from households with higher income on a variety of academic and school readiness measures including vocabulary and communication skills, numeric and mathematic skills, ability to concentrate and cooperate with other children (Thomas, 2007; Willms, 2007). Research has highlighted a total of six poverty-related factors that impact child development in general and school readiness in particular including: a. incidence of poverty, b. the depth of poverty, c. the duration of poverty, d. when poverty takes place (i.e. the age of the child), e. poverty within the community and f. the impact poverty has on the child's social network (i.e. parents, relatives, friends and neighbours) (Ferguson et al., 2007). Poverty is also a strong co-factor of parenting practices with some evaluations suggesting that at school entry, children from disadvantaged backgrounds could already be years behind their economically advantaged peers (Brooks-Gunn, Britto & Brady 1999). Finally, a child's home has a particularly strong impact on school readiness since children from low-income families often do not receive the stimulation and do not learn the social skills required to prepare them for school (Ferguson et al., 2007).

Racial/ethnic-minority status has predicted school readiness challenges across domains including: deeper or more chronic poverty than white children, increased likelihood of facing discrimination and additional social inequalities that can inhibit access to early childhood education and ultimately hinder the development of school readiness in those affected children (Blair et al., 2011; Burchinal & Willoughby, 2013; Nesbitt et al., 2013; Wight, Chau, & Aratani, 2011).

Parental factors. Prior to entering school, the family is normally the most important context for development with positive parenting practices and styles being among the strongest predictors of good school performance (Bradley and Corwyn

2005; Burchinal et al. 2002; Morrison and Cooney 2002; Richter 2004; Rogoff 2003; Werner and Smith 2001). Even though research mainly focuses on the two years prior to school entry, families have an on-going effort in preparing children for school with a combination of parenting practices that promote learning and development including: antenatal visits, breastfeeding, bedtime routines (see next paragraph) and early stimulation behaviours (World Health Organization, 1999). A wide body of research in both developed (e.g. United States) and developing countries showed that positive parenting practices including greater engagement, higher levels of interactions with children, stimulation tactics, and appropriate and supportive responsiveness support led to better performance at school, better communication and cognitive skills and more enthusiasm for learning (Esher et al., 2006; Hart & Risley 1995; Pianta, Smith & Reeve 1991). Problematic and negative parenting practices play an additionally important adverse role in school readiness with problems of inconsistent daily routines, limited and problematic supervision and care associated with lower school readiness (Hyman 2006; McLoyd 1998).

Bedtime routines and book reading. An important element of parenting is bedtime routine. As described in the previous section, bedtime routines play an important role in a variety of areas associated with child development. In recent years, the American Academy of Paediatrics highlighted the importance of bedtime routines in developing a healthy attitude towards learning, reading and ultimately school (American Academy of Paediatrics, 2014). According to the American Academy of Paediatrics (2014) children who read regularly with their parents (or are read to by their parents) experience ideal patterns of brain development and that action strengthens the parent-child relationship. Additionally, reading and its associative impact have shown improvements in language, literacy and socio-emotional skills development (American Academy of Paediatrics, 2014; Fiese, Eckert, & Spagnola, 2005). Bedtime routines represent an optimal time for book sharing and book reading and both of those actions can constitute the core of a regular, consistent and beneficial bedtime routine for children of all ages following closely recent recommendations by the American Academy of Paediatrics (i.e. pilot program “Brush, Book, Bed”).

Nutrition. Both poor nutrition and food insecurity have a strong correlation with socio-economic and demographic factors while nutrition in particular is influenced heavily by bad oral health, parenting practices and beliefs (Lodolini et al., 1992). Food insecure infants and toddlers (i.e. those where reliable access to sufficient, affordable and nutritious food is not guaranteed) are 1.4 times more likely to be at risk or developmental delays (Rose-Jacobs et al., 2008). Children who eat more nutritious diets are able to concentrate better and think more critically while children who eat unhealthy diets tend to be lethargic, withdrawn and experience inferior immune systems (Brown & Polit, 1996; Currie, 2005). Additionally, poor children from birth to age five are about a third more likely to be anaemic and about 20 per cent more likely to present with vitamin (especially vitamin A) and iron deficiencies (Currie, 2005). In the case of iron deficiency there is a range of implications including: immune function, cognitive functioning, and energy metabolism (Currie, 2005).

Preschool education. High-quality formal childcare is thought to improve outcomes for children, and, if it targets children from deprived backgrounds, to reduce inequalities in society (Blanden et al., 2014). As highlighted before, children from economically disadvantaged families are less likely to experience stimulating learning opportunities in their home environments and they are also less likely to be enrolled in early education programs and centre-based child care. Studies in developing countries show that early childhood programmes lead to higher levels of primary school enrolment and educational performance while on the contrary, children who start school late are more likely to fall behind or drop out completely (UNICEF, 2012).

In England, all three and four-year-olds are entitled to a free part-time nursery place during the school year, and similar policies are in place in Scotland and Wales and from 2013 this policy has been extended to disadvantaged two-year-olds (Blanden et al., 2014). Between 1999 and 2007, the proportion of three-year-olds in England benefitting from a free nursery place rose from 37 to 88 per cent making the UK is now one of the highest spenders on pre-primary services in Europe (OECD

2008). Blanden et al., (2014), in the first paper to evaluate the causal effect of free preschool education for 3-year-olds on child outcomes in England, showed that an increase in the proportion of 3-year-olds covered by free places led to improved cognitive and non-cognitive outcomes at age 5. Those effects were larger for boys than girls and some weaker evidence showed larger effects for those from lower rather than higher socio-economic backgrounds (Blanden et al., 2014).

Child's health, including oral health. Health problems can affect a child's school readiness both directly and indirectly. For example, chronic conditions may lead to school absences and inability to maintain concentration while at school amongst others (Currie, 2005). Poor health can also impact upon school readiness by changing the way the family treats a child, leading to limited beneficial activities, for example, parents who perceive a child as frail or vulnerable may be overly protective; discouraging them from engaging in stimulating and developmentally appropriate activities (Currie, 2005). With regards to oral health specifically, direct implications include: missing days from school, sleepless nights due to pain and problematic concentration at school due to dental pain and discomfort (Blumenshine et al., 2008; Jackson et al., 2011). Additionally, poor oral health indirectly influences school readiness through its impact on psychosocial development and especially self-esteem and self-confidence (Bonecker et al., 2012).

Child's cognitive development. The majority of studies in this area focus on the role of cognitive control (sometimes referred to as executive function) in self-regulated and goal-oriented learning (Welsh et al., 2010). Executive function is a construct formulated by multiple inter-related high-level cognitive processes and skills including: working memory, attention set-shifting, and inhibitory control all of which show substantial development during the preschool years (ages 3-5) (Anderson, 2002; Lezak 1982). These skills allow children to organize their thinking and behaviour with increasing flexibility, maintaining concentration on a specific task, hold more information and manipulate that information, decrease their reactive response, engage in self-regulated behaviour that adheres to rules and responsibilities and engaging appropriately with peers and teachers in the context of

the classroom (Barkley, 2001; Blair, 2006; Blair & Diamond, 2008; Hamre & Pianta, 2005; Hughes & Ensor, 2007; Gathercole et al., 2008; Ladd, Birch, & Buhs, 1999; Stuss & Alexander, 2005).

Child's psychosocial and emotional development. Social development refers to children's ability to interact with others in a social context with skills such as working as part of a team, cooperation with others, taking turns and expressing themselves effectively in front of others (Cohen et al., 2005). Emotional development includes such factors as children's perceptions of themselves (e.g. self-esteem, self-confidence) and their abilities to both understand the feelings of other people and to interpret and express their own feelings (Cohen et al., 2005). Self-esteem in particular has been the focus of a lot of research with regards to its impact on school readiness and school performance overall. Research findings however do not indicate whether self-esteem is a cause or a result of school performance (Baumeister et al., 2003). Nevertheless, people with high self-esteem may set higher goals than people with low self-esteem, they may be more willing to persist in the face of initial failure and less likely to be affected by feelings of incompetence and self-doubt (Baumeister et al., 2003).

1.3.b. Impact of poor school readiness on later life

The impact of poor school readiness should be examined on both an individual (child) and wider (family, society) context. Early childhood experiences represent a major developmental and social transition stage for children and therefore it is crucial to understand the variability of school readiness within children and its impact on their later life (Denham, Warren-Khot, Bassett, Wyatt, & Perna, 2012). Considering the individual context, school readiness has impact beyond the first years of school education with children who have higher levels of school readiness at age five presenting generally with more successful grades at school, being less likely to drop out of high school and even earn more as adults (Duncan et al., 2007, Duncan et al., 2010). With respect to adulthood, similar research has demonstrated that children who enter school ready to learn and easy transitions

between academic stages and are more likely to be employed as adults (Rouse, Brooks-Gunn and McLanahan 2005). Academic achievement, employability and an overall positive school experience are associated with improved mental and physical health, less involvement in crime and better overall quality of life (Araya et al., 2003; Black et al., 2015; Grossman, 2000; Steele et al., 2007).

Considering the wider context, poor school readiness and its associated implications result in a number of problems for society as a whole. Although the return on investment for early childhood initiatives is higher than for any other human capital development programme, on average governments invest less than 5 per cent of total public spending on preschool education (UNICEF, 2012). That initial investment has considerable returns on areas such as public savings through lower costs for criminal justice and welfare systems (Klein and Starkey 2004). As described above, children who are prepared for school are more likely to succeed at school and become earning and tax paying adults (UNICEF, 2012). The financial investment in early childhood leads to increased economic activity and adult human capital development therefore school readiness has a vital role in sustaining and promoting the social and economic development of a country (Heckman and Kruger 2003; UNICEF, 2012).

1.4. Executive function

The final area of interest regarding bedtime routines and child wellbeing and development is executive function. To date, there is little direct research on bedtime routines and executive function. However, the wider range of repetitive behaviours undertaken during bedtime routines can have an important association with the development and manifestation of executive function. Moreover, the age of children who experience those repetitive behaviours as part of their bedtime routines can be important given the stage of their cognitive development.

The frontal lobes of the brain are home to a group of distinct, but highly

interrelated and inter-correlated cognitive processes, commonly referred to as executive functions (Stuss & Alexander, 2000). Based on available research it is hypothesized that those processes are responsible for a variety of behaviours including planning and organizational skills, initiation of action and development of strategies to achieve goals (Lezak, 1982). Executive function is a complex and challenging area of research. Only 30 years ago it was considered that cognitive processes associated with executive function appeared in early adolescence following an adequate level of maturity in the frontal lobes (Golden 1981). Today, it is well established that executive function appears much earlier than this, and that early signs can be observed from as early as infancy (Diamond 1985). Executive function is a construct formulated by multiple inter-related high-level cognitive processes and skills (Lezak 1982). Based on Anderson (2002) the key elements of executive function include “a) anticipation and deployment of attention, b) impulse control and self-regulation, c) initiation of activity, d) working memory, e) mental flexibility and utilization of feedback, f) planning ability and organization, g) selection of efficient problem-solving strategies, and h) monitoring of performance”. These processes and skills develop throughout childhood (reaching full maturity in early adulthood) but for preschool age children the focus has been mostly on self-regulation, impulse control, working memory and mental flexibility however, research evidence demonstrated that planning, organization and decision-making skills can be observed in young ages too (Anderson, 2002; Welsh et al. 1991).

1.4.a. Development of Executive Function

In general, the preschool period is associated with rapid development in motor, language, cognitive, and social skills (Anderson, 2002). Available research demonstrates that during the preschool period executive processes develop at an unprecedented rate. However, it is important to note that there are enormous individual differences and inter-individual variability in both the developmental trajectories and the manifestation of executive function in preschool children (Anderson & Reidy, 2012). In a nutshell, the on-going maturation process of the executive domains and their associated neural networks is heavily dependent on refinement of additional executive and non-executive function skills as well as the

increased coordination and integration of those systems (Andreson & Reidy, 2012).

Cognitive development is thought to reflect brain development with rapid brain development in early childhood reflecting rapid development of cognitive processes at the same period (Casey et al. 2000; Casey et al 2005). During early childhood primary cortical areas such as the auditory and the visual cortex alongside areas such as the medial prefrontal cortex show high levels of synaptic density and witness a period of synaptic elimination at variable trajectories (Huttenlocher & Dabholkar, 1997). Additionally, total brain volume increases and reaches 95% of its adult size by age 6 years however, according to each region and its tissue type there are clear differences in brain volume trajectories (Lenroot & Giedd, 2006). From age four white matter volume increases steadily with grey matter volumes in frontal and parietal lobes reaching peak development during mid-childhood with white matter increasing faster and greater in volume (Giedd et al., 1999; Matsuzawa et al., 2001). An increase in myelination can provide an explanation for the increase in white matter volume in this age range (Tsujimoto, 2008). Myelination of the major cerebral tracts begins in the post-natal period, with greatest development in the first two years of life and it continues throughout childhood and adolescence (Gao et al., 2009; Paus et al., 2001). From as early as the post-natal period individual tracks that are present in the frontal lobe are identifiable and those tracks continue to develop throughout the preschool period (Hermoye et al., 2006). In combination, the maturation of white matter, the increase in myelination and the increasing complexity of neural networks, are thought to offer vital support in the development of cognitive functions alongside changes in the grey matter (Johnson, 2001; Tau & Peterson, 2010).

Apart from cortical changes other factors have also been closely associated with the development of executive function. An important factor apparently linked to executive function development is socio-economic status (Raver et al., 2013). Low socio-economic status has been associated with poor overall development in children (Bradley & Corwyn, 2002). Recent research showed an association between environmental adversity and higher levels of stress with the stress response likely to influence directly executive function in children (Arnsten & Li, 2005; Blair et al., 2011;

Dickerson & Kemeny, 2004; Evans & Schamberg, 2009). Raver et al. (2013) further supported this finding by providing clear evidence for the association between chronic exposure to poverty, chronic exposure to psychological stressors and children's executive function. Additionally, low socio-economic status is associated with less available educational, sensory and information opportunities for the developing child leading to a potentially poor environment in terms of the developmental stimuli (Bradley & Crowyn, 2002).

Parenting styles and practices have recently been associated with executive functioning in children however, available research is still limited and more in-depth analysis is needed (Cruz-Alaniz et al., 2015). In general, studies have shown that executive function might be affected by continuous social exposure with the family environment offering daily opportunities for the child to improve and challenge their executive functioning (Friedman & Scholnick, 1997). Regarding parenting styles per se, most of the research has focused specifically on positive rather than negative parenting practices and their association with executive function (Cruz-Alaniz et al., 2015). Hughes & Ensor (2006) demonstrated moderate correlations between negative parenting practices and harsh parenting styles and executive function. Another study showed an association between early childhood adverse experiences including neglect and abuse and development of executive function (Barret & Fleming, 2011). With regards to positive parenting, all available evidence demonstrates a relative effect of those practices and styles on children's executive function (Blair et al., 2014; Bernier et al., 2010; Kok et al., 2014; NICHD Early Child Care Research Network, 2005). Additionally, parents' executive function has a potentially crucial role in the child's overall development (Cruz-Alaniz et al., 2015). The implication of parent's executive function on the overall development of the child and its executive function development is crucial given the association between executive function and parenting styles and parenting practices (Cruz-Alaniz et al., 2015; Barret & Flemming, 2011).

Sleep is another area associated with executive function and overall cognitive development and it has a vital and complex role in maintaining good health (Kelly,

Kelly & Sacker, 2013). Sleep is regulated by a combination of social and biological factors including parenting styles and behaviours (Kelly, Kelly & Sacker, 2013). Shortened sleep duration can impact upon cognitive performance while sleep deprivation and inconsistent sleeping patterns that occur at key developmental stages is known to impact cognitive function (Kelly, Kelly & Sacker, 2011; Touchette et al., 2007). Sleep is crucial for brain plasticity and it creates the basis for further learning the next day (Kelly, Kelly & Sacker, 2013). Additionally, circadian rhythms are important for overall development and they can be disrupted when consistent sleep schedules are not in place (Witman et al., 2006).

Despite the lack of direct evidence on bedtime routines and development of executive function in young children critical processes and factors for the development of executive function in children are also present when it comes to bedtime routines. Those critical processes and factors include quality and stability of sleep, parenting and overall nurturing. These critical factors for executive function development are key for bedtime routines. For example, parents are the ones who implement the bedtime routines with their parenting styles and skills put into practice on a nightly basis around and during their bedtime routine while sleep has been extensively and concretely linked to the quality of bedtime routines. Moreover, and as discussed previously, executive functioning can also affect parenting practices and skills themselves therefore providing another important possible link with bedtime routines since problematic executive functioning could be key to the overall quality of bedtime routines.

1.4.b. Implications of Executive Function in everyday life

Executive function impacts upon a range of life aspects ranging from performing everyday tasks to academic success and higher cognitive performance (Anderson & Reidy, 2012). While critical for academic performance (Clark et al. 2010; Espy et al. 2004; Willoughby et al. 2011), executive function also seems to be linked to emotional, behavioral and social functioning (Blair 2002; Wiebe et al. 2011; Schoemaker et al. 2012). To better understand the wide range of functions and

behaviours that executive function impacts upon it is useful to focus on studies and evidence from children who experience deficits in executive function. Cognitive deficits associated with executive function include: poor inhibitory control, difficulties in utilizing feedback, problems in planning and organizational activities, difficulties in generating/implementing problem solving strategies, deficits in working memory and poor ability to reason (Anderson & Reidy, 2012).

Executive function is not solely associated with cognitive processes but it is also implicated in other areas including emotional, behavioural and social actions (Gioia, Isquith, Guy, & Kenworthy, 2000). Children with executive function impairments may present with a broad range of behaviours ranging from being apathetic, unmotivated, and unresponsive to being impulsive and argumentative (Anderson & Reidy, 2012). Also, poor interpersonal skills and difficulties in social relationships are common characteristics of impairments in executive function with children manifesting socially inappropriate behaviours such as asking embarrassing or inappropriate questions and/or make statements that can hurt others without consideration (Anderson & Reidy, 2012). Regarding social behaviours, it is important to note that due to the covert nature of executive impairments, they are often misunderstood or mistaken for lack of motivation, laziness, or impulsivity (Stern & Prohaska, 1996). Also, several studies have shown that young children with elevated rates of problem behaviours demonstrate clear deficits in executive functions (Hughes & Dunn, 2000; Hughes, Dunn, & White, 1998).

Additionally, research evidence has linked executive function impairments with psychopathological manifestations (Hughes & Ensor, 2010). Pennington & Ozonoff (1996) concluded that EF deficits are consistently found in both attention deficit/hyperactivity disorder (ADHD) and autism spectrum disorders. Also, in both childhood and adolescence, poor inhibitory control is associated with higher BMI (Reinert et al., 2013). Preschool children may be more prone to emotional-based eating in the absence of hunger when they present with lower executive functioning (Pieper & Laugero, 2013). Finally, another important area that impacts upon both every day and overall quality of life is self-regulation which is associated with

impairments in executive function. Barkley (2012) described self-regulation as the group of behaviours that involves “any action individuals direct at themselves so as to result in a change in their behaviour (from what they might otherwise have done) in order to change the likelihood of a future consequence or attainment of a goal”. The areas that self-regulation impacts upon have direct consequences in overall quality of health through an inability to consistently apply health-beneficial behaviours, goal-oriented approaches, change behaviours and practices that impact upon health quality and avoid repetition of failures and future consequences (Barkley, 2012; Terry & Leary, 2011).

Overall, executive function is a key area of interest due to its diverse implications for daily life and development especially in the case of young children. A better understanding is necessary with regards to mechanisms involved in the development of executive function in preschool age children, the manifestation of executive function processes in that age group and the role of bedtime routines and activities around bedtime in the eventual development and formation of executive functioning.

Overall conclusion

With their recurrent nature, bedtime routines are amongst the commonest family activities. The variety of activities undertaken during bedtime routines has been found to have wide implications for child development and wellbeing. Nevertheless, research into bedtime routines remains limited with key questions yet to be answered. Dental disease, school readiness and executive function in young children present three areas of particular interest in terms of their relationship with bedtime routines. Studies that implement innovative approaches in examining bedtime routines in families with young children from diverse and deprived backgrounds that focus on specific outcomes can increase our overall understanding on this particular, frequent family activity.

Summary

What we know now

- Bedtime routines are an important family activity with implications that span key child development and wellbeing areas
- In relation to bedtime routines the most researched area remains quality of sleep. Other areas, including dental disease, school readiness and executive function require further exploration
- Dental disease is the most common, preventable disease in the world and can affect child wellbeing and development, family functioning as well as public finances and the health service
- School readiness has attracted a wider interest from researchers and the public in recent years however, there are still controversies around its definition and assessment despite evidence on its importance for further development and success in life
- Executive function is an umbrella term that encompasses a series of cognitive functions that are vital for everyday functioning with preschool children especially prone to their effects
- Bedtime routines, especially activities around oral hygiene behaviours and diet have been linked to dental health outcomes
- Research remains limited on the importance of bedtime routines for executive functioning
- Reading before bed as part of an optimal bedtime routine is important for the development of school readiness in young children

Next chapter

- In order to better understand bedtime routines we need to first assess and quantify them. The next chapter will therefore focus on the best way of assessing and quantifying bedtime routines in order to maximise data collection and participant engagement while avoiding intrusive and burdensome practices.

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This chapter has been submitted for publication:

Kitsaras, G., Goodwin, M., Allan, J., Kelly, M. P., & Pretty, I. A. (TBC) Interactive text surveys in public health research: a novel assessment for bedtime routines. BMC Medical Research Technology, (TBC).

Results from this chapter have been presented at:

- (1) Society of Clinical Trials (SCT) Annual Scientific Meeting, Portland, OR, USA
May 2018
- (2) UCL Centre for Behaviour Change, 5th Annual Conference, London, UK
April 2019

Chapter 2

Interactive text surveys in public health research: a novel assessment for bedtime routines

Abstract

Background: Traditional research methodology especially questionnaires and paper-based assessments limit in-depth understanding of fluid dynamic processes that can impact upon wellbeing and development like bedtime routines. Current digital technological developments alongside greater use and familiarity among an ever-expanding part of the wider public create the potential of utilising such technological developments in research. Two studies examined the possibility of developing an interactive text-survey assessment of bedtime routines focusing on user feedback and a stepped approach that informed decision making processes.

Methods: Two versions of the interactive text-survey were developed. Both assessments including questions on bedtime routine activities and were delivered for 5 and 7 consecutive nights respectively to participating parents' mobile phones. A total of 50 and 200 parents participated in the two studies. Apart from the completion of the text-survey, feedback was completed by participants while data on response, completion and retention rates were also captured.

Results: Both studies maintain good retention rates (100 and 92.5%). Response rates were high in both studies (86 and 87%) with only a small percentage of participants reporting problems caused by completing the assessment. Regarding bedtime routines, both studies allowed for the collection of in-depth data that led to a better understanding of the prevalence and frequency.

Conclusion: Both studies showcased the potential of deploying text-surveys within public health research for capturing and quantifying real-time information on recurrent dynamic processes. Changes and adaptations based on recommendations are a crucial next step in further exploring the diagnostic and potential intervention properties of text survey and text messaging approaches.

Keywords

Digital technologies – mobile health – child – wellbeing – development – assessment – bedtime routines

Introduction

Capturing high quality and quantity of data is the cornerstone for every successful research project. Most research studies, especially those focusing on behavioural, psychosocial and wider public health research, utilise traditional approaches including paper-based questionnaires, interviews and surveys (von Niederhausern et al. 2017). These approaches can create barriers to participation for specific population groups while increasing risk to the quality of data (i.e. higher drop-outs, lower response rates) (Dorsey et al., 2015; Friend 2015; von Niederhausern et al. 2017). Easier access, higher uptake and better use of new technologies, especially mobile phones, creates the potential of shifting a number of research related activities away from traditional approaches (Dorsey et al., 2015; Friend 2015; von Niederhausern et al. 2017). In recognition of this shift, organisations around the globe including the US Food and Drug Administration recommends electronic capture of data for clinical trials instead of traditional paper-based methods (FDA, 2009). Moreover, research conducted by pharmaceutical companies amongst others utilises a significantly high level of mobile-based technologies (37%) for their clinical trials research (von Niederhausern et al. 2017).

Currently, use of mobile phones for communication and entertainment purposes is higher than ever before with approximately 93 per cent of the population owning a mobile phone in the United Kingdom (OFCOM, 2016). The use of text messages remains high with an average of 100 text messages per mobile phone subscription per month in the UK (OFCOM, 2016). Contrary to other technologies, people from low socioeconomic status and varying ethnicities have similar access to mobile technology to the rest of the population (Mittello et al., 2012). Low-income and minority groups, not only show similar rates of using mobile phones but they also report higher rates of text-messaging than other groups (OFCOM, 2016; Mitello et al., 2012). Additionally, mobile phone use is highest among less educated adults and those who rent or frequently change addresses (Fjeldoe, Marshall & Miller, 2009). Therefore, and in a research context, mobile phone-based text surveys may

represent an important tool for accessing, with minimum effort and intrusiveness, a large number of diverse participants while achieving high quality and quantity of data.

Assessment of bedtime routines in families with young children represents an area where text-surveys can be implemented in order to gain a better understanding on the fluid and dynamic processes involved in them. Bedtime routines have shown important associations with a variety of areas involved in child development and wellbeing especially quality of sleep, dental health, parental psycho-emotional wellbeing, attitude towards learning and cognitive development (Davies & Bridgman, 2011; Hale et al, 2009; Hill et al., 2016; Kelly, Kelly & Sacker, 2013; Levine, 2001; Mindell et al., 2016, Sadeh, Tikotzky & Scher, 2010). Despite evidence highlighting their importance, there is clear lack of a reliable, flexible, innovative and user-friendly assessment for bedtime routines (Henderson & Jordan, 2010).

The main approach when assessing bedtime routines has been paper-based questionnaires. Only a few studies utilised real-life capture of bedtime routines via video recording, possibly due to the intrusiveness of this method and the associated ethical implications. When using paper-based questionnaires with a retrospective design the possibility of recall and desirability bias are always present. Moreover, in most cases ethical considerations constrain the use of video recordings. With routines being incredibly variable and dynamic and with special consideration for intrusiveness and likelihood of bias it is important to approach the entire notion of bedtime routines assessment from a different angle. The proposed different perspective should utilise innovative, user-friendly technologies that will allow for greater quantity and better-quality data on bedtime routines while minimising intrusiveness and disruption to participants.

Objectives

There are 2 main objectives to this study, both linked together in an overall stepped approach for creating an innovative yet robust assessment. The first set of

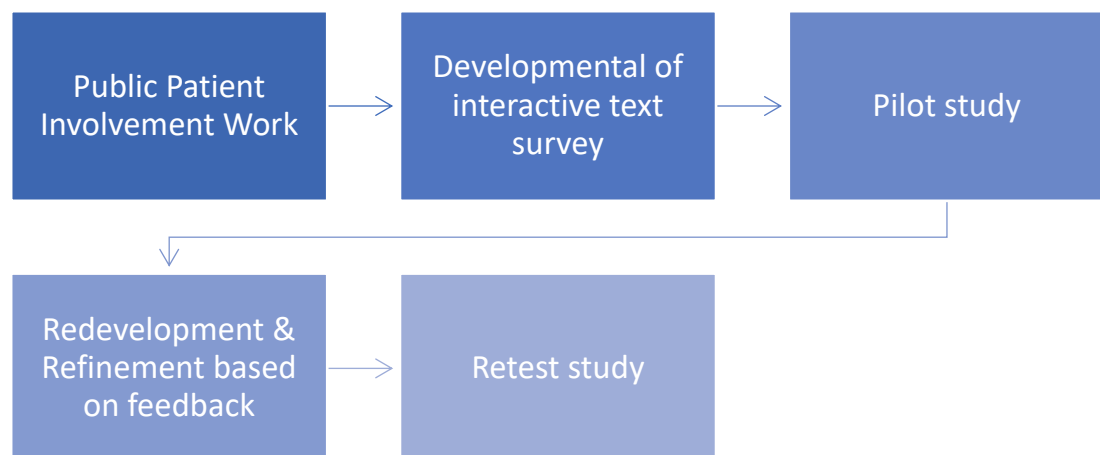
objectives, objectives A, include: (a1) examination of the best way of assessing target behaviour and development of an automated, interactive, text-survey assessment delivered directly to participants' mobile phone and (a2) a pilot study to evaluate its uptake, collect feedback from users and examine its effectiveness in assessing bedtime routines. The second round of objectives, objectives B, include: (b1) redevelopment and refinement of the assessment based on the results of (a2) and (b2) re-test the same assessment within a larger sample to explore uptake, feedback and effectiveness

Methodology

Overall process

The study followed a series of steps, as presented in figure 2.1. All steps were necessary since they informed the next stage of the study with important findings mapping back to the 2 main objectives and their 4 sub-objectives.

Figure 2.1. Overview of steps undertaken in this study



Public & Patient Involvement (PPI)

PPI work, prior to beginning the overall study, was completed during two separate visits to the preschool centres. The targeted sample for the PPI was parents

with children between the ages of 3 to 5 years. During the visits, a total of 15 mothers (no fathers attended the centres during the PPI work) with their children were approached. Each mother was asked questions based on a semi-structured interview developed before the visit. The questions revolved around their views on the best way of assessing their bedtime routines, as a recurrent dynamic health-related behaviour. As a thank you for their time each family received free toothpaste, toothbrushes for both adults and children and a 2-minute tooth-brushing timer.

Development of interactive text-survey

Following the completion of the PPI work, the interactive text-survey was developed in partnership with a company specialising in text messaging solutions. The overall structure of the finalised product can be seen in Appendix A.

Focusing on proposed ideal bedtime routine, as described by previous studies and expert opinion, the assessment of bedtime routines focused on 5 target areas: (a) consistency (determined as child going to bed within a space of an hour every night), (b) tooth brushing, (c) snack/drinks before bed, (d) use of electronic devices before bed and (e) book reading. Parents pre-determined the exact time they preferred to receive the text survey however, there was the option to delay the completion of the survey by 30-minutes, 1 hour or even opt-out for that night. Detailed instructions for the appropriate answers for each question were provided and if someone responded incorrectly, a clarification text was sent to them immediately to help them with their responses. Failure to reply following the instructions in two consecutive attempts led to the end of the survey for that night. The questions on the interactive text-survey were both open-ended and closed. Filter questions (Yes/No) led participants to different types of questions. If a participant replied to all questions of the survey, then he/she would have replied to a total of 9 questions. The minimum number of replies, when completing the assessment was set to 7. The assessment was administered for 5 consecutive nights after the child had gone to bed.

The text-survey was accessed via a secure, password protected online platform where researchers could add new participants while data collection was underway. All participants were added to the online system using their unique participant ID to pseudo-anonymise. Additionally, researchers could monitor the completion of each night's survey for each participant and notice when someone was not responding or not-completing all the questions. At the completion of the study data were securely downloaded from the survey system.

The research team opted-out from activating a "short-code" that would have allowed participants to reply free-of-charge. The charge that applied to each reply was made clear to participants at the beginning of the study. The charge per text message reply was at standard message rate and so was dependent upon their mobile phone contract and their provider. Short-codes have a significant cost while text messages are either free (included in someone's mobile contract) or only cost a small amount per text. Should a participant raised the issue of cost, the research team was ready to provide additional compensation to cover that cost and ensure equal participation for all.

Pilot study

This study was approved by the Health Research Authority in the UK (IRAS ID: 219018)

Sample. In total 50 families participated in the pilot study. All participants came from the Greater Manchester area. The mean age for the parents was 35 years (SD=5) with their children having a mean age of 4 years and 2 months (SD=0.8 months). Most adults were females (78% of the sample) while children were split relatively evenly with 24 males and 26 females. The large majority of the sample (66%) was White with Asian/British Asian and Black/British Black/Caribbean accounting for the remaining percentage with 18% and 16% respectively. Many adults had no university-level education (35 out of 50) and most were either part-time employed (19%) or stay at home parents (21%). Most lived in deprived areas (68% had Index of Multiple Deprivation (IMD) scores in the 4th and 5th quintiles) with no participants in the most affluent 1st quintile.

Recruitment & Eligibility. Participants were recruited: (a) through an active study on General Dental Anaesthetic teeth extraction who had expressed interest in participating in future studies and (b) through general dental practices. Two selection criteria were applied during recruitment: (a) having children between the ages of 3 and 5, (b) sufficient English literacy to provide informed consent and complete questionnaires and assessments and (c) access to a working mobile phone in order to receive-reply to text messages. During recruitment, information leaflets for both adults and children were provided; parents completed consent forms while child assent was sought throughout the process in order to ensure the willingness of each child to participate in the study.

Data collection. All participants received the interactive text-survey to their mobile phones at a pre-determined time for a total of 5 consecutive nights. As described above, the assessment focused on their bedtime routine activities with a combination of open and closed questions. At the end of the study, all participants were provided with anonymised feedback forms about their experience and their views on the interactive text-survey. Finally, data relating to uptake, response and retention rates were collected through the electronic platform.

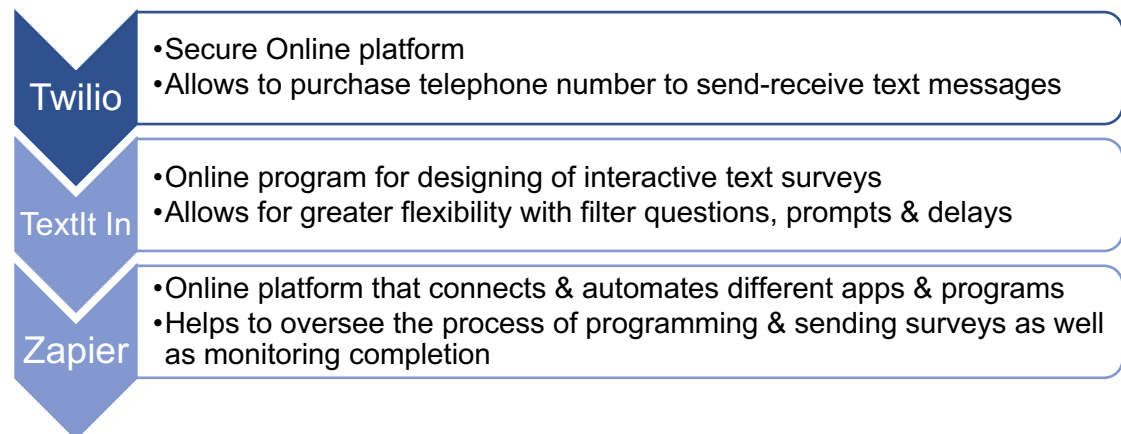
Data analysis. All data were coded into SPSS (IBM SPSS Statistics for Macintosh, Version 25.0) with analysis focusing on: (a) information provided around bedtime routines in their 5 key areas (consistency, tooth brushing, diet before bed, book reading, use of electronic devices), (b) feedback from participants on their experience using the interactive text-survey including suggestions on how to improve it and (c) uptake, retention and response data.

Redesign based on feedback

Following the completion of the pilot study and based on overall feedback as well as lessons learnt from a researcher's perspective, it was decided to part ways with the company specialising in text messaging solutions. Instead, it was decided

that the redesign of the assessment should be based on readily available software and online platforms that allows the research team to access, create and modify the content of the assessment in a faster and more cost-effective way. In total, 3 readily available software and online platforms were used for the redesign of the study. The overall structure of the re-designed assessment can be found on Appendix B.

Figure 2.2. Readily available platforms used in redesigning the text-survey



The core approach regarding the assessment of bedtime routines remained unaltered. Participants still received a series of open and closed questions around their bedtime routine activities for a number of consecutive nights. All participants were offered the same filter questions as well as explanations when replying back. All participants were also offered an opt-out option on a nightly basis with an overall opt-out function for the entire study added at the end of each night’s assessment. All participants were given delayed reply options at the start of their assessment to better adapt to their individual needs and changing circumstances. For the re-test study, the number of minimum questions increased to 8 with a maximum of 10 questions per participant, per night. Number of questions was varying based on filter questions such as “Did your child eat/drink anything the hour before bed?” where a positive answer triggered an additional question on the type of food/drink. As with the previous steps, all participants were entered into the system via an electronic platform using their unique IDs and all data were managed through secure, University-based, password protected computers. Table 2.1 below presents a summary of the key characteristics of both pilot and re-test interactive text-surveys as they were delivered to participants.

Re-test study

This study was approved by the Health Research Authority in the UK (IRAS ID: 238552)

Sample. In total, 200 parents were recruited. As with the pilot study, participants were recruited from across Greater Manchester. Parents had a mean age of 34.6 (SD=5.01) with the youngest participant being 25 years of age and the oldest 46 years of age. The vast majority of participants were females with only 13% (N=24) being male. Most families had only 1 child (65%) with 5% of families having 3 or more children. In terms of children's characteristics, all were between the ages of 3 and 7. In total, 48.1% of the sample was of white ethnic background, 39.5% was of Asian/British-Asian background and 12.4% was of Black/Black British/ Caribbean ethnic background. The vast majority of participants (77.8%) lived in deprived areas with an overall mean IMD score of 41.83 (SD=16.43) and a maximum IMD score of 79.65, double the threshold for the 5th IMD quintile.

Table 2.1. Key characteristics of pilot and re-test interactive text surveys

Characteristic	Pilot interactive text-survey	Re-test interactive text-survey
Number of minimum questions	7	8
Number of maximum questions	9	10
Open questions	Y	Y
Closed questions	Y	Y
Question on current parental mood	X	Y
Question on self-assessed bedtime routine score	Y	Y
Questions on key bedtime routine activities (e.g. tooth brushing etc.)	Y	Y
Opportunity to delay completion	Y	Y

Opportunity to opt-out on a nightly basis	Y	Y
Predetermined time to receive assessment	Y	Y
Nights receiving assessment	5	7
Average completion time	00:01:30	00:02:00
Activation of short-code for free-of-charge replies	X	X

Recruitment & Eligibility. Recruitment took place between February and July 2018. Participants were approached during their routine appointments in general dental practices. Exclusion criteria including: (a) not having English proficiency, (b) not owning a mobile phone and (c) having only children under the age of 3 or over the age of 7 years of age. Participants were informed about the requirements of the study and asked to provide consent. During recruitment, each participant was informed about the compensation that they would receive at the end of the study in the form of online shopping vouchers. The compensation for their time in the study stood at £10. Early withdrawal affected the amount of compensation.

Data collection. All participants received the interactive text-survey to their mobile phones at a pre-determined time for a total of 7 consecutive nights. As described above, the assessment focused on their bedtime routine activities with a combination of open and closed questions. Contrary to the pilot study, feedback was collected using an automated feedback system utilising a text-survey. The automated feedback system asked participants to reply to a series of open and close-ended questions using both numeric scales (for satisfaction, ease of use etc.) as well as text responses for general feedback and comments. Finally, data relating to uptake, response and retention rates were collected through the electronic platform

Data analysis. All data were coded into SPSS (IBM SPSS Statistics for Macintosh, Version 25.0). As with the pilot study, data analysis focused on: (a) bedtime routine activities with data collected from the interactive text-survey, (b)

feedback data regarding user experience and (c) uptake, retention and response rate information.

Results

Pilot study

Uptake, retention & response rates. The overall response rate was 86% with the lowest individual response rate at 60% (3 out of 5 nights). All participants replied to at least 3 nights' worth of text surveys. In total 25 (or 50 %) of all participants replied to all 5 nights. The first and fourth night of the 5 nights had the lower response rate of 78% (39 out of 50) and 80% (40 out of 50) respectively. Text reminders were extremely successful in prompting participants to reply to the next night's survey. When a participant failed to reply a reminder was manually sent aiming at prompting them to reply the following night. All of the 11 participants who failed to reply to the first night's text-survey after receiving their reminder, successfully completed the assessment on night 2. In total, 30 reminders were sent out during the study and all were successful in prompting participants to reply to the text survey the following night. Regarding completion of the text-surveys, if a participant started answering questions of the survey, then he/she continued until the last question resulting in 100% completion rate per survey with no missing data resulting from non-completion.

From the beginning until the conclusion of the study there were no drop-outs resulting in absolute retention of all participants (n=50). Participants were offered the chance to opt out at any given point by contacting the research team however, that option was never used.

Feedback from users. On a 1 to 5 scale, participants reported a satisfaction of 4.3 with regards to the administration and completion of the interactive text-survey over the 5-night period. Participants gave 4.5 out of 5 average score on easiness in

using the assessment. All participants selected text-surveys as their preferred method for future research on bedtime routines. The majority of participants had no recommendations for improving the text survey. Of those who made recommendations, the majority focused on the cost associated with replying to the text-survey (n=9). A significant number of participants mentioned the need for more guidance when responding to each question (n=5), another requested the option to respond later even when survey had already commenced (i.e. if something suddenly happens and they are about to finish with the questions) (n=4) while proposals for having fewer questions (n=2) and a number to call when problems arise (n=3) were the less common recommendations. Finally, some participants (n=5) mentioned that the interactive text-survey acted as a useful reminder for the things they need to do on a nightly basis to have a better bedtime routine in place.

Effectiveness in assessing dynamic behaviours. Overall, the interactive text-survey was successful in assessing the dynamic nature of bedtime routines. The interactive text-survey provided, on average, over 30 unique data points per participant reflecting changes on a nightly basis as they occurred during bedtime routines. Overall, the unique data points, helped to establish patterns amongst participants regarding their bedtime routines. Tooth brushing and avoiding snack were the most common activities around bedtime with 84 and 70 per cent of the sample reporting them as part of their routine. Avoiding use of electronics and TV before bed was also a common activity with around 66 per cent of parents reporting it as part of their routine. Finally, 52 per cent reported consistent bed times for their children. On a bedtime routine activity level, the most commonly missed activity was book sharing with only 38 per cent of parents reporting reading to their children before bed. These results allowed for a better exploration of bedtime routines in families with young children and their associations with vital child wellbeing and development outcomes such as school readiness, cognitive functioning and dental health.

Re-test study

Uptake, retention & response rates. From the 200 participants required, a total of 185 completed data collection resulting in an overall 92.5% retention rate. A total of 11 participants failed to reply to any of the text surveys and 4 participants opted out of the study after providing replies to at least 1 night of text surveys using the automated opt out function.

From the 185 people who completed data collection, there was an average response rate of 87%. There was a steady decrease in the response rate per night during the study with the 3 first nights showing response rates over 90% while the last 2 nights of the assessment showed response rates below 80%. This may reflect fatigue with the assessment over time. On average, participants replied to at least 5.5 nights of text surveys. The majority of participants replied to 6 nights (80 out of 185) while 62 participants replied to the full 7 nights, 39 replied to 5 nights and 4 replied to only 4 nights of text surveys. When participants received the text survey and engaged by replying to it, they completed the full survey. As with the pilot study, once a participant has started completing an assessment, then he/she continued until the last question resulting in 100% completion rate per survey with no missing data resulting from non-completion.

Feedback from users. The majority of participants enjoyed their participation in the study with an average satisfaction score of 4.6 out of 5 with no score below 3. The vast majority of participants reported high satisfaction scores in receiving and replying to the text messages for 7-nights. The average satisfaction score was 4.3 out of 5 and again, no score fell below 3. Only a small number of participants reported problems caused to their bedtime routines due to receiving and replying to the text messages every night and for 7 nights in total. Out of 114 participants who provided feedback only 5 (or 4.4%) reported such problems. The low number of people who reported problems may highlight the limited intrusiveness of text messages in assessing behaviours. Participants found the text messages and the questions asked through them extremely easy to understand with an average satisfaction score of 4.9

out of 5. All participants would recommend using text-surveys for assessing bedtime routines in future research. The majority of those who provided feedback (55.3%) supported the development of a bedtime routines text messaging support system for those who struggle with their bedtime routines. Finally, a marginal majority of participants (51.7%) reported being helped by the nightly text messages in better remembering what to do during their bedtime routines.

Effectiveness in assessing dynamic behaviours. During the study, participants replied to a total of 1125 text surveys generating 9157 unique data points. On average, each participant generated 50 unique data points by replying to an average of 9 questions per night during the course of the study. As with the pilot study, the deployment of the interactive text-survey allowed for a more in-depth observation of bedtime routine activities in families with young children. From data collected, most families showed little variation in the prevalence and frequency of their bedtime routine activities during the study. A small majority of participants (52.4%) reported brushing their children's teeth every night while only a small percentage (1.1%) reported never brushing teeth before bed. With regards to diet, 58% of participants reported allowing food and/or drinks the hour before bed at some point during the week. A total of 24.9% of participants read to their children every night of the week, 9.2% never read or shared a book with their children during the course of the study while on average 29.2% of parents read or shared a book with their children for at least half of the nights. Finally, with regards to use of electronic devices the hour before bed, 14.6% of parents allowed electronic devices to be used the hour before bed every night.

Pilot & re-test studies: key metrics

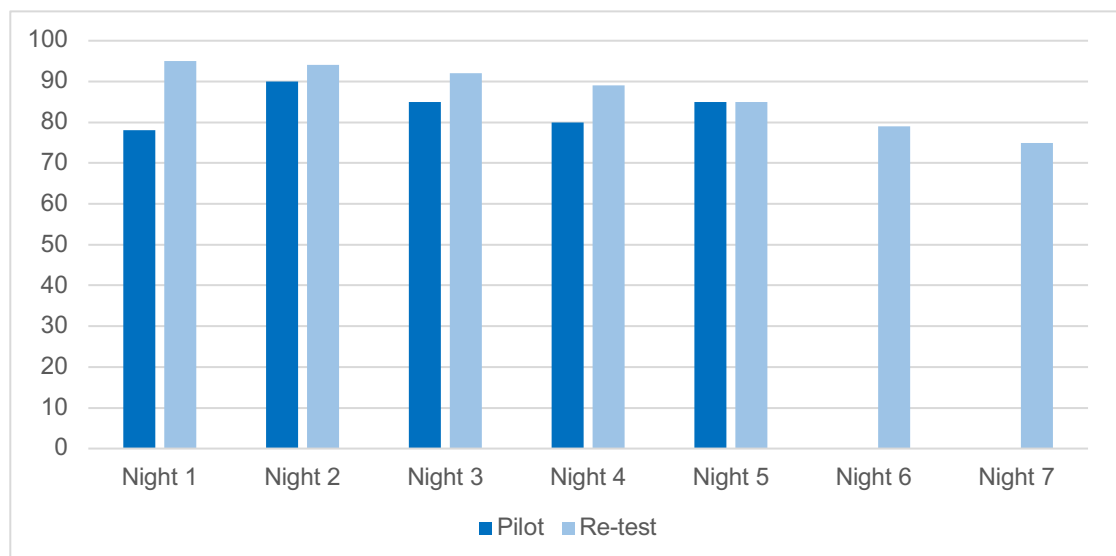
Table 2.2 summarises and compares results from the pilot and re-test studies across a series of key areas including: (a) retention rates, (b) response rates, (c) overall feedback, (d) easiness of use, (e) reported problems to routine due to receiving the text messages, (f) would recommend using text-surveys for bedtime routine assessment, (g) average unique data points captured and (h) overview of

assessment content-quality. Figure 2.3 reflects fluctuations in response rates per night between the pilot and re-test studies. Both studies maintained similar rates with regards to retention and responses while also maintaining good overall user experience with limited to no intrusion. Finally, both studies managed to capture good quality and quantity of data on bedtime routines.

Table 2.2. Between studies comparisons on key metrics

Metric	Pilot study	Re-test study
Retention rate	100%	92.5%
Response rate (overall)	86%	87%
Overall feedback score (scale 0-5)	4.3 / 5	4.6 / 5
Easiness of use (scale 0-5)	4.5 / 5	4.9 / 5
Reported problems to routine due to receiving assessment	5%	4.4%
Recommended text-surveys for future assessments	100%	100%
Supported development of text messaging bedtime routine intervention	N/A	55.3%
Average unique data points	30	50

Figure 2.3. Response rates per night in both pilot and re-test studies



Discussion

Both versions of the interactive text-survey assessment of bedtime routines provided large quantities and good quality data on the targeted behaviour. They also managed to keep participants engaged throughout the duration of the studies with limited drop-outs. Finally, both versions of the assessment created a user-friendly, non-intrusive experience for participants as reflected in their feedback. Based on results from data collected and feedback provided, the novel assessment of bedtime routines based on interactive text-surveys was successful.

The benefits of administering an interactive text-survey assessment for recurrent dynamic behaviours can be divided into three areas: (a) limiting recall bias, (b) securing higher volumes of data and (c) providing a better experience for participants. Recall bias can have a potentially detrimental effect on research findings by either underestimating or overestimating the true effect of a given behaviour (Althubaiti, 2016). Recall bias can be affected by a number of areas with time elapsing between targeted behaviour and assessment of that behaviour being one of the most prominent (Kip et al., 2001). In traditional assessments, including questionnaires, with a retrospective approach (in some cases up to a month after the targeted activity took place) recall bias has the potential to influence both the quality and the quantity of collected data due to the time lapsed (Althubaiti, 2016). In recurrent and dynamic behaviours, like bedtime routines, with their fluid nature a narrow timeframe between activity and assessment of targeted activity is crucial in order to be able to capture and investigate their intricate nature. With the development and utilisation of approaches that capitalise on narrow time-frameworks recall bias can potentially be eliminated.

As for the second area, securing higher volumes of data, the deployment of the text-survey assessment for bedtime routines led to a significantly higher response rate than with traditional questionnaires (Nulty, 2008). Additionally, once a participant started the survey, they completed it with no missing responses. That

resulted in an average of 30 and 50 unique data points per participant in the pilot and re-test study respectively. Finally, with respect to providing a better experience for participants, across all questions on the feedback form most participants reported no issues and reported a high satisfaction rate. Moreover, and when asked at the end of the study, every participant showed a clear preference for a text-survey style assessment against other measures including questionnaires and video recordings. Across health-related research and intervention studies, there is a significant variation in retention rates with some studies reporting retention rates as high as 97% and as low as 56% (Walters et al., 2017; Zweben et al., 2009). Approaches, such as interactive text-surveys, should be further explored and utilised as an alternative method in achieving better user engagement and retention.

In both studies, text surveys were used primarily for data collection as an alternative to traditional questionnaire and paper-based assessments for bedtime routines. As discussed, utilisation of text surveys and text messages is not limited to data collection with multiple other potential functionalities from recruitment to interventions (NHS, 2016). Their increasing availability in conjunction with higher use of mobile phone across all age and demographic groups presents a great opportunity for harnessing their wide spectrum of applications in both research and clinical settings. Multiple organisations like the National Health Service (NHS) in the United Kingdom now deploy text messages and text surveys in contacting and reminding patients about their appointments and/or to gather feedback about services (NHS, 2016). These examples showcase in practice how mobile phone-based text surveys and text messages can be used in a reciprocally beneficial relationship where service users or participants and organisations are mutually benefited. Solely for clinical applications, today's demanding, dynamic and highly variable healthcare needs present a great opportunity for mobile phone-based text messages given their cost effectiveness, high adaptability and flexible format (Car et al., 2012; Leong et al., 2006). That opportunity is also relevant for paediatric populations given their clear preference for tailored, technology-based and interactive programs such as mobile phone-based text messages and surveys (Shapiro et al., 2008).

Finally, medicine and healthcare as a whole are slowly, yet steadily moving to a personalised model of care as shown by the recent P4 (Predictive, Preventive, Personalized and Participatory) model (Flores et al., 2013; Hood & Auffray, 2013). This model emphasises the importance of transforming the service from a reactive to a proactive one with regards to disease and care (Sagner et al., 2017). Even though these models are mainly focusing on clinical and long-term conditions including diabetes, cancer and cardiovascular diseases, the same approach could possibly be used in a variety of health, wellbeing and development related behaviours. The P4 model of medicine and healthcare are driven by the evolution, expansion and the merging of three trends: (a) systems biology / systems medicine, (b) digital technologies for healthcare and (c) consumer-driven healthcare (Flores et al., 2013). Therefore, text message-based applications, including text-surveys, due to their versatility, low-cost per participant, ease of use, high personalisation and adaptation that transcends cultural, linguistic and demographic boundaries can be an active component in the era of P4 medicine and healthcare.

Limitations

The utilisation of a stepped approach in designing, refining and redeveloping the interactive text survey possibly minimises its limitations. However, there are a few areas where limitations can occur. One of the most likely areas is with regards to risk of bias, especially desirability bias. As with every assessment that relies on self-reported data desirability bias cannot be fully excluded. Also, and as highlighted by the comments made by several participants, despite attempting to only assess bedtime routines it might be possible that, by reminding participants about the components of a good routine, the text-survey acted as an unintended intervention leading to changes in some family's routines. That is not necessarily a negative limitation since this type of feedback allowed for the consideration of intervening properties regarding text-surveys and text-messaging for bedtime routines. Finally, another limitation to consider is around the lack of reference measure on assessing bedtime routines alongside the utilisation of the interactive text-survey.

Another overall limitation, not just with this particular study, is on the measuring of socio-economic status and the use of area-based measures of deprivation like the Index of Multiple Deprivation (IMD). IMD is a brute instrument of measuring deprivation since it utilised postcodes to provide an overall deprivation score within a particular area. In practice, IMD can therefore omit pockets of less or more deprived individuals and groups within a specific location resulting in practical limitations when interpreting findings. Other methods such as the use of income, employment and educational level all have separate limitations and cannot accurately provide a holistic understanding of someone's socio-economic and real-life, practical situation. Therefore, with no particular "gold standard" in the assessment of deprivation, a combination of instruments including the IMD and other variables like education, income and employment can be used in conjunction to provide a clearer picture.

Moreover, issues relating to the homogeneity of the sample (i.e. all from an urban centre) can be considered as an additional limitation. Lack of participants from rural and harder to reach areas outside large population centres means that the observed outcomes cannot be generalised outside of inner cities. Rural areas can present with unique characteristics including lack of adequate mobile phone coverage, different structure of a family's day etc. that all need to be accounted in with a different methodological approach compared to urban populations. Finally, the selected recruitment sites (i.e. dental practices) and the fact that participants were regular attendees in those practices requires special mention. It is possible that parents who attended their routine dental appointments presented with a different makeup of bedtime routines compared to those with irregular and random attendance in dental practices. Combining different recruitment locations away from solely dental practices is a way to resolve and overcome this limitation.

Recommendations

Despite their success, necessary changes and recommendations for future uses are vital in further exploring the benefits of text-surveys in assessing health-

related behaviours. These changes can focus both on further improving user interaction with the system as well as maintaining an overall good user experience with specific changes on: (a) provision for a number to call when and if issues or difficulties arise during the completion of the text survey and (b) free-of-charge replies by activating a “short-code” especially for research focusing on deprived socioeconomic areas and populations. Moreover, based on the feedback of some participants and on this particular area of research, it might be important to consider the development and examination of a text message bedtime routines intervention for achieving and sustaining better routines for families with young children.

Conclusion

The results of both studies showed the potential of deploying text-surveys within public health research as an attempt to capture real-time information on dynamic and highly variable recurrent behaviours that can have subsequent implications with development and wellbeing. It also demonstrated that text-surveys, possibly due to their non-intrusiveness and generally easier user interface, can be reliable alternatives for capturing data when compared to traditional methods or other technologies. Overall, text-surveys and text messages are emerging as a valuable alternative route for capturing data and delivering interventions in wider public health research.

Summary

What do I know now?

- Text surveys were successful at assessing bedtime routines in families with young children across the socioeconomic divide
- Text surveys created an overall positive participant experience as reflected on their feedback
- Text surveys might present a different way forward for the assessment of dynamic and personal recurrent behaviours with health and development consequences

Next chapter

- Following chapters will explore, specific areas of child wellbeing and development and their association with quality of bedtime routines in order to increase our understanding on this dynamic and repetitive set of behaviours

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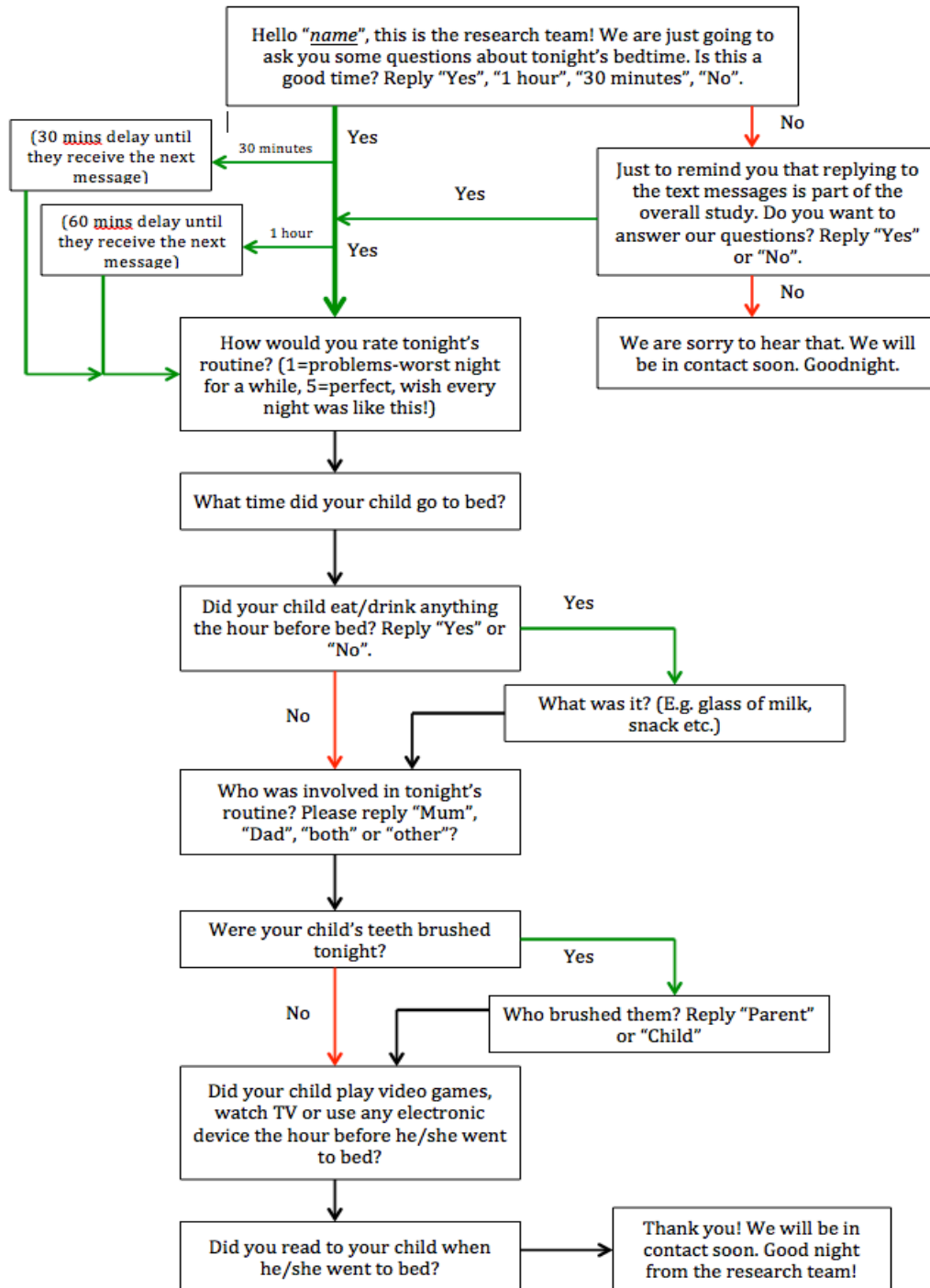
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Appendices

Appendix 2.A

Title: Branching flowchart for the pilot interactive text survey

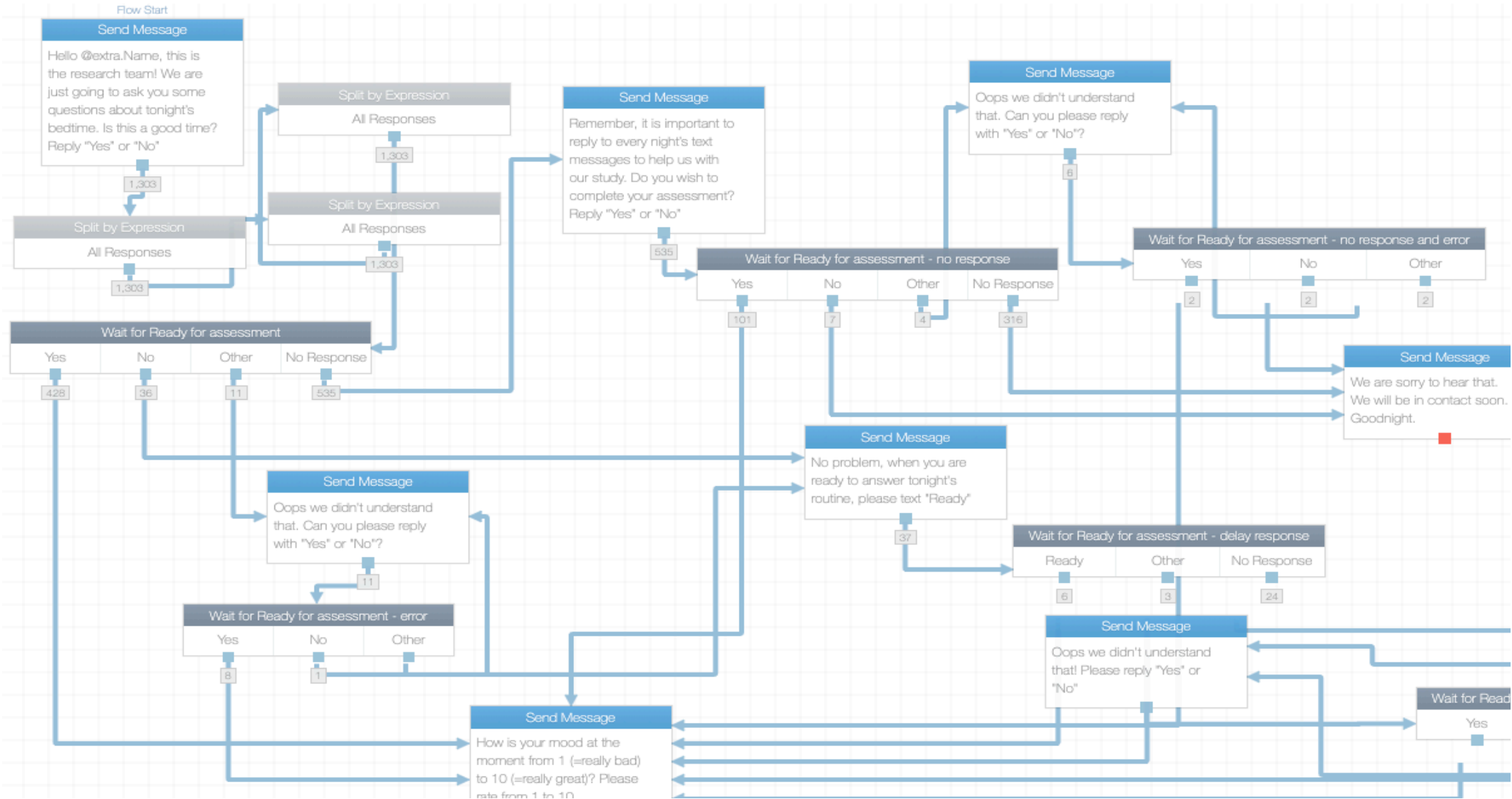
Description: Flowchart presents questions with acceptable answers and overall structure of the novel assessment of bedtime routines as administered during the pilot study.

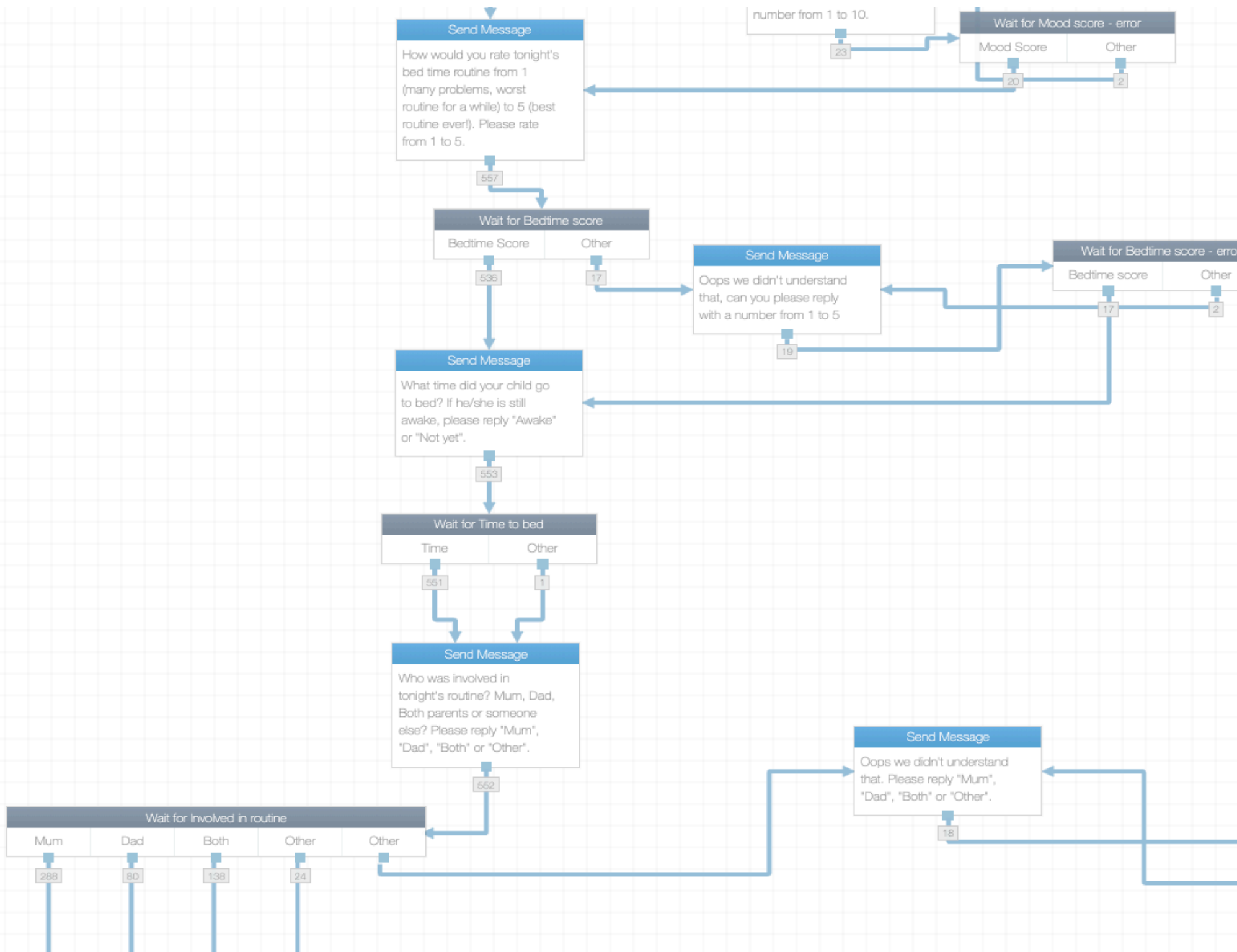


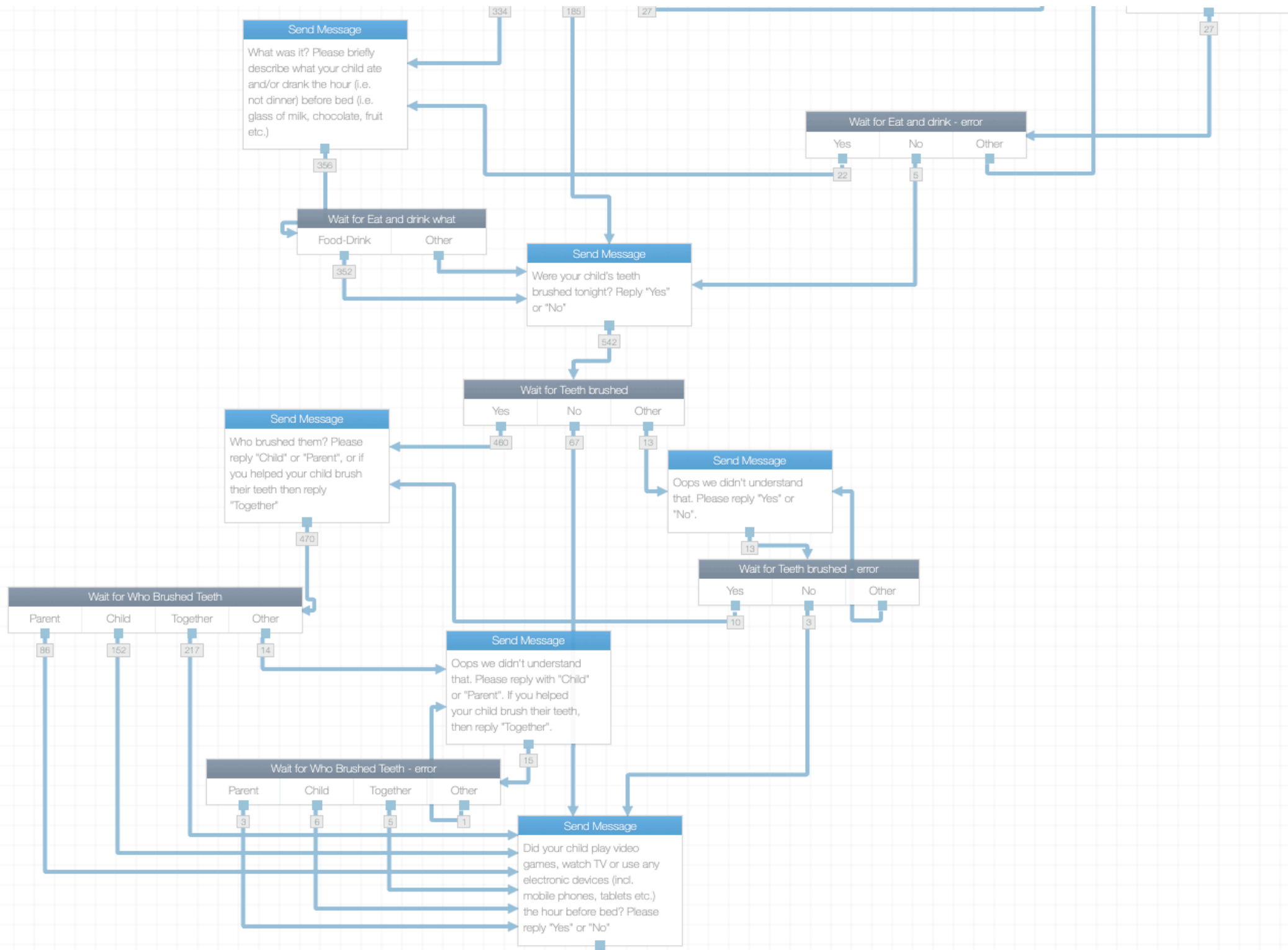
Appendix 2.B

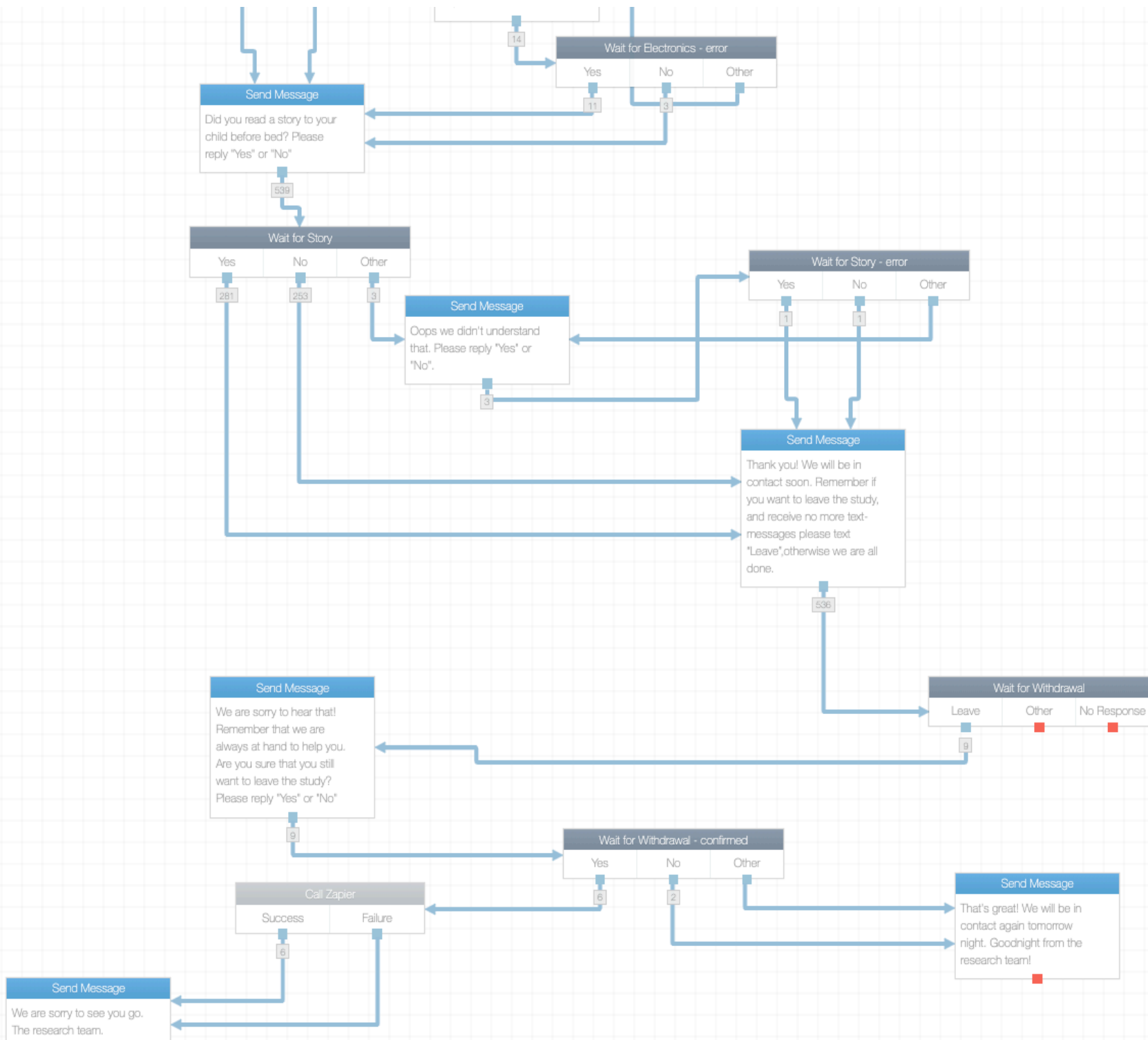
Title: Branching flowchart for the re-test interactive text survey

Description: Flowchart presents questions with acceptable answers and overall structure of the novel assessment of bedtime routines as administered during the re-test study.









Send Message

Did you read a story to your child before bed? Please reply "Yes" or "No"

Wait for Story

Yes No Other

Send Message

Cops we didn't understand that. Please reply "Yes" or "No".

Wait for Story - error

Yes No Other

Send Message

Thank you! We will be in contact soon. Remember if you want to leave the study, and receive no more text-messages please text "Leave", otherwise we are all done.

Send Message

We are sorry to hear that! Remember that we are always at hand to help you. Are you sure that you still want to leave the study? Please reply "Yes" or "No"

Wait for Withdrawal

Leave Other No Response

Wait for Withdrawal - confirmed

Yes No Other

Call Zapier

Success Failure

Send Message

That's great! We will be in contact again tomorrow night. Goodnight from the research team!

Send Message

We are sorry to see you go. The research team.

Abstract

Background. Bedtime routines has shown important associations with areas associated with child wellbeing and development. Research into bedtime routines is limited with studies mainly focusing on quality of sleep. The objectives of the present study were to examine the relationship between bedtime routines and a variety of factors associated with child wellbeing and to examine possible determinants of bedtime routines. **Methods.** A total of 50 families with children between 3 and 5 years old took part in the study. Data on bedtime routines, parenting styles, school readiness, children's dental health, and executive function were collected. **Results.** Children in families with optimal bedtime routines showed better performance in terms of executive function, specifically working memory ($t(44) = -8.51, p \leq .001$), inhibition and attention ($t(48) = -9.70, p \leq .001$) and cognitive flexibility ($t(48) = -13.1, p \leq .001$). Also, children in households with optimal bedtime routines scored higher in their readiness for school ($t(48) = 6.92, p \leq .001$) and had better dental health ($U = 85.5, p = .011$). Parents in households with suboptimal bedtime routines showed worse performance on all measures of executive function including working memory ($t(48) = -10.47, p \leq .001$), inhibition-attention ($t(48) = -10.50, p \leq .001$) and cognitive flexibility ($t(48) = -13.6, p \leq .001$). Finally, parents with optimal bedtime routines for their children deployed a more positive parenting style in general (i.e. authoritative parenting) compared to those with suboptimal bedtime routines ($t(48) = -6.45, p \leq .001$). **Conclusion.** The results of the present study highlight the potentially important role of bedtime routines in a variety of areas associated with child wellbeing and the need for further research.

Keywords

Child – bedtime – parenting – school readiness – dental caries – executive function

Background

Public Health England (PHE) classifies wellbeing as: *“mental and physical health elements incorporating emotional, social and developmental aspects along with? perceived satisfaction and optimal quality of life”* (PHE, 2015). A limited number of existing studies have shown important associations between bedtime routines and a number of factors linked to child development, child wellbeing and parenting (Davies & Bridgman, 2012; Hale et al., 2009; Kelly, Kelly & Sacker, 2013; Levine, 2001; Sadeh, Tikotzky & Scher, 2010; Hale et al., 2011). Quality of sleep, dental health, school performance including school readiness, socio-emotional and cognitive development have shown important, yet in some cases limited, associations with bedtime routines. These factors can directly affect components associated with overall wellbeing including mental and physical health as well as emotional, social and developmental aspects while impacting perceived satisfaction and quality of life resulting indirectly (Davies & Bridgman, 2012; Hale et al., 2009; Kelly, Kelly & Sacker, 2013; Levine, 2001; Sadeh, Tikotzky & Scher, 2010; Hale et al., 2011).

Overall, bedtime routines and quality of sleep has attracted the most research interest with studies consistently showing that better quality bedtime routines are associated with better sleep quality and duration for both adults and children (Sadeh, Tikotzky & Scher, 2010; Hale et al., 2011; Mindell et al., 2015). Other studies have highlighted the importance of bedtime routines in developing a healthy attitude towards learning, reading and ultimately school (Davies & Bridgman, 2012). Children who read regularly with their parents as part of their bedtime routine (or are read to by their parents) show improvements in language, reading and literacy rates as well as better school readiness (Davies & Bridgman, 2012; Duncan et al., 2007). School readiness, closely associated with a healthy attitude towards school, has impact beyond the first years of school education with children who have higher levels of school readiness at age five presenting generally with more successful grades at school, being less likely to drop out of high school and even earn more as adults (Duncan et al., 2007). Finally, associations have been found between bedtime routine

patterns of brain development, and socio-emotional skills development and a stronger parent-child relationship (Spagnola & Fiese, 2007).

Another area closely associated with bedtime routines is dental health. Oral hygiene behaviours (brushing teeth, avoiding snacks before bed) as part of bedtime routines have shown significant correlations with improved oral health with lower prevalence of caries (decay) in both children and adults (Davies & Bridgman, 2012; Gibson & Williams, 1999; Paunio et al., 1993). On the contrary, children whose parents allow them to consume products rich in sugars during bedtime routines show higher levels of caries compared to children whose parents have a more robust routine in place (Levine, 2001). Poor dental health during childhood can have a negative impact on the life of preschool children and their parents (Abanto et al., 2011). From a wider health perspective, the negative impact of dental caries at an early age includes chewing difficulties, decreased appetite, weight loss, sleeping difficulties, changes in behaviour (such as irritability), implications for psychological development (with low self-esteem having been suggested) and decrease in school performance (Abanto et al., 2011; Bonecker et al. 2012; Goodwin et al., 2015). Additionally, dental problems in young children possess a significant financial expense for families with high direct and indirect costs (Sheiham 2006). In certain cases, dental caries require hospitalization and visits to emergency departments that can be extremely stressful for parents and frightening for children (Goodwin et al., 2015). Untreated dental disease in children increases their risk for dental extraction under general anaesthetic a process that has significant impact on children and their families and which can increase the risk of dental anxiety (Tickle et al., 2009). Apart from child and family related implications dental caries also impact upon public finances and function of healthcare systems around the globe with US\$298 billion (or 4.6% of global health expenditure) spent on direct dental treatments alone (Listl et al., 2015).

Finally, bedtime routines have been associated with emotional and psychological wellbeing in parents and children. Children with non-regular bedtime routines experience more frequent behavioural difficulties than others (Kelly, Kelly &

Sacker, 2013) and parents with optimal bedtime routines for their children report lower levels of anxiety, anger and fatigue (Mindell et al., 2009). Research on family routines in general demonstrates the importance of parent-related as well as child-related factors (parental self-regulation, parental efficacy, parenting practices, socio-emotional wellbeing, parent-child relationship) in allowing positive routines to be developed and established (Spagnola & Fiese, 2001). Consistent and beneficial routines are essential for positive child development and family functioning and can expose the extent of affirmative and negative parenting practices within a family (Spagnola & Fiese, 2001). Routines also have important associations with parent-child dynamics and overall family functioning (Henderson & Jordan, 2010).

“Gold standard” of bedtime routines. Despite the reported likely importance of bedtime routines, no clear statement or policy on what constitutes an optimal bedtime routine exists. Based on available studies and limited guidelines from different organisation and professional bodies, an optimal bedtime routine for infants and preschool children is likely to; be consistent throughout the week and weekend, follow the recommended sleep times for each age group (i.e.10-13 hours of sleep, including naps, for children between 3 and 5 years of age etc.), include tooth brushing and avoidance of drinks (such as bottle feeding) and snacks before bed, minimise the use of electronic devices and television around and during bedtimes, consider a bath or shower before bed and finally, include book reading and book sharing activities before sleep (Sadeh et al., 2010; Hale et al., 2011; Hill et al., 2016; Paruthi et al., 2016).

As optimal bedtime routines have multiple potentially beneficial components the cumulative effect of all of them can result in multiple positive outcomes and wider benefits for wellbeing and development. However, the majority of research in this area focuses on just one beneficial outcome of routines – sleep quality. That focus is creating a gap in our understanding that needs to be addressed by more inclusive studies that move away from quality of sleep and examine other areas associated with wellbeing and development as highlighted by a review from Mindell & Williamson (Mindell et al., 2017).

Objectives

The principle objective of this study was to investigate if bedtime routines are associated with a diverse range of key indicators of child wellbeing and development. More specifically, the study investigated whether optimal bedtime routines are associated with (a) greater readiness for school, (b) better dental health and (c) higher executive function in preschool age children. These three areas of child health and wellbeing were selected due to their important associations with further child development, overall wellbeing, achievement and impact on quality of life. Moreover, prior research into bedtime routines heavily focused on quality of sleep as its primary objective with only a limited number of studies incorporating additional measurements of health, wellbeing and development. Additionally, an examination of possible determinants of bedtime routines formed the secondary objective of the study by exploring whether optimal routines are more likely in families where parents have (a) higher executive function and (b) positive parenting styles.

Methods

This study was approved by the Health Research Authority in the UK (IRAS ID: 219018)

Participants

One parent and one child from each of fifty (50) families took part in the study. Parents had a mean age of 35 years ($SD=5$) and were, as expected in research involving families, predominantly female (78%). Most (70%) had no university-level education and were either part-time employed (19%) or stay at home parents (21%). Children had a mean age of 4 years ($SD=0.8$ months) and were relatively evenly split by gender (48% male, 52% female). Socio-demographic characteristics of the sample represented the overall demographic composition of the area where the study was conducted with 66% White, 18% Asian and 16% Black in terms of ethnicity. Finally regarding their socio-economic background, based on the Index of Multiple Deprivation (IMD) where higher quintiles represent higher deprivation, 10% of the

sample came from the 2nd quintile, 22% from the 3rd, 26% from the 4th and 42% from the 5th quintile respectively. There were no refusals to participate in the study and no withdrawals throughout the duration of data collection. Appendix A contains full characteristics of the sample.

Recruitment

During February to May 2017, 50 participants were recruited in the study: (a) through an active study on General Dental Anaesthetic teeth extraction who had expressed interest in participating in future studies and (b) through General Dental Practices (GDPs). Two selection criteria were present during recruitment: (a) having children between the ages of 3 and 5 and (b) sufficient English literacy to provide informed consent and complete questionnaires and assessments. During recruitment, information leaflets for both adults and children were provided; parents completed consent forms while child assent was sought throughout the process in order to ensure the willingness of each child to participate in the study. Parents were the ones initially approached at GDPs resulting in researchers not being aware of each child's attendance to regular dental appointments.

Data collection process

Data collection took place between March and June 2017, while recruitment was underway, either in house visits, in the dental practices where the families were recruited or in a neutral venue. Two visits/meetings were necessary in order to complete the data collection with the first visit/meeting comprising of the parent-related assessment and the second meeting including the child-related assessments. In between the two visits/meetings, parents were sent a 5 nightlong interactive text questionnaire to assess the quality of each night's bedtime routines. Each participating family received a total of £50 in shopping vouchers as compensation for their time.

Measurements

a. Bedtime routines

All available measures of bedtime routines utilise a retrospective design with many of them containing a long-list of questions with increased risk of recall bias. The present study, following Patient Public Involvement (PPI) work, opted for the development of an interactive text-based survey for the assessment of bedtime routines.

Focusing on the areas previously identified from the literature as being components of optimal bedtime routines, the interactive assessment focused on 5 target areas: a. consistency (determined as child going to bed within the space of an hour every night), b. tooth brushing, c. avoidance of snack/drinks before bed, d. avoidance of electronic devices before bed and e. book reading (see Appendix B for the branching logic of the text-survey). The interactive text-survey was sent for 5 consecutive nights directly to participating parents' mobile phones. Questions were both open-ended (e.g. "What did the child eat before bed?") and closed (e.g. "How would you rate tonight's routine from 1 (=problems, worst night for a while) to 5(=perfect, wish every night was like this!). Consistency of implemented bedtime routines was monitored by a closed question (Who was involved in tonight's routine? Please specify "Mum", "Dad", "Both" or "Other").

A score of 1 was assigned for each of the components of the bedtime routines parents reported on a nightly basis. For example a family that reported brushing teeth, avoiding snacks and reading a book before bed received a score of 3 out of 5 for that night. Average scores for the 5 nights were calculated and used for further analyses. High scores indicate better bedtime routines. Cumulative, rather than separate component-based scores, were utilised in order to better understand the overall impact of bedtime routines as with previous research (Mindell et al., 2016). Effects of social desirability bias were considered as a possible limitation. However, the design of the assessment with its fast pace, short and direct questions and the

administration over a 5-night period were considered important counter-measures to minimise the effect of this type of bias.

b. School readiness

School readiness was assessed using the Bracken School Readiness Assessment-3rd Edition (BSRA-3) (Bracken, 2007). BSRA-3 consists of 88 items/tasks for children to complete under instruction, measuring concepts such as colours, number/counting, letters, size/comparison and shapes. The task takes approximately 15 minutes to administer and is suitable for children aged between 3 years and 6 years and 11 months. The BSRA-3 is a nonverbal task, minimising interference from language development, and it determines if a child is ready for school (Bracken, 2007). BSRA-3 has good test-retest reliability across time for all age groups (.76 to .92) and its internal consistency with split-half reliability is excellent (.95). High scores indicate greater readiness for school. Assessment of school readiness across all children participating in the study, even for the ones already in school, is crucial since many children in the first year of primary school still present as not school ready (Crawford et al., 2016).

c. Child dental health

Child dental health was objectively assessed through dmft (decayed, missing or filled primary teeth) scores assigned either through examination of dental charts, history of extraction of carious teeth under general anaesthetic or by a registered dentist. dmft scores are amongst the most commonly used methods in oral epidemiology for assessing dental caries prevalence and overall dental health. Higher dmft scores indicate poorer dental health. For this study, dental charts were collected from recruitment sites (i.e. dental practices) and they were later checked by a registered dental professional based at the Dental Health Unit, The University of Manchester. dmft scores were then derived from the charts and coded into SPSS for later analyses.

d. Executive function

Executive function was assessed by two separate assessments. First, executive function for both adults and children was assessed using the National Institute of Health (NIH) Toolbox for the assessment of neurological and behavioural function (NIH-Toolbox) (Zelazo et al., 2013). All assessments were administered electronically through an iPad. Three (3) neuropsychological assessments of executive function were selected focusing on attention/inhibition (=Flanker Inhibitory Control and Attention Task), working memory (=List Sorting-Working Memory Task) and cognitive flexibility/shifting (=Dimensional Change Card Sort) representing the three main domains of executive function (Miyake & Friedman, 2012). Higher scores in the NIH-Toolbox assessment indicate better executive functioning.

Perceived executive functioning in day to day life was assessed using the Behavioural Rating Inventory of Executive Function (BRIEF) with versions focusing on adults (18+) (BRIEF-A) and preschool (3-5) (BRIEF-P) (Gioia et al., 2000). BRIEF-A is composed of 75 items. Both BRIEF-P and BRIEF-A have appropriate internal consistency and temporal stability with $\alpha = 0.97$ and $\alpha = 0.96$ for the composite score in the BRIEF-P and BRIEF-A respectively. Low scores indicate better executive functioning (i.e. less dysfunction).

e. Parenting styles

The short-version of the Parenting Style and Dimensions Questionnaire (PSDQ) (Robinson et al., 1995) was administered to assess parenting styles. The PSDQ produces scores in three parenting styles: authoritative, authoritarian and permissive with underlying sub-dimensions. The score for each sub-dimension is calculated on the mean of all items within the sub-dimension. Each parenting style is calculated by taking the mean of the scores for the sub-dimensions within each style. The authors reported internal consistency reliabilities (Cronbach alphas) for mothers' and fathers' reports to be .86 (authoritative), .82 (authoritarian), and .64 (permissive).

Statistical analysis

All paper-based measurements (BRIEF-A/P, PSDQ, BSRA-3) were scored following the official professional manuals of the developers. BRIEF-A/P uses T scores (M = 50, SD = 10) that are transformations of the raw scale scores. BSRA-3 uses standard scores based on the age of the child and his/her raw score. Age-corrected scores (M=100, SD=15) from the neuropsychological assessment (NIH-Toolbox) were automatically calculated. Based on the 0-5 scales used to score bedtime routines, families with scores between 0 and 2 were coded as having “suboptimal bedtime routines” while families with scores between 3 and 5 were coded as having “optimal bedtime routines”. All data were entered into SPSS version 22 (IBM, 2013).

Bivariate correlations (Pearson’s *r*) were conducted between standardised metrics collected for the study (BSRA-3 for school readiness, BRIEF-A/P & NIH-Toolbox for executive function and PSDQ for parenting) to ensure that, as with previous studies, these measurements present strong inter-correlations that will allow for subsequent analyses. Between groups comparisons (independent sample *t*-test) were conducted for optimal and sub-optimal bedtime routines while a Mann-Whitney U test was conducted to examine differences in dental health between children with optimal and suboptimal bedtime routines.

Results

Comparisons based on bedtime routines for parenting, executive function and school readiness

Table 3.1 shows there were significant differences across all metrics. Positive (i.e. authoritative parenting) was more common in household with optimal (M=3.6, SD=0.68) than suboptimal (M=2.3, SD=0.72) bedtime routines, $t(48) = -6.45, p \leq .001$. Negative parenting including both authoritarian and permissive parenting styles was more common in households with suboptimal (M=2.5, SD=0.57) (authoritarian) /

($M=3.3$, $SD=0.97$) (permissive) than optimal ($M=1.5$, $SD=2.5$) (authoritarian) / $M=1.9$, $SD=0.54$) (permissive) bedtime routines, $t(48)= 6.50$, $p \leq .001$ for authoritarian and $t(48)= 5.82$, $p= .003$ for permissive parenting. Children presented as less ready for school with lower scores of school readiness in households with suboptimal ($M=81.2$, $SD=5.4$) rather than optimal ($M=106.1$, $SD=8.00$) bedtime routines, $t(48)= -12.15$, $p \leq .001$.

As for executive function, in the case of adults and regarding the assessments performed using the neuropsychological assessment, poorer performance on the inhibition and attention task was found in parents of households with suboptimal ($M=83.7$, $SD=4.9$) than optimal ($M=102.7$, $SD=7.00$) bedtime routines, $t(48)= -10.50$, $p \leq .001$. Also, parents with suboptimal bedtime routines scored lower in the working memory task ($M=80.4$, $SD=7.05$) than those with optimal routines ($M=100.1$, $SD=6.13$), $t(48)= -10.47$, $p \leq .001$. Finally, lower scores of cognitive flexibility were observed in parents reporting suboptimal ($M=84.3$, $SD=4.96$) than optimal ($M=105.3$, $SD=5.59$) bedtime routines, $t(48)= -13.6$, $p \leq .001$. In the case of children, lower scores in the attention and inhibition task were present in suboptimal ($M=84.3$, $SD=7.29$) than optimal ($M=103.2$, $SD=7.49$) bedtime routines, $t(48)= -9.70$, $p \leq .001$. Also, children from households with suboptimal bedtime routines showed poorer performance in working memory ($M=83.0$, $SD=7.29$) compared to those from households with optimal ($M=100.3$, $SD=6.25$) bedtime routines, $t(44)= -8.51$, $p \leq .001$. Finally, children with suboptimal bedtime routines showed less cognitive flexibility ($M=84.1$, $SD=5.25$) than those with optimal ($M=105.1$, $SD=5.74$) bedtime routines, $t(48)= -13.1$, $p \leq .001$. Regarding self-reported executive functioning (BRIEF-A & BRIEF-P), both parents and children in households with suboptimal bedtime routines scored higher ($M=53.1$, $SD=2.51$) (adults) / ($M=48.3$, $SD=2.61$) (children) – indicating poorer executive function- compared with those in households with optimal bedtime routines ($M= 45.3$, $SD=3.59$) (adults) / ($M=42.7$, $SD=2.88$) (children), $t(48)= 8.42$, $p \leq .001$ for adults and $t(48)= 6.92$, $p \leq .001$ for children.

Comparisons based on bedtime routines for children's dental health

The Mann-Whitney test indicated that children in families with optimal bedtime routines presented with better dental health, i.e. less decay and fewer missing or filled teeth ($dmft = 0$) ($Mdn=4$) compared to children in families with suboptimal bedtime routines ($dmft > 0$) ($Grand\ Mdn=2$), $U=85.5$, $p= .011$.

Associations between metrics

Table 3.2 presents the results of the bivariate correlations. In general, across all metrics, significant correlations exist in the directions expected. Interestingly, and contrary to available research that observed at best moderate correlations, there were strong correlations between the self-reported executive function inventory and objective neuropsychological assessments of both adults and children. Negative correlations are expected due to the nature of the scores obtained between the two assessments. In children, there was a strong negative significant correlation between the Global Executive Composite of BRIEF-P and inhibition and attention of the neuropsychological assessment, $r(50)= -.610$, $p \leq .001$, the Global Executive Composite of BRIEF-P and working memory of the neuropsychological assessment, $r(46)= -.575$, $p \leq .001$ and Global Executive Composite of BRIEF-P and cognitive flexibility of the neuropsychological assessment, $r(50)= -.639$, $p \leq .001$. Also, in the case of adults, there was a strong negative significant correlation between the Global Executive Composite of BRIEF-A and inhibition and attention of the neuropsychological assessment, $r(50)= -.654$, $p \leq .001$, the Global Executive Composite of BRIEF-A and working memory of the neuropsychological assessment, $r(50)= -.636$, $p \leq .001$ and the Global Executive Composite of BRIEF-A and cognitive flexibility of the neuropsychological assessment, $r(50)= -.656$, $p \leq .001$.

School readiness was significantly correlated with better executive function in children with $r(50)=.819$, $p \leq .001$ for inhibition and attention, $r(46)=.755$, $p \leq .001$ for working memory and $r(50)=.795$, $p \leq .001$ for cognitive flexibility indicating that

better executive function was related to greater readiness for school. Adults with better EF exhibited more positive parenting with authoritative parenting highly positively correlated with all executive function metrics for adults with $r(50)=.664, p \leq .001$ for inhibition and attention, $r(50)=.649, p \leq .001$ for working memory and $r(50)=.705, p \leq .001$ for cognitive flexibility. Conversely, poor performance on executive function measurements was associated with more negative parenting practices (i.e. authoritarian and permissive parenting) with $r(50)= -.608, p \leq .001$ for attention/inhibition, $r(50)= -.593, p \leq .001$ for working memory and $r(50)= -.627, p \leq .001$ for cognitive flexibility and $r(50)= -.462, p \leq .001$ for attention/inhibition, $r(50)= -.469, p \leq .001$ for working memory and $r(50)= -.552, p \leq .001$ for cognitive flexibility for authoritarian and permissive parenting respectively. Finally, higher parent executive function scores were associated with higher child executive function scores across all metrics of executive function with $r(50)= .783, p \leq .001$ for attention/inhibition, $r(50)= .686, p=.001$ for working memory and $r(50)= .590, p \leq .001$ for cognitive flexibility.

Table 3.1. Differences on parenting, executive function and school readiness between families with optimal and suboptimal bedtime routines

		Optimal Bedtime Routines (M, SD)	Sub-optimal Bedtime Routines (M, SD)	df	Sig. (2-tailed)	Mean Difference (95% C.I.)
Parenting	Authoritative Parenting	3.4 (0.68)	2.3 (0.72)	48	.001 ¹	-1.313 (-1.721, -.904)
	Authoritarian Parenting	1.5 (2.50)	2.5 (0.57)	48	.001 ¹	1.040 (.719, 1.362)
	Permissive Parenting	1.9 (0.54)	3.3 (0.97)	48	.003 ²	1.392 (.9000, 1.882)
Executive Function / Adults	Inhibition-Attention Adults	102.7 (7.00)	83.7 (4.90)	48	.001 ¹	-18.983 (-22.615,-15.351)
	Working Memory Adults	100.1 (6.13)	80.4 (7.05)	48	.001 ¹	-19.650 (-23.431, -15.868)
	Cognitive Flexibility Adults	105.3 (5.59)	84.3 (4.96)	48	.001 ¹	-21.017 (-24.123, -17.910)
	BRIEF-Adults (Global Executive Composite) ³	45.3 (3.59)	53.1 (2.51)	48	.007 ¹	7.800 (5.938, 9.662)
	School Readiness	106.1 (8.00)	81.2 (5.40)	48	.001 ¹	-24.900 (-29.020, -20.780)
Executive Function / Children	Inhibition-Attention Children	103.2 (5.59)	84.3 (7.29)	48	.001 ¹	-18.850 (-22.753, -14.946)
	Working Memory Children	100.3 (6.25)	83.0 (7.29)	44	.001 ¹	-17.310 (-21.406, -13.213)
	Cognitive Flexibility Children	105.1 (5.74)	84.1 (5.25)	48	.001 ¹	-21.066 (-24.289, -17.843)
	BRIEF-Preschool Children (Global Executive Composite) ³	42.7 (2.88)	48.3 (2.61)	48	.005 ¹	5.566 (3.950, 7.182)

1 Equal variances assumed

2 Equal variances not assumed

3 Lower scores indicate better executive function

Table 3.2. Associations between school readiness, executive function & parenting

		School readiness	Executive Function / Adults				Parenting			Executive Function / Children			
			Inhibition Attention	Working memory	Cog. flexibility	GEC ¹	Authoritative Parenting	Authoritarian Parenting	Permissive Parenting	Inhibition Attention	Working memory	Cog. flexibility	GEC ¹
School readiness		1											
Executive Function / Adults	Inhibition Attention	.819**	1										
	Working memory	.755**	.932**	1									
	Cognitive flexibility	.795**	.933**	.945**	1								
	GEC ¹	-.629**	-.610**	-.575**	-.639**	1							
Parenting	Authoritative Parenting	.602**	.645**	.608**	-.683**	-.715**	1						
	Authoritarian Parenting	-.624**	-.608**	-.519**	-.631**	.560**	-.615**	1					
	Permissive Parenting	-.611**	-.465**	-.464**	-.540**	.621**	-.649**	.623**	1				
Executive Function / Children	Inhibition Attention	.519**	.783**	.733**	.548**	-.635**	.664**	-.608**	-.462**	1			
	Working memory	.569**	.636**	.686**	.553**	-.603**	.649**	-.593**	-.496**	.942**	1		
	Cognitive flexibility	.407**	.641**	.541**	.590**	-.657**	.705**	-.627**	-.552**	.955**	.953**	1	
	GEC ¹	-.540**	-.408**	-.572**	-.665**	.661**	-.563**	.558**	-.474**	-.654**	-.636**	.656**	1

¹Global Executive Composite of BRIEF-A/P assessment

** Correlation is significant at the .001 level (2-tailed)

Discussion

The present study attempted to explore the effects of bedtime routines on child wellbeing and development and their association with parenting and executive function. Overall, results indicated the optimal routines were associated with better dental health, cognitive function and school readiness in children and that optimal routines were more likely to be present in households where parents were authoritative in style and had good executive function. Many of the findings from this study are unique while others follow existing observations from previous studies in the field.

Effect of bedtime routines on child wellbeing and child development

The between group comparisons based on the quality of bedtime routines (optimal or suboptimal) resulted in highly significant differences across all metrics associated with child wellbeing and child development. For school readiness the results of the present study echoed recommendations and findings from previous studies where children with suboptimal routines, with an absence of activities like book sharing and book reading, presented with lower school readiness a metric closely associated with subsequent school performance and academic achievement (High et al., 1998). Another area where the findings of the study are consistent with previous studies is in relation to dental health. Children with suboptimal bedtime routines, including in some cases absence of brushing teeth and/or consuming snacks before bed, presented with worse dental health (dmft > 0) compared to children whose routines included tooth brushing and no snacks before bed (dmft=0). The findings of the present study follow similar research in the field where children with robust routines that included dental health behaviours like teeth brushing and avoidance of late-night snacks showed lower levels of caries and generally more improved dental health (Kelly, Kelly & Sacker, 2013; PHE, 2015; Goodwin et al., 2017).

Finally, with regards to the observed differences in executive function between children with optimal and suboptimal bedtime routines, with the former presenting better scores across all metrics of executive function, this finding is new. Previous studies on the development and manifestation of executive function focused primarily on brain development and cortical changes with factors such as deprivation, environmental factors, parenting and sleep (Barrett & Fleming, 2011; Bradley & Corwyn, 2002; Raver et al., 2013; Touchette et al., 2007). Executive function, a complex and highly interdependent group of cognitive processes, develops at an unprecedented rate during the preschool period and it is open to multiple influences (Anderson, 2002, 2012). The complex nature of executive function and the myriad factors associated with their development make it difficult to draw firm conclusions from the present results, but the differences in executive function between children with optimal and suboptimal routines are large highlighting the need for further investigation. Sleep, directly affected by the quality of bedtime routines, can be a potentially significant mediator in the observed differences however; quality of sleep was not assessed in the present study potentially limiting our understanding. Moreover, parents with good executive function will be potentially more likely to have children with good executive function due to genetic and biological underpinnings given evidence of high heritability regarding executive function (Friedman et al., 2008). Based on the apparent importance of bedtime routines for child development and wellbeing, it is vital to gain a better understanding while also considering possible future early interventions to support those with suboptimal routines.

Parenting styles and parental executive function as possible determinants of the quality of bedtime routines

Between group comparisons based on the quality of bedtime routines showed significant differences in parenting styles and parent executive function between parents with suboptimal bedtime routines as compared to those with optimal bedtime routines. Parents with optimal bedtime routines systematically scored better on executive function tasks including inhibition/attention, working

memory and cognitive flexibility and their parenting style was also consistently more authoritative as compared to parents with suboptimal bedtime routines. The differences in executive function between parents with optimal and suboptimal routines can be the result of the previously known relationship between executive functioning and parenting styles (Crandall et al., 2015; Deater-Deckard, 2014) where the lower the executive function the more negative the parenting practices, and vice versa, with subsequent implications for the quality of family routines, bedtime routines included. Moreover, it is possible that executive function has a more direct relationship with bedtime routines given the multiple skills associated with that time-period in each family's day. All elements of executive function are likely to be vital for bedtime routines including working memory, that needs to be updated to maintain and manipulate information, attention, crucial in maintaining focus and guiding reactions, inhibition, to control impulsive behaviours and control negative emotions and finally shifting, to switch attention across multiple areas and situational demands (Barret & Fleming, 2011; Ribner, Fitzpartick & Blair, 2017). During bedtime, it can be hypothesised, that parents need to exercise the full extent of their cognitive and behavioural regulation capacities in order to achieve an optimal routine in an acceptable timeframe.

Since this is the first time that different parenting styles and parent executive function are examined in relation to their effect on the quality of bedtime routines and the present data are cross sectional, no firm conclusions can be made. It is important to further examine the stability of the observed, significant, differences in parenting styles and executive function with regards to optimal and suboptimal routines with the inclusion of other important parameters. A series of questions arise from the findings of this study and future studies will need to better understand the very nature of bedtime routines and how they are shaped. Are bedtime routines a direct product of parenting styles and practices with parent executive function serving as a possible mediator of that relationship or vice versa? If bedtime routines change, given that bedtime routines are behaviours repeated over a period of time, will the changes affect parenting and parent executive function? Finally, with changes in parenting styles and practices and even improvements in executive function,

despite its inherent decline over time due to aging, will changes in bedtime routines occur?

Children's executive function & school readiness

Consistently with existing literature in the field, school readiness scores were strongly positively associated with better executive function scores in the cognitive assessment and strongly negatively associated with the parent-completed inventory. The three aspects of executive function (working memory, inhibition/attention and cognitive flexibility) assessed during the study are considered fundamental for school readiness (Ribner, Fitzpatrick & Blair, 2017). Greater ability in cognitive flexibility, attention, inhibition and working memory is crucial in self-regulation and subsequently in allowing children to organise their thinking, minimise reactivity, increase social competence and ultimately support early learning, school readiness and school achievement (Blair, 2002; Hughes & Ensor, 2011; Stuss et al., 2005). School readiness is a multi-faceted construct with influences from a variety of factors including socio-economic status, parenting practices with executive function being one of them (Bradley & Corwyn, 2002).

Parent & child executive function and the role of parenting styles

At the moment, mixed and relatively limited results exist with regards to early childhood executive functioning and its association with parental executive function with some studies reporting strong associations that faded over time as the child grew (von Suchodoletz et al., 2017). In our study, parents and children presented strong correlations across all different metrics of executive function in both the neuropsychological assessments and the self-report inventories. Previous studies have shown that executive function might be affected by continuous social exposure with family environment offering daily opportunities for the child to improve and challenge their executive functioning (Friedman et al., 2014). Therefore, parents with lower executive function can directly and indirectly affect those crucial opportunities for the child to explore and practice its executive function leading to possible

subsequent decreased executive function compared to children whose parents have higher executive function. With previous mixed results the present findings contribute to on-going attempts to gain a better understanding of the complex nature of the development and manifestation of executive functioning in preschool age children.

Finally, and in full accordance with previous studies in the field, positive parenting (i.e. an authoritative parenting style) was strongly positively associated with higher executive function. Moreover, negative parenting styles (i.e. authoritarian and permissive) were significantly negatively correlated with executive functioning showing that the parents with worse executive function were more inclined to manifest authoritarian and/or permissive parenting styles and vice versa. The importance of executive function on parenting styles and practices is not difficult to understand when taking into consideration different aspects associated with both elements.

Limitations

Despite the significant, and in areas unique, findings of the present study some limitations exist. The main limitation of the study is its cross-sectional design that did not account for all possible confounders resulting in constraints regarding our understanding of the potentially causal relationships between the variables measured. Another limitation is the lack of information on potentially important metrics such as: child's psychosocial development, parental psychological wellbeing and child's quality of sleep that can have direct and/or indirect effects on observed associations. With regards to the latter, quality of sleep is associated with a number of social-emotional, cognitive, physical health and family functioning domains therefore future studies will need to account for it in order to be able to present an inclusive and holistic picture of all possible associations. Finally, the use of dental charts and dmft scores for the examination of the dental health of children presents its own set of limitations than extend more generally to the use of epidemiological

assessments over clinical caries assessment. This approach, despite being cost-effective and timely, cannot provide an in-depth examination of the dental health status of the children potentially limiting our overall understanding. The dental charts assessment was not able to identify if missing teeth were a result of extractions or lost naturally. Clinical examinations could have provided a more robust picture for children's dental health resulting in potentially more complex and advance analyses.

Conclusion

The main objective of the present study was to explore if bedtime routines affect child wellbeing as measured by dental health, school readiness and executive function. Additionally, the role of parenting and parental executive function as possible determinants of the quality of bedtime routines was examined. Following the analyses, all available findings point to the importance of routines with regards to child wellbeing with significant differences in key metrics between children who have optimal and suboptimal bedtime routines. Moreover, positive parenting and better executive function were both significantly associated with optimal routines allowing for a better understanding in the complex nature of mechanisms involved in the establishment and manifestation of bedtime routines. The present study showed important associations of bedtime routines with a variety of health-related metrics involved in child wellbeing and their relationship with parent-related factors. Despite limitations, the results of this study are unique in the literature, showing the need for more in-depth exploration of bedtime routines given their potentially crucial role in child wellbeing and their association with parent-related factors.

Summary

What do I know now?

- Quality of bedtime routines are associated with significant differences across children's school readiness, dental health and executive function scores
- Stricter and more rigid parenting styles are associated with poorer routines while higher parental executive function leads to better bedtime routines
- These findings can support further exploration of the mechanisms involved in the formation of bedtime routines and their impact across key areas of child wellbeing and development

Next chapter

- Having shown that bedtime routines are important for child development and wellbeing it is now pertinent to examine the routines themselves in more detail including the prevalence and specific activities that families undertake as well as the factors leading to the formation and the establishment of bedtime routines

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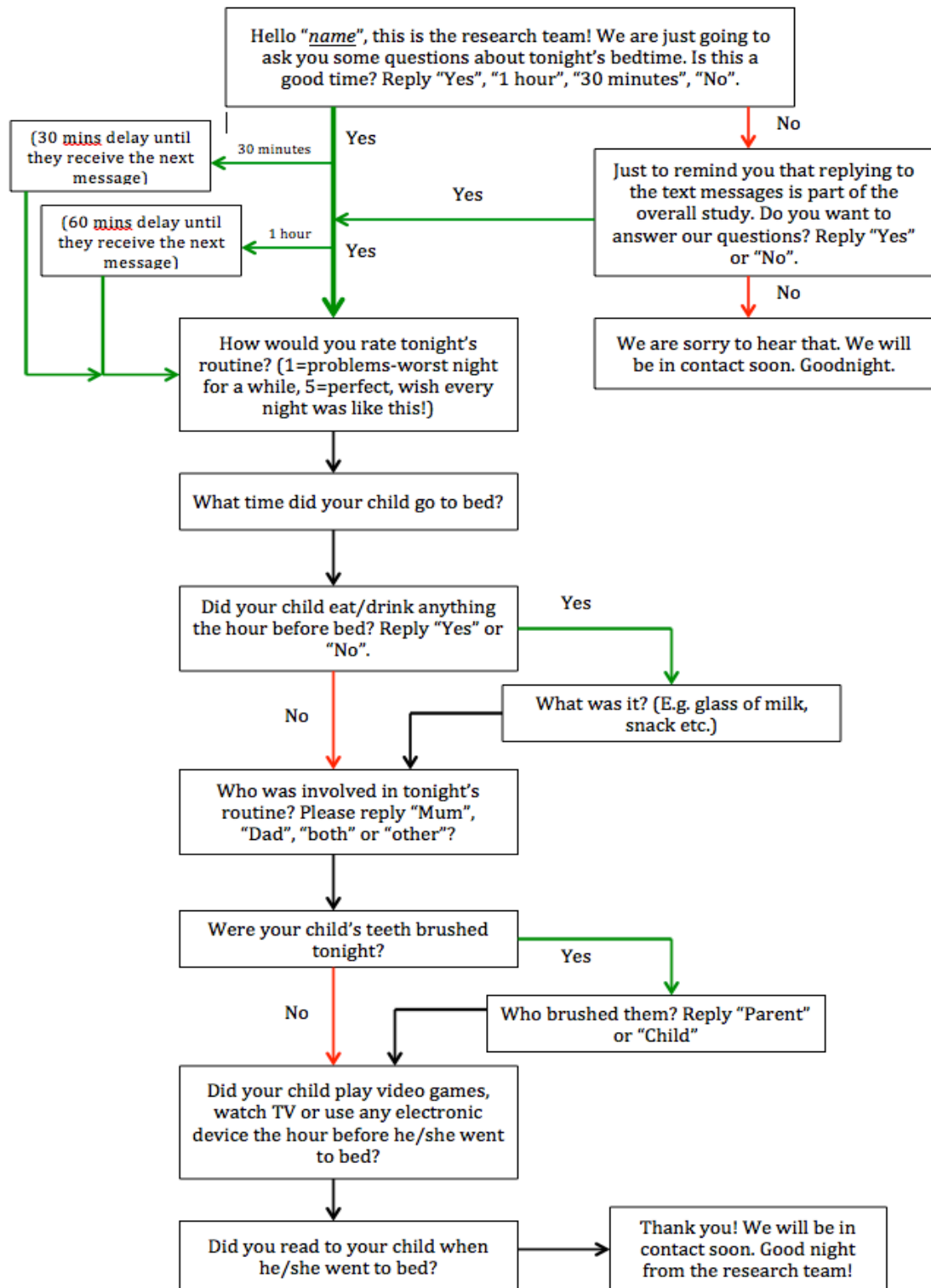
Appendices

Appendix 3.A: Descriptive statistics of sample

		<i>n</i>	<i>%</i>
Gender Parents	Male	11	22.0
	Female	39	78.0
Gender children	Male	24	48.0
	Female	26	52.0
		<i>M</i>	<i>SD</i>
Age	Parents	34.6	5.0
	Children	4.2	0.8
		<i>n</i>	<i>%</i>
Education	Postgraduate	2	4.0
	University	13	26.0
	Post-high school	21	42.0
	High school	14	28
Ethnicity	White	33	66.0
	Asian/British-Asian	9	18.0
	Black/British-Black	8	16.0
Employment	Full-time	5	10.0
	Part-time	19	38.0
	Self-employed	5	10.0
	Stay at home	21	42.0
IMD quintile	1 st quintile	0	0
	2 nd quintile	5	10.0
	3 rd quintile	11	22.0
	4 th quintile	13	26.0
	5 th quintile	21	42.0

Appendix 3.B. Branching logic of text survey bedtime routines assessment.

For 5 consecutive nights each participating family received the same initial text message (Hello “name” ...). Depending on their responses they continued to receive text messages until they reached the end of the survey.



This chapter has been submitted for publication:

Kitsaras, G., Goodwin, M., Allan, J., Kelly, M. P., & Pretty, I. A. (TBC). Bedtime routine characteristics of families with young children living in deprived areas. *Journal of Family Psychology*, (TBC).

Chapter 4

Bedtime routine characteristics of families living in deprived areas

Abstract

Bedtime routines have been shown to have significant associations with a variety of wellbeing and development metrics. Despite their importance, information is limited regarding frequency of activities and characteristics within these routines especially within diverse and deprived populations. The aim of this study was to examine bedtime routine characteristics and activities in a predominantly deprived population. In total 185 parents with children ages 3 to 7 provided data around their bedtime routine activities using an automated text-survey assessment over a 7-night period. Information around socioeconomic and demographic characteristics were also gathered during recruitment. A small majority of parents managed to achieve all crucial elements of an optimal bedtime routine every night with 53% reporting brushing their children's teeth every night, 25% reading to their children every night and 30% achieving consistency when putting their children to bed. Results showed significant differences between weekend (especially Saturday) and weekday routines $F(1,100)= 97.584, p < 0.001$ with an additional effect of employment type $F(1, 175) = 7.151, p < 0.05$. Results highlight variability in bedtime routine activities and characteristics between families in mostly deprived areas. Many families undertook, in a consistent manner, activities that are closely aligned with good practices and recommendations on what constitutes an optimal bedtime routine. Routines remained relatively stable during weekdays but showed signs of change over the weekend. Additional studies on mechanisms and elements affecting the formation, development and maintenance of bedtime routines are needed.

Keywords

Bedtime routines – child – parents – wellbeing – development - deprivation

Introduction

Bedtime routines can be described as a recurrent, dynamic and common set of activities that take place roughly the hour before children go to bed (Fiese, 2002). Previous studies on bedtime routines have shown the importance of bedtime routines in terms of quality of sleep, dental health, school performance and school readiness, psycho-social and emotional development, overall family functioning and parental socio-emotional wellbeing (Davies & Bridgman, 2012; Duncan et al., 2007; Hale et al., 2009; Hale et al., 2011; Kitsaras et al., 2018; Kelly et al., 2013; Levine, 2001; LeBourgeois et al., 2005; Mindel et al., 2015; Sadeh et al., 2010). Moreover, intervention studies have shown that it is possible to intervene and alter these routines with subsequent benefits for children and parents alike (Mindell & Williamson, 2018). Based on available information, an optimal bedtime routine should: (a) be consistent throughout the week and weekend following the recommended sleep times for each age group, (b) include tooth brushing, (c) avoid drinks (such as bottle feeding) and snacks before bed, (d) minimise the use of electronic devices including television around and during bedtimes and (e) finally, include book reading and book sharing activities before sleep (Davies & Bridgman, 2012; Duncan et al., 2007; Hale et al., 2009; Hale et al., 2011; Kitsaras et al., 2018; Kelly et al., 2013; Levine, 2001; LeBourgeois et al., 2005; Mindel et al., 2015; Mindell & Williamson, 2018; Sadeh et al., 2010).

Despite growing evidence on their importance, there is a limited, overall understanding on the characteristics and prevalence of bedtime routines across different countries and across populations of varying socio-economic and demographic composition (Mindell & Williamson, 2018). Mindell & Williamson (2018) in their systematic review highlighted the issue of limited studies around bedtime routine characteristics especially with respect to diverse socio-economic and demographic populations. From available research, it is known that most families have some sort of routine around bedtime but little is known on what actually takes place during that routine (Mindell & Williamson, 2018). US studies have shown

differences in the implementation and characteristics of bedtime routines between families of different ethnic and socioeconomic background but similar studies are lacking on a global scale (Mindell et al., 2010). The same review identified the additional need for longitudinal studies that examine bedtime routines in more detail rather than through the utilisation of one-off retrospective measures.

Regarding bedtime routine activities and characteristics these can encompass a diverse range of interactive, non-interactive and hygiene behaviours that parents implement as part of the bedtime routine (Mindell & Williamson, 2018). There are 11 behaviours that parents undertake including: bottle feeding/drinks, snacks, bath/hygiene behaviours, being rocked, singing songs, listening to music, reading books, massage, watching TV/using electronic devices, praying and running around (Mindell & Williamson, 2018). These behaviours can be further categorised into adaptive (i.e. hygiene behaviours, reading books) and maladaptive (i.e. snacks/drinks, watching TV/using electronic devices) (Jordan & Henderson, 2010). These 11 behaviours around bedtime routines are not consistent throughout childhood since rocking will eventually stop as the child moves from infancy to toddlerhood and beyond while other behaviours, like watching TV/using electronic devices, may become more prevalent as a child ages (Brockman et al., 2016; Mindell & Williamson, 2018).

With their recurrent manner, bedtime routines are one of the most common activities for families. Since bedtime routines have been shown to be important not only for each family's schedule but for overall child wellbeing and development it is crucial to gain a better understanding of their characteristics and constituent activities. Closer and more in-depth examination of the complex and dynamic behaviours and how these impact on health and development is vital. Therefore, the main purpose of this study is to examine, summarise and analyse bedtime routine characteristics and activities in families with young children living in deprived areas in England. This study will adopt an approach that relies on dynamic assessment of behaviour rather than administering retrospective questionnaires. Utilization of non-paper-based, electronic data capturing is considered important given the dynamic

and fluid nature of bedtime routines and the need to capture the routines close to the time they occurred. Paper-based, retrospective measurements of dynamic behaviours present with a series of limitations including lower return and response rates, barriers to participation for specific demographic groups and increased risk of recall bias (Dorsey et al., 2015; von Niederhäusern et al., 2017). On the contrary, use of electronic data capturing, especially surveys delivered via text messages, can enable higher return/response rates as well as inclusivity for participants from deprived and low socioeconomic status areas (Mittello et al., 2012).

Overall, this study aims to bridge the gap in knowledge and available information regarding bedtime routines in families with young children from primarily deprived socio-economic backgrounds. It also aims to better understand prevalence of bedtime routines and examine if there are specific characteristics and factors that can impact on the quality of bedtime routines such as demographic and socioeconomic characteristics.

Methods

This study was approved by the Health Research Authority in the UK (IRAS ID: 238552)

Sample & Recruitment

In total, 200 parents were recruited with children between the ages of 3 to 7 years of age. Recruitment took place between February and July 2018. Participants were approached during their routine appointments in general dental practices in four areas around the city. There was an overall consent rate of 65% with 308 people approached in total. Each area was chosen due to its diverse ethnic composition (from data obtained from the Office of National Statistics in the UK) and its high scores on the Index of Multiple Deprivation (IMD) (the official measure of relative deprivation of small areas or neighbourhoods in England). General dental practices were chosen due to the nature of the study that required collection of dental charts for further analyses. Exclusion criteria included: (a) not having English proficiency, (b)

not owning a mobile phone and (c) having only children under the age of 3 or over the age of 7 years of age. Participants were informed about the requirements of the study and asked to provide consent as per the approved protocol (Integrated Research Application System (IRAS) ID: 235885). Eligible participants were firstly identified by each General Dental Practice's manager. Initial contact was made through the manager and the admin staff at the reception of each dental practice. The researcher then explained the purpose, aim and requirements of the study in detail. Participants were also informed about the option to opt-out from the study at any point. During recruitment, each participant was informed about the compensation (£10 shopping vouchers) that they would receive at the end of the study in the form of online shopping vouchers.

Data collection

Data collection took place over a 7-night period in order to capture a wider range of data points per participant including fluctuations in bedtime routines occurring between weekdays and weekends. In line with a previous study on bedtime routines, child wellbeing and development (Kitsaras et al., 2018) an automated text-survey system was utilised for assessing bedtime routines. The automated text-survey included both open and close ended questions (a breakdown of questions asked at a nightly basis is presented in Appendix A). Questions covered all areas associated with an optimal bedtime routine. Due to the age of children included in the study (3 to 7) and their overall importance for short and long-term health, wellbeing and development 5 key areas were targeted with the automated assessment on a nightly basis. These 5 key areas included: time consistency, diet before bed (incl. drinks and snacks before bed), oral hygiene behaviours (i.e. toothbrushing), use of electronic devices (incl. watching TV) before bed and book reading/sharing before bed. Each of the 5 key areas was assessed with a combination of open and closed ended questions that were repeated each night until the end of data collection at night 7. Each night's assessment began with a self-assessment question regarding parental perception of BTR quality based on a 0 ("worst routine for a while") to 5 ("best routine, no problems at all").

During recruitment, parents agreed on a predetermined time for receiving the assessment. The assessment was delivered to their mobile phone with an introductory text message that informed them it was time to complete the survey. Each night participants were given the choice to delay completion or not complete the assessment at all. Additionally, at the end of each night's assessment, participants were given the option to automatically opt-out of the study. All questions from the text-survey contained clearly labelled accepted answers to help with further coding and interpretation of data. As part of this study, children did not need to complete or physically be involved in any activity or assessment. Finally, information on socioeconomic and demographic characteristics were collected during recruitment through the completion of a brief demographics form (Appendix B).

Data analysis

All data relating to bedtime routines were coded and analysed using SPSS (IBM SPSS Statistics for Macintosh, Version 25.0.). Data were descriptively analysed in order to examine frequency and prevalence of bedtime routines and activities. Since not all families responded to every night of the assessment, percentage scores were used instead of raw scores to reflect frequencies. Each night's routine was assessed based on available guidelines on what constitutes an optimal bedtime routine. As with a previous study (Kitsaras et al., 2018) a score of 1 was assigned to each of the 5 selected activities if parents undertook it as part of their child's bedtime in line with the current guidelines regarding bedtime routines. These activities included: (a) tooth brushing, (b) food/drinks before bed, (c) use of electronic devices before bed, (d) reading a book before bed and (e) consistency in terms of what time the child went to bed. For example, a family that reported brushing teeth, avoiding snacks and reading a book before bed received a score of 3 out of 5 for that night. Average scores for the 7 nights were calculated and used for further analyses. High scores indicate better bedtime routines. Providing a score for each night's routine helped standardise and quantify the quality of each night's routine within our sample leading to more options for further analyses. Reverse coding was used for specific

questions so that higher scores indicate better routines, for example if a family replied that their child/children used electronic devices one night alongside brushing their teeth, they would score 0 for electronic use (since they did not achieve an optimal behaviour around use of electronic devices) while they would score 1 for brushing behaviour (since by brushing their teeth they achieved that specific behaviour that night).

Multiple comparisons were used (repeated measures general linear models) to examine within- and between-subject variance regarding a participant's bedtime routine scores over the study period and also the possibility of a 'weekend effect' impacting the quality of bedtime routines. Demographic and socioeconomic information were used to examine possible effects on overall quality of bedtime routines using one-way analysis of variance (ANOVA). Finally, in terms of missing data, analyses were calculated with missing data excluded and then with median imputation replacing missing data. Analyses performed with any 'missing data excluded' and 'median imputation replacing missing data' showed no significant difference in the results. Therefore, it was determined that missing data did not significantly affect the results or subsequent conclusions that could be drawn. All data presented is based on the original data set with missing data excluded from analysis.

Results

Sample characteristics

In total, out of 200 parents 185 (92% retention rate) completed data collection. Parents had a mean age of 34.6 (SD=5.01) with the youngest participant being 25 years of age and the oldest 46 years of age. The vast majority of participants were female with only 13% (N=24) being male. Most families had only 1 child (65%) with 30% of families having 2 children, and 5% of families having 3 or more children. In terms of children's characteristics, all were between the ages of 3 and 7 and 105

(56.8%) were male. The demographic composition of the sample was diverse and it closely reflected the composition of the areas where recruitment took place. In total, 48.1% of the sample were white, 39.5% were Asian/British-Asian and 12.4% were Black/Black-British/Caribbean.

The Index of Multiple Deprivation (IMD) was used to calculate the socio-economic status of participating families. Both IMD scores and IMD quintiles were used in subsequent analyses. Higher IMD scores reflect more socio-economic deprivation. The vast majority of participants (77.8%) lived in deprived areas with an overall mean IMD score of 41.83 (SD=16.43) and a maximum IMD score of 79.65, double the threshold for the 5th IMD quintile. In terms of educational background, the vast majority of parents were graduates of high school (both in terms of GCSEs and A-levels) at 63.8% while 29.2% were graduates of post-high school, non-University degrees (i.e. colleges) with only 7% (or 13 participants) having graduated University. Finally, most participants (40.5%) were stay at home parents with 29.7% working part-time, 19.5% working full-time, 7% being students and only 3.2% stating that they are unemployed.

Response rates

All but one participant replied to at least 3 out of 7 nights. The participant who replied for only 2 nights was removed from subsequent data analyses due to low number of replies. From the remaining 184 participants, the majority of them (N=100) replied to every night of the assessment while 56 replied to 6/7 nights, 16 replied to 5/7 nights, 9 replied to 4/7 nights and finally, only 3 participants replied to 3/7 nights.

Overview of bedtime routine characteristics and activities

In total, five different bedtime routine activities were measured as part of this study. These are presented as percentage of participants who completed the activity based on their replies on a nightly basis. Table 4.1 summarises the overview of

bedtime routine characteristics and activities. In general, a small majority of participants reported brushing their children’s teeth every night (53%). Only 4.4% of participants reported completely avoiding snacks or drinks the hour before bed while 36 (19.7%) reported having snacks or drinks every single night before bed. From those allowing food and/or drinks the hour before bed, 44.3% gave their children water or unflavoured milk, 16.9% allowed consumption of fruit or vegetables while 14.3% allowed sugary or savoury snacks including chocolate, crisps or soft drinks. Finally, a total of 25.1% of participants read to their children every night of the week, 9.3 % never read or shared a book with their children during the course of the study, only 8.2% (15 out of 184) did not allow use of electronic devices at all the hour before bed while around 30% of parents achieved time consistency (i.e. within the hour of the time that the child went to bed the night before) in getting their children to bed every night.

Table 4.1. Overview of each targeted activity as part of bedtime routine

Activity	Achieved every night		Never performed		Achieved at least 50% of nights replied		Achieved less than 50% of nights replied		n total % total	
	N	%	N	%	N	%	N	%		
Tooth brushing before bed	97	53	2	1.1	61	33.3	23	12.6	184	100
Diet before bed (allowing snacks and/or drinks)	36	19.7	8	4.4	63	34.4	76	41.5	184	100
Book reading before bed	46	25.1	17	9.3	54	29.5	66	36.1	184	100
Using electronic devices before bed (allowing use)	27	14.7	15	8.2	80	43.8	61	33.3	184	100

Time consistency in getting child to bed	56	30.6	10	5.5	67	36.6	50	27.3	184	100
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Comparisons between nights of assessment

In order to examine if there was an effect over the week of answering the text messages that led to sustained changes in the reported quality of bedtime routines a repeated measurements ANOVA was completed. This looked to examine any differences between the first night of the assessment versus the remaining nights to determine changes in bedtime routine scores overtime. Due to the nature of recruiting participants there were differences regarding the start of data collection, for example some participants might have started their data collection on a Monday (night 1) while someone else might have started on a Friday (night 1). A Significant difference was observed for night 1 vs. night 2 $F(1,92) = 5.194, p. <.001$, night 1 vs. night 4 $F(1,92) = 6.186, p. <.001$ and night 1 vs. night 5 $F(1,92) = 7.886, p. <.001$. On the contrary there is no significant change between night 1 vs. night 3, night 1 vs. night 6 and night 1 vs. night 7

The results of the analysis showed that even though there were significant differences between night 1 and some nights however, there was an overall lack of a clear pattern of observed and sustained changes carried across all nights. Effects of demographics and socioeconomic characteristics (education level, IMD score, ethnicity, employment status) were included in this analysis with no significant modifications regarding observed differences.

Examining weekend effects on quality of bedtime routines

Examining possible effects of weekend nights compared to weekday nights was conducted using repeated measures ANOVAs. Possible changes in overall bedtime routines quality was examined by comparing Saturday and Sunday scores with scores on different nights of the weeks. The results of this analysis showed that

across all other nights (Sunday, Monday, Tuesday, Wednesday, Thursday, Friday) there were significant differences in the overall bedtime routine scores when compared to Saturday's score. Table 4.2 presents the results of this analysis comparing Saturday and Sunday results to the rest of the week. Effects of demographics and socioeconomic characteristics (education level, IMD score, ethnicity, employment status) were included in this analysis with no significant modifications regarding observed differences.

Table 4.2. Examining weekend effects on quality of bedtime routines

Weekend / Weekdays		M (SD)* Night 1	M (SD)*	F	Sig.
Saturday	Sunday	2.27 (1.12)	2.74 (.89)	78.155	.132
	Monday		3.37 (1.00)	97.584	.000
	Tuesday		3.64 (.94)	106.452	.000
	Wednesday		3.47 (1.39)	103.318	.000
	Thursday		3.19 (1.22)	73.818	.000
	Friday		3.27 (.94)	84.167	.000

Weekend / Weekdays		M (SD)* Night 1	M (SD)*	F	Sig.
Sunday	Monday	2.74 (.89)	3.37 (1.00)	32.314	.000
	Tuesday		3.64 (.94)	.789	.000
	Wednesday		3.47 (1.39)	103.318	.000
	Thursday		3.19 (1.22)	1.474	.000
	Friday		3.27 (.94)	6.678	.000
	Saturday		2.27 (1.12)	2.752	.132

Examining effect of demographic and economic characteristics on quality of bedtime routines

A series of one-way ANOVAs was calculated to examine possible effects of demographic and socioeconomic characteristics affecting the overall quality of bedtime routines. Employment status (full-time, part-time, stay at home parent, student, unemployed), education (university, college, high school/A-level, high-school/GCSEs, other), age of parent, age of children, number of children, ethnicity (white/white-British, black/black-British-Caribbean/British-Caribbean, Asian/British-Asian, other) and IMD scores were included in this analysis. The results of the analysis showed that only employment has a significant effect on overall quality of bedtime routines $F(1, 175) = 7.151, p < .05$. Post-hoc comparisons between the different types of employment showed that there are significant differences in mean bedtime routines scores between full-time vs. part-time employed parents and full-time vs. stay at home parents. Parents employed full-time were shown to have, on average, a lower (and therefore less optimal) bedtime routine score (mean = 2.7, SD=.64) compared to both parents working part-time (mean = 3.23, SD=.89) and stay at home parents (mean = 3.23, SD=.74) . Based on these results, it appears that both stay at home parents and parents working part-time achieved better overall bedtime routine scores when compared to those parents who work full-time.

Discussion

Multiple agencies, organisations and government bodies have long emphasised the importance of early childhood development as well as overall childhood experiences in long-term, future wellbeing and development (Anderson et al., 2003). One of the areas closely associated with early childhood development and child wellbeing in general is the quality of bedtime routines (Allen et al., 2016; Combs-Orme et al., 2011; Mindell & Williamson, 2018). Bedtime routines contain multiple and diverse elements with each component both individually and combined affecting child development and wellbeing (Mindell & Williamson, 2018). So far, little is known

about bedtime routines in socially, demographically and ethnically diverse populations with even more limited information in the context of the United Kingdom. This study examined bedtime routines in families with young children from deprived areas. The key results of the analyses show that there is a difference in the quality of bedtime routines between weekdays and the weekend with routines significantly worse in the latter period. Also, some parents appear unable to achieve all elements of an optimal routine in a consistent manner.

Importance of bedtime routine activities in overall child wellbeing and development

The present study simply examined prevalence, frequency and characteristics of bedtime routines in families with young children living in deprived areas with no metrics around impact of those routines. Therefore, there is no basis for causal or associative connections between the results of this study and the impact of optimal vs. suboptimal bedtime routines. However, and based on available data regarding bedtime routines, successful and consistent implementation of an optimal bedtime routine can have important and long-term benefits for children and their families alike. Good oral hygiene behaviours, including frequent tooth brushing before bed as well as avoidance of food and/or drinks excluding water and unflavoured milk before bed can lead to overall better dental health (Levine, 2001; Tinanoff & Reisine, 2009). Lack of dental problems early in life can then have positive implications for child's overall development leading to avoidance of dental extractions, dental pain, loss of sleep due to dental pain and missing days in school (Abanto et al., 2011; Bonecker et al., 2012; Goodwin et al., 2015). Apart from dental health, good dietary habits the hour before bed have shown important associations with obesity rates (Anderson et al., 2016; Evans et al., 2015). In this study, it was found that just over half (53%) of parents managed to consistently brush their children's teeth every night with around 1.1% never reporting brushing their children's teeth over the course of the data collection process. Moreover, the majority of parents (97 out of 184) allowed either snacks or drinks other than water or unflavoured milk the hour before bed resulting in problematic dietary habits for their young children. Both poor and inconsistent oral

hygiene behaviours as well as poor dietary habits can result in issues with dental problems with findings from this study highlighting the need for improvement in both of these behaviours.

Book reading or sharing a book with children as part of the bedtime routine can promote child literacy, improve school performance and enhance school readiness in young children with subsequent possible implications in later achievement and attainment (Duursma et al., 2008; Hale et al., 2011; High et al., 1998). Based on the results of this study, around 10 per cent of parents never read to their children before bed while another 36.1% read or shared a book with their children for less than half of the nights replied. Book reading or sharing a book with a young child as part of his/her bedtime routine is a crucial element for successful later development and therefore it is a behaviour that needs proactive and consistent participation from parents.

Having a consistent, appropriate time children go to bed could aid in achieving adequate hours of sleep. In addition, maintaining the routine around a stable and protected time each night can further reinforce the formation of habits and rituals for the family and the child (Fiese, 2002; Spagnola & Fiese, 2007). Finally, optimal routines can lead to better family functioning with less behavioural issues (i.e. tantrums, bedtime resistance) while enhancing parent-child relationships and interactions and improving parental socio-emotional wellbeing (Adams & Rickert, 1989; Custodero et al., 2003; Mindel et al., 2009). In terms of time consistency, this is the only area where a larger majority of parents either achieved it every night or tried and achieved it at least for half of the nights they replied to the text surveys. Overall, 67.2% of parents managed to achieve consistency in getting children to bed with only 5.5% or 10 out of 184 people failing to do so every single night of the data collection period.

The only activity where results presented a more mixed picture between those with overall optimal and those with overall sub-optimal bedtime routines was use of electronic devices before bed. Use of electronic devices at some point during

the week was reported from 92% of the sample. Based on available data collected from the automated text-survey, it is not possible to distinguish what type of engagement with electronic devices that 92% had. Use of electronic devices is a broad subject ranging from watching TV to reading an e-book on a portable reader. The recent rise in access rates to electronic devices from a younger age and time spent in front of a screen has prompted a more robust look on possible effects and implications. Recent studies have shown that prolonged exposure to electronic devices can lead to overall issues around development with particularly important implications around sleep as well as cognitive, educational and behavioural development (Cain & Gradisar, 2010; Hill et al., 2016). With a possible important link between the use of electronic devices and overall child wellbeing and development it is important to further explore the types of interactions and uses of those devices in the context of bedtime routines.

Finally, results showed evidence of a prevailing “weekend” effect where the quality of bedtime routines deteriorates closer to and around the weekend when compared to weekdays or school-nights. This is an interesting and previously non-reported finding. Anecdotal evidence could suggest that parents and families at large might alter their behaviours between weekday and weekend nights. Normally, a weeknight will span from Sunday (since the next day, Monday, is a school day) to Thursday with Friday and Saturday treated as weekend nights. However, previous studies (although only a handful of studies have focused on the weekend/weekday distinction with regards to family function) have considered Monday-Friday as the weekdays and Saturday-Sunday as the weekend mirroring a “normal” working week and traditional weekend classifications (Adam et al., 2007). The mere labelling of some nights as school-nights and other nights as weekend nights can provide sufficient justification for the creation of cognitive, at first, and later, practical and behavioural modifications and altered expectations on what children are supposed to do and not do. Even though parents try and, in many ways, succeed to maintain their optimal bedtime routines during the week when the weekend comes, cognitive overload, physical exhaustion, modified expectations and overall environmental changes (parents and children are at home together for longer hours, there might be

unexpected changes to the family's scheduled due to the fact that it is the weekend etc.) might result in the observed deterioration of bedtime routines. There is no specific evidence base for this hypothesis but the conscious and sub-conscious power that simple labels might have on people's behaviours and expectations has been previously observed (Kazdin & Cole, 1981). Despite this finding, it is important for further research in this area to better understand the practical implications of classifying a day as weekday or weekend based on family dynamics and practices. Also, an examination of other factors that can trigger changes in routines such as holidays need to be further explored to complete the picture around bedtime routines in families with young children.

Demographic, socioeconomic factors and implications for bedtime routines

Limited information is available on sociodemographic and ethnic influences with respect to prevalence, characteristics and activities involved as part of bedtime routines (Mindell & Williamson, 2018). Studies focusing on deprived populations and diverse ethnic samples come primarily from US samples with only a few studies on cross-cultural differences on a global scale (Mindell & Williamson, 2018). Previous studies have reported differences in prevalence and frequency of bedtime routines and activities involved in a routine between white and non-white samples as well as samples from predominately Asian countries and regions (Mindell et al., 2010; 2010; Yoo, Slack & Holl, 2010). In the present study, White/White-British, Black/Black-British-Caribbean/Caribbean-British and Asian/British-Asian groups were represented in accordance to the ethnic composition of the communities where recruitment took place. Despite prior evidence of significant differences in the quality and frequency of bedtime routines amongst different ethnic groups (Mindell & Williamson, 2018) this study failed to show this difference. This is a new finding especially within the context of the United Kingdom where prior studies on bedtime routines activities did not report data and findings on ethnic differences. Additionally, with a long-established misrepresentation of minority ethnic groups in health research (Redwood & Gill, 2013) it is crucial for studies to be able to include and report on communities that are routinely overlooked. Examination of diverse

populations can allow for better and more inclusive findings for a recurrent family activity that transcends sociodemographic and ethnic boundaries.

The only effect regarding socio-demographic, ethnic and economic factors resulting in significant differences of bedtime routine scores was associated with type of employment. Results showed that part-time employed parents and stay at home parents scored significantly higher than full-time employed parents in terms of their quality of bedtime routines. This is also a new finding regarding bedtime routine research with no previous study reporting such observed differences between types of employment. Due to the nature of the present study it is difficult to dismantle the exact nature of this result and therefore, further studies examining this observed difference are necessary.

Limitations

Risk of bias, especially desirability bias, is probably the most important possible limitation of this study. As with every self-reported measure, it is difficult to control for the effects of desirability bias since it is the responsibility of the participant to reply with accuracy and honesty with no means of guaranteeing the accuracy of their responses. The development and deployment of the mobile-based text-survey assessment of bedtime routines aimed at reducing effects of desirability bias by introducing a more intrinsic approach that utilised a rapid and more automated response pattern from participants. Another limitation or potential strength of this study can be found in the use of text messages to measure very simplistic constructs around bedtime routines, i.e. if children used electronic devices at all before bed, and the lack of further exploration. Further qualitative work will be necessary in the future to measure these constructs in more depth however, for now, this study provides a broad yet necessary overview of bedtime routines in families from deprived socioeconomic areas. Finally, despite the importance of engaging and researching bedtime routines with a primarily deprived sample, this approach can be an additional limitation of this study. The lack of greater numbers of non-deprived families resulted in lack of comparable data regarding their bedtime routines.

Conclusion

This study aimed at exploring bedtime routines activities and characteristics in mostly deprived families with young children. Based on the results of the analysis, there were distinct differences in activities and their frequency between families. Even from these preliminary and largely descriptive results it is clear that families do not always manage to follow the recommended activities around bedtime. This study provided an interesting yet missing point of view on an important and recurrent family activity with possible health, development and behavioural implications. Further research is necessary in order to examine causal mechanisms and elements involved in the development, establishment and maintenance of bedtime routines.

Summary

What do I know now?

- Bedtime routines are prevalent in families across the socio-demographic and socioeconomic divide
- Families implement similar bedtime routine activities with variations on frequency and adherence for most of them
- There seems to be initial support of a “weekend” effect where bedtime routines go off-course and return to normal during weekdays

Next chapter

- With a firm understanding on bedtime routine characteristics, other areas like dietary habits and dental health will be explored to further uncover implications of this dynamic set of behaviours

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Appendices

Appendix 4.A.

Open and closed-ended questions sent to participants each night using the automated text survey system (as presented in more details in Chapter 2, Appendix 2.B.)

Q1	HELLO! This is the research team! We are just going to ask you some questions about tonight's bedtime. Is this a good time? Reply "Yes" or "No"
Q2	How would you rate tonight's bed time routine from 0 (many problems, worst routine for a while) to 5 (best routine ever!). Please rate from 0 to 5.
Q3	What time did your child go to bed? If he/she is still awake, please reply "Awake" or "Not yet".
Q4	Who was involved in tonight's routine? Mum, Dad, Both parents or someone else? Please reply "Mum", "Dad", "Both" or "Other".
Q5	Did your child eat or drink anything the hour (i.e. not his/her dinner) before bed? Please reply "Yes" or "No".
Q5.a.	What was it? Please briefly describe what your child ate and/or drank the hour (i.e. not dinner) before bed (i.e. glass of milk, chocolate, fruit etc.)
Q6	Were your child's teeth brushed tonight? Reply "Yes" or "No"
Q6.a.	Who brushed them? Please reply "Child" or "Parent", or if you helped your child brush their teeth then reply "Together"
Q7	Did your child play video games, watch TV or use any electronic devices (incl. mobile phones, tablets etc.) the hour before bed? Please reply "Yes" or "No"
Q8	Did you read a story to your child before bed? Please reply "Yes" or "No"
Q9	Thank you! We will be in contact soon. Remember if you want to leave the study, and receive no more text-messages please text "Leave", otherwise we are all done.

Appendix 4.B.

Brief demographics form completed during recruitment

1.1. Gender Parent

1.2. Age Parent

1.3. Ethnicity

1.3. Nationality

1.5. Gender Child

1.6. Age Child

2.1. Qualifications

2.2. Employment status

3.2. Do you have other children?

3.3. Age(s) of other children

4.1. How many adults in household?

4.2. Who's involved in daily routines?

5.1. Child/Children registered with GP & Dentist (Yes/No)?

This chapter has been submitted for publication:

Kitsaras, G., Goodwin, M., Allan, J., Kelly, M. P., & Pretty, I. A. (TBC). Bedtime oral hygiene behaviours, dietary habits & children's dental health. Community Dental Health, (TBC).

Chapter 5

Bedtime oral hygiene behaviours, dietary habits & children's dental health

Abstract

Objective; This cross-sectional study examines the relationship between oral hygiene behaviours, dietary habits around bedtime and children's dental health. **Participants;** A total of 185 parents with children between the ages of 3 and 7 years from deprived areas participated in the study. **Main outcome measures;** Data on bedtime routine activities were collected using an automated text-survey system. Children's dental health status was established through examination of dental charts and dmft scores. **Results;** 52.4% of parents reported that their children's teeth were brushed every night. The majority of children (58.9%) had dmft scores over zero. The mean dmft score for those experiencing decay was 2.96 (SD=2.22) with an overall mean dmft score of 1.75 (SD=2.24). There were weak, yet significant correlations between frequency of tooth brushing, frequency of snacks/drinks before bed and dmft scores ($r=-.284$, $p<.001$ and $r=.247$, $p=.001$ respectively). Finally, increasing brushing frequency was associated with a reduction in the likelihood of a dmft greater than 0 (Exp(B) = 0.9). **Conclusions;** Despite families implementing oral hygiene behaviours as part of their bedtime routines those behaviours varied in their consistency. Also, results of this study highlight the need for additional studies that consider bedtime routine-related activities and especially the combined effects of oral hygiene practices and dietary habits due to their potentially important relationship with children's dental health with subsequent implications in their overall wellbeing and development.

Keywords

Dental caries – child – parents – behaviour - diet

Introduction

Dental caries is the most common preventable disease with an estimated 60 per cent of children worldwide experiencing dental caries that can often lead to pain, discomfort and may impact negatively on quality of life (Marcenes et al., 2013). Dental caries is a multifactorial disease that starts on a microbiological level and is affected by salivary flow and composition, exposure to fluoride, consumption of dietary sugars and by preventive behaviours (e.g. cleaning teeth) (Selwitz et al., 2007). In early stages, dental caries can be reversed but without proper care, can progress until the tooth requires extraction (Selwitz et al., 2007).

Bedtime is a particularly important time for both diet and preventive behaviours with regards to dental health (Department of Health, 2009; Scottish Intercollegiate Guidelines Network, 2014; Levine, 2001). Consumption of food and drink, especially those, containing free sugars at bedtime is an important risk factor for caries due to decreased salivary flow shifting the balance toward demineralization rather than remineralization (Leving et al., 2007; Moynihan et al., 2014). Available guidelines, public organisations and bodies (including the National Health Service in the UK) emphasise the importance of Parental Supervised Brushing (PSB) twice daily with fluoridated toothpaste, with one of the occasions being before bedtime, as well as controlling dietary sugar intake especially at bedtime (Department of Health, 2009; Scottish Intercollegiate Guidelines Network, 2014; Levine, 2001; Baghlaf et al., 2018). Both control of free sugar intake, especially before bed, and twice daily brushing rely on the development and maintenance of healthy family routines (Pine et al., 2016). Apart from dental health, bedtime routines, as a recurrent family behaviour, have shown important associations with key child wellbeing and developmental areas including quality of sleep, school readiness, school performance, psychosocial development as well as family functioning and parental wellbeing (Kelly et al., 2013; Hale et al., 2011; Mindel et al., 2015; Kitsaras et al., 2018).

Oral diseases during childhood can have a negative impact on the life of preschool children and their parents (Abanto et al., 2014). The negative impact of dental caries in an early age includes chewing difficulties, sleeping difficulties, changes in behaviour (e.g. irritability), implications with psychological development (such as low self-esteem), loss of school days with subsequent decrease in school performance (Abanto et al., 2014; Sheiham, 2006; Flistrup et al., 2003). Moreover, dental caries, if left untreated, can lead to dental extractions under general anaesthetic with further implications for children's psychosocial wellbeing with increased pain, need for hospitalisation, increased anxiety for parents as well as public finances and public healthcare pressures (Goodwin et al., 2015). In Manchester, North West England, many thousands of children a year undergo dental extractions with general anaesthetic (Goodwin et al., 2015).

Objective

This paper provides a closer look at the dental-related data of a sample that participated in a larger study examining bedtime routines in families with young children. Results from the larger study have been presented in a previous chapter (Chapter 4). The main objective of this closer examination was to gain a better insight into bedtime oral hygiene behaviours and dietary habits in families with young children. Also, this closer examination looked at children's dental health status and the effect bedtime oral hygiene behaviours and dietary habits around bedtime can have on prevalence and severity of dental health problems.

Methods

Recruitment

A total of 200 parents were recruited for a larger study examining bedtime routines in families with young children. The larger study produced information on bedtime routine characteristics and behaviours in those families. Recruitment took

place between February and July 2018 in the United Kingdom (UK). Participants were approached during their routine appointments in general dental practices in four areas around the city. Exclusion criteria including: (a) not having English proficiency, (b) not owning a mobile phone and (c) not having any children between the age of 3 and 7 years of age. Participants were informed about the requirements of the study and asked to provide consent as per approved protocol. During recruitment, each participant was informed about the compensation that they would receive at the end of the study in the form of vouchers. The compensation for their time in the overall study stood at £10. Early withdrawal affected the amount of the compensation. All aspects of the larger study on bedtime routines in families with young children were approved as per Integrated Research Application System (IRAS) ID: 238552 application.

Data collection

Data were collected about: (a) families' bedtime routine activities and (b) children's dental health status. In terms of assessing bedtime routine activities, data collection took place over a 7-night period in order to capture a wider range of data points per participant including fluctuations in bedtime routines occurring between weekdays and weekends. In line with a previous study on bedtime routines, child wellbeing and development (Kitsaras et al., 2018) an automated text-survey system delivered directly to each participant's mobile phone was utilised for assessing bedtime routines. The automated text-survey included both open ended and closed questions with specific questions about oral hygiene behaviours (i.e. if they brushed their teeth that night and who brushed the children's teeth) as well as diet (including snacks and drinks) before bed. The dental health status of children was assessed through their dental charts collected and completed by the general dental practices during routine appointments. Copies of dental charts were requested at the end of the study. The charts reflected the dental health status of the children as seen on their routine appointment when recruitment took place.

Data analysis

At the end of data collection, all data relating to bedtime routines were coded and analysed using SPSS (IBM SPSS Statistics for Macintosh, Version 25.0). For dental health status, dmft (decay, missed, filled teeth (primary teeth)) scores were used. Data were descriptively analysed in order to examine frequency and prevalence of bedtime routines and activities included as part of each family's routine. Since not all families responded to every night of the assessment, percentage scores were used instead of raw scores to reflect frequencies. A correlation analysis was used to examine the relationship between tooth brushing, diet before bed and dmft scores. Finally, a binary regression analysis was performed to explore which of the key variables relates to having a dmft score over zero.

Results

Sample characteristics

From the 200 parents recruited, a total of 185 (92% retention rate) completed data collection. Parents had a mean age of 34.6 (SD=5.01) with the majority being females with only 24 males. Most families had only 1 child (65%) while only 5% of the families had more than 3 children. In terms of children's characteristics, just over half (56.8%) were males. In total, 48.1% of the sample was of white ethnic background, 39.5% was of Asian/British-Asian background and 12.4% was of Black/ Black-British/ Caribbean ethnic background. The Index of Multiple Deprivation (IMD) was used to calculate socio-economic status of participating families. Both IMD scores and IMD quintiles were used in subsequent analyses. Higher IMD scores reflect more socio-economic deprivation. The vast majority of participants (77.8%) lived in deprived areas with an overall mean IMD score of 41.83 (SD=16.43) and a maximum IMD score of 79.65.

Bedtime oral hygiene behaviours & diet

A small majority of participants (52.5%) reported that their children's teeth were brushed every night while a small percentage (1.1%) reported that their children's teeth were never brushed. With regards to diet, 58% of participants reported allowing food and/or drinks the hour before bed at some point during the week. In terms of who brushed the children's teeth, there was an almost equal distribution among parents brushing their children's teeth (34.1%), parents supervising their children while children brush their teeth (31.9%) and children brushing their teeth with no supervision or assistance (34%).

Only 4.3% of participants reported completely avoiding snacks or drinks the hour before bed while 36 (19.5%) reported having snacks-drinks every single night before bed time. From those allowing food and/or drinks in the hour before bed, 44.3% gave their children water or unflavoured milk, 26.9% allowed consumption of fruit or vegetables while 24.3% allowed sugary or savoury snacks including chocolate, crisps or soft drinks. The remaining replies (4.5%) concerned the dinner the families had that night reflecting lack of understanding of the question. Excluding water and unflavoured milk, more than half of the sample allowed consumption of snacks and/or drinks the hour before bed.

Dental health status

The majority of children (58.9%) had dmft scores over zero with a maximum dmft score of 13. The mean dmft score for those experiencing decay was 2.96 (SD=2.22) with an overall mean dmft score of 1.75 (SD=2.24). The mean decay score for those experiencing decay was 1.10 (SD=1.57) while the mean filled score was 1.86 (SD=1.65). The majority of dmft scores ranged from 1 to 4 in both decay (49.5% of cases) and filled (77% of cases) components. Due to issues with the information provided from the dental charts, no information was available regarding missed teeth due to decay. Bivariate correlations showed no significant associations on IMD scores

or children's age with regards to dmft scores. A Kruskal-Wallis analysis showed no significant differences with regards to ethnicity and dmft scores.

Relationship between bedtimes and dental health

A bivariate Pearson correlation revealed a weak yet significant negative correlation between dmft scores and percentage of nights brushing teeth $r=-.284$, $p<.001$ showing that less frequent tooth brushing at night is associated with higher dmft scores. Also, there is a weak yet significant positive correlation between dmft scores and percentage of nights having snack and/or drink before bed $r=.247$, $p=.001$.

Binary logistic regressions were performed to examine the relationship among key variables and dmft scores. IMD scores, children's age, frequency of brushing teeth before bed and frequency of having snack and/or drinks before bed were included in the model. The logistic regression model was statistically significant $\chi^2(4) = 60.994$, $p <.001$. The model explained 37.9% (Nagelkerke R^2) of the variance in dmft scores over 0 and correctly classified 75.7% of the cases. As brushing frequency increased the likelihood of having a dmft score over 0 decreased ($\text{ExpB} = 0.9$). Increasing age was also associated with higher likelihood in having a dmft score higher than 0. There was no significant effect with regards to % of nights having food/drinks the hour before bed and IMD scores. No assumptions were violated. A second binary logistic regression was performed where those who either did not allow snacks/drinks before bed or allowed only water or unflavoured milk were included. The results were non-significant ($p=.068$).

Discussion

This study examined oral hygiene behaviours and dietary habits before bedtime in families with young children and their relationship with children's dental health. As with previous research, the results of this study showed the importance of bedtime oral health hygiene and dietary habits in relation to children's dental health.

The results from the study showed that despite families implementing oral hygiene behaviours during bedtime those varied and could have been improved with respect to their frequency and content in accordance with available guidelines and recommendations. While a small majority (52.4%) of participants reported that their children's teeth were brushed every night, there was a significant number of replies regarding not brushing every night with a marginal 1.1% not brushing teeth at all before bed. Results from the analysis showed that there is a mixed picture with regards to who brushed the children's teeth with around a third of children brushing their teeth alone without any supervision. That mixed picture is reflected in national average data from the United Kingdom regarding unsupervised toothbrushing (White et al., 2006). Unsupervised tooth brushing can have detrimental effects on dental health status in young children and despite available recommendations a large proportion of children (50% of 5-year olds) brush their teeth without any adult supervision (White et al., 2006). Different factors have been identified as important in terms of not following good practice recommendations and not translating evidence-based guidelines such as supervised tooth brushing into daily practice. Despite most parents being aware of the importance of tooth brushing; issues relating to children's resistance, lack of resources as well as lack of behavioural management techniques from the parent's perspective result in problematic implementation of good practices on oral care (Marshman et al., 2016; Hamilton et al., 2018; Duijster et al., 2014).

Apart from tooth brushing, diet before bed, especially consumption of food and/or drinks with their associated free sugars, is another important factor for children's dental health (Leving et al., 2007; Moynihan et al., 2014). Dietary links to dental health have been long-established and from a physiological and biological perspective there is good evidence regarding the importance of avoiding free sugars in general (Goodwin et al., 2017). Dietary habits the hour before bed could be a potential proxy measure of overall dietary and snacking habits in young children (Baghlaf et al., 2018; Goodwin et al., 2017). Results from this study showed that the vast majority of parents allowed their children to have snacks and/or drinks before bed. However, from those who allowed snacks and/or drinks, a large percentage

(44.5%) allowed water or unflavoured milk the hour before bed while the rest allowed consumption of fruit, vegetables (especially fruit juices, squash etc.) or snacks including chocolate, crisps or soft drinks. Water, unflavoured milk as well as fruit and vegetables where the cellular structure has not broken down (i.e. puree, blended etc.) are treated as natural sugars with limited implications for dental health (Public Health England, 2014). On the other hand, free sugars (i.e. natural sugars which have been broken down as well as added sugars in food and drinks) have shown damaging effects on dental health due to their cariogenic load (Goodwin et al., 2017; Public Health England, 2014).

In terms of dental health status, the majority of children participating in this study (58.9%) presented with obvious decay experience as calculated by their dmft scores. This score is more than double the national average (23.3%) for England based on the most recent National Dental Epidemiology Programme (Public Health England, 2018). Despite the sample consisting of many children with dmft scores over zero (dmft>0), the mean dmft score for those with decay experience (dmft>0) was 2.96 close to the national average (dmft = 3.4) (Public Health England, 2018). When comparing each ethnic group of the study to the national average dmft scores, there were slightly higher mean scores for dmft in each ethnic group of the study compared to the national average. In terms of missing teeth, that information was lacking from the sample's dental data. Lack of information on missed teeth is primarily due to lack of clarity and quality of dental charts provided by participating general dental practices.

Lack of frequent and appropriate tooth brushing alongside frequent consumption of free sugars the hour before bed can have a significant negative effect on dental health (Department of Health, 2009; Levine, 2001; Levine et al., 2007, Pine et al., 2016). In line with previous studies, both frequency of tooth brushing as well as frequency of snacks/drinks the hour before bed showed significant, yet weak, correlations with overall dmft scores. When excluding all participants who either did not allow snacks/drinks or allowed only water or unflavoured milk, there was no significant results with regards to having a dmft score over zero. Only the frequency

of tooth brushing was found to be an important variable in determining whether children would have dmft scores over zero. The absence of significant results regarding dietary habits before bed could reflect the high percentage of parents who either did not allow or allowed only water and/or unflavoured milk before bed.

Establishment of good oral hygiene behaviours and dietary habits early in life is important in achieving long-term good dental and avoiding dental caries and decay from an early age (Selwitz et al., 2007). Avoidance of early childhood caries is another crucial element for the future given the important link between early childhood caries and later dental health status in adolescents and adults (Selwitz et al., 2007). From a behavioural theory perspective, consistency is key in achieving well-established and evidence-based recurrent routines that encompass all necessary beneficial activities such as tooth brushing (Sytsma et al., 2001; Plaud & Plaud, 1998). The importance of approaches with a more behavioural element has been recently highlighted from UK-based organisations including Public Health England (2014). Also, establishing good bedtime routines that incorporate good and consistent oral hygiene practices and good dietary habits can lead to important implications with regards to public finances and the health service (Public Health England, 2014). Therefore, it is vital for parents, children and families as a whole to prioritise the formation, establishment and maintenance of optimal bedtime routines from an early age.

Limitations

One possible limitation of this study concerns the assessments used for data collection. Bedtimes were assessed dynamically with little time between the initial occurrence of the targeted activity and the assessment of that activity. On the contrary, dental health status reflected the effect of processes that have happened in the past with their results evident in the present. Dental caries is a slowly progressing, chronic disease and hence can take many years to develop to the stage of frank cavitation. Despite this contrast, available evidence shows that behaviours and routines such as bedtime-related activities remain relatively stable with little

changes in their composition and activities once they have been established. Therefore, the bedtime routines and activities observed as part of this study were most likely present in the past when dental health status was being determined. Another limitation can be found in the use of dmft scores through the examination of routinely available dental data from general dental practices. This approach, despite being cost-effective and timely, cannot provide an in-depth examination of the dental health status of the children potentially limiting our overall understanding. The dental charts assessment was not able to identify if missing teeth were a result of extractions or lost naturally. Also, due to the fairly small sample, the nature of the dental data provided and the cross-sectional design it is not possible to assume causality with regards to bedtime routine oral health-related activities and children's dental health.

Conclusion

Bedtime-related activities, including oral hygiene behaviours, present an important area for further exploration from a wider public health and oral health specific approach given their relationship with key wellbeing and development areas. Promotion, establishment and maintenance of optimal bedtimes including good oral hygiene behaviours is a crucial first step for successful short and long-term oral health policies as well as child wellbeing and development targets. Simple transmission and provision of information is not enough in formulating and establishing optimal bedtime routines that incorporate oral health behaviours. More sophisticated and bespoke approaches should be explored in order to actively support and engage families in the short and long-term process of achieving optimal bedtime routines.

Summary

What do I know now?

- Differences in oral hygiene activities and dietary habits before bed, especially lack of tooth brushing and consumption of sugary snacks, can lead to issues with children's dental health
- Despite current guidelines and available information, some parents fail to follow good oral hygiene practices and dietary habits before bed

Next chapter

- What are the barriers and the process that parents undergo in order to establish their bedtime routines? The next chapter will try to explore those issues and better understand the process of establishing, implementing and maintaining bedtime routines.

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This chapter has been submitted for publication:

Kitsaras, G., Goodwin, M., Allan, J., Kelly, M. P., & Pretty, I. A. (TBC). Perceived barriers & facilitators for bedtime routines in families with young children. *British Journal of Educational Psychology*, (TBC).

Chapter 6

Perceived barriers & facilitators for bedtime routines in families with young children

Abstract

Bedtime routines are a highly recurrent family activity with important health, social and behavioural consequences. Despite their importance, information regarding formation, establishment and maintenance of bedtime routines remains limited. Objective; This study examined perceived barriers to, and facilitators of, formulating, establishing and maintaining optimal bedtime routines in families with young children from deprived socio-economic areas. A total of 12 parents participated in the study. They completed a semi-structured interview based on the Theoretical Domains Framework (TDF). A deductive approach was used mapping statements into the 14 domains of the TDF. Key barriers to implementing an optimal bedtime routine included lack of appropriate knowledge and sources of information, problematic skills development, social influences, cognitive overload, lack of self-monitoring, lack of motivation and negative emotions. Facilitators to implementing an optimal bedtime routine included social role/identity, environment/access to resources, positive intentions, beliefs about consequences and reinforcement. In particular, optimal bedtime routines were less likely to be enacted when parents were tired/fatigued and there was a strong effect of habit, with suboptimal routines maintained over time due to past experiences and a lack of awareness about the contents and importance of a good bedtime routine. Finally, parents exhibited a lack of motivation to change existing bedtime routines resulting in behavioural inertia. Several theory-based, and potentially modifiable, determinants of optimal bedtime routines were identified in this study, providing important information for future interventions. Several of the key determinants identified were transient (tiredness) and/or non-conscious (habit), suggesting that future interventions may need to be deployed in real time, and should extend beyond conventional techniques.

Keywords

Theoretical Domains Framework – Behaviour change – Parenting – Child – Wellbeing – bedtime routine

Background

Bedtime routines are one of the most frequently performed family activities encompassing a series of actions undertaken by families with young children in the hour before bedtime (Fiese, 2002). Most families start implementing their bedtime routines with their children from an early age (Mindell & Williamson, 2018). At present, the best available evidence suggests that optimal routines should: (a) be consistent throughout the week and weekend following the recommended sleep times for each age group, (b) include tooth brushing, (c) avoid drinks (such as bottle feeding) and snacks the hour before bed, (d) minimise the use of electronic devices and television around and during bedtimes and (e) finally, include book reading and book sharing activities before sleep (Hale et al., 2009; Kelly et al., 2013; Kitsaras et al., 2018; Levine, 2001;). Past studies have demonstrated the importance of bedtime routines for both child-specific (quality of sleep, dental health, school performance and school readiness, psycho-social and emotional development) as well as parent/family-specific outcomes (overall family functioning and parental socio-emotional wellbeing) (Goodwin et al., 2015; High et al., 1998; Hill et al., 2016; Kitsaras et al., 2018; Levine, 2001; Mindell et al., 2009). Moreover, intervention studies have shown that it is possible to intervene and moderate these routines with subsequent benefits for children and parents alike (Mindell & Williamson, 2018).

Despite their importance, available information on bedtime routines is limited. Most previous studies were conducted with homogenous samples from the upper end of the socioeconomic spectrum. Consequently, little information is available on the characteristics of bedtime routines in deprived populations where health, social and behavioural outcomes are often poorer (Mindell & Williamson, 2018). Also, there is a lack of available information regarding the mechanisms which lead to the formation, establishment and maintenance of bedtime routines in general (Mindell & Williamson, 2018). Finally, there is little to no research examining parental perspectives of bedtime routines despite bedtime routines being a recurrent behaviour “enacted” by parents and “received” by children.

The present study addresses these issues by using a theoretical framework (the Theoretical Domains Framework; TDF) to explore the barriers and facilitators that parents from economically deprived households face when developing and maintaining bedtime routines for their children. The TDF is a framework which summarises 84 possible determinants of behaviour into 14 overarching “theoretical domains” allowing for a comprehensive exploration of all possible determinants of bedtime routines in families with young children (Michie et al., 2011). The TDF has been extensively used in healthcare and behavioural research and it is linked to the Behaviour Change Wheel (BCW), a theory-based framework designed to guide intervention development in a structured, systematic and evidence-based way (Michie et al., 2013). Through the use of the TDF, possible barriers and facilitators regarding bedtime routines can be systematically explored leading to greater understanding of this complex and highly recurrent behaviour and helping to identify potentially modifiable determinants of optimal and suboptimal bedtime routines.

Objective

This study uses the Theoretical Domains Framework (TDF) to explore perceived barriers and facilitators of the formation, establishment and maintenance of bedtime routines in families with young children from economically deprived households.

Methodology

Participants & Recruitment

Sampling followed a convenience sampling strategy. A total of 12 parents with young children between the ages of 3 to 7 years old were recruited for this study. Parents were recruited from an on-going cross-sectional study on bedtime routine characteristics and effects of bedtime routines in child wellbeing. Participants were compensated for their time in the form of £10 vouchers for online shopping. All

elements relating to the design and conduct of the study were approved by the Health Research Authority and the National Health Service Research Ethics Committee in the United Kingdom (Integrated Research Application System (IRAS) ID: 235885).

Data collection

Interviews were completed either in person or via telephone. Telephone interviews were included as they required less time commitment and so were more acceptable to some participants. All interviews were completed between May and September 2018. In total, 8 participants completed an in-person interview with 4 opting for a telephone interview. In each interview, a detailed semi-structured interview schedule based on the 14 TDF domains was used (Appendix A). Each TDF domain was explored with a combination of different questions designed to prompt different perspectives. At the end of the interview, participants were encouraged to make additional comments and statements about elements of their own experience not covered by the interview schedule. Interviews lasted between 14 and 45 minutes (average = 24 minutes) and were all completed by the same interviewer. The interviewer had extensive experience across his undergraduate degree in Psychology, his MSc in Clinical Psychology and paid working experience in developing interview schedules, conducting interviews as well as analysing and interpreting qualitative results. The issue of reflexivity, attitude of attending systematically to the context of knowledge construction, especially to the effect of the researcher, at every step of the research process, was contained through a series of steps including the co-development of the interview schedule with a third party to ensure that questions are not biased and provide coverage across all necessary domains, use of a third party transcription service to produce accurate and genuine transcripts of the interviews and the deployment of two independent coders for the analysis of the interviews.

Data analysis

Each audio recording was transcribed verbatim using a transcription service. The TDF has a strict process of analysing qualitative results to allow for consistency across different interviewers and studies using this tool. The preferred method of the analysis of the interview is a deductive approach where two independent coders used a deductive approach to map each statement to one of the TDF domains (or code as outside of the TDF). Any disagreements in coding were resolved through discussion. Remaining disagreements were resolved by a third independent coder. Barriers and facilitators were identified based on participants' responses. Overarching themes were also identified and summarized while frequency counts were used to determine the most commonly endorsed domains and specific component constructs.

Results

Sample characteristics

In total, 12 individuals (11 females & 1 male, with a mean age of 35 (SD=3) participated in the study. Average IMD score was 36.4 (SD=4.1) classifying as "most deprived". Table 6.1. presents a summary of key demographics.

Table 6.1. Demographic characteristics

Ethnicity		
	White	9
	Asian/British-Asian	3
Education		
	University	4
	College	8
Nationality		
	British	11
	Saudi	1
Number of children		

	1	5
	2	5
	3 +	2
IMD		
	1 st quintile	0
	2 nd quintile	0
	3 rd quintile	2
	4 th quintile	0
	5 th quintile	10

Inter-rater reliability

Cohen's kappa (κ) was calculated in order to examine inter-rater reliability between the two independent coders. A total of 289 statements were examined and mapped into relevant TDF domains. Based on the results of the analysis and following guideline outlined by Landis and Koch (1977) there was substantial agreement between the two coders ($\kappa=.891$, $p<.005$). This substantial agreement highlights the successful implication of reflexivity control measures ensured by the use of two independent coders and an experienced interviewer.

Overview of data saturation

Data saturation where no new themes emerged from one interview to the next was achieved and therefore data collection ceased after the twelfth interview. All domains of the TDF were covered by participants' replies. In total, 3 participants provided replies that mapped to every TDF domains while on average participants provided replies that mapped to at least 12 out of the 14 domains. An overview of data saturation is shown on table 6.2.

Table 6.2. Overview of saturation per TDF domain.

<i>ID</i>	Knowledge	Skills	Social professional role	Beliefs about capabilities	Optimism	Beliefs about consequences	Reinforcement	Intention	Goals	Memory, Attention, Decision	Environment Resources	Social influences	Emotion	Behavioural Regulation
<i>QI001</i>	X	X	X	X	X	X	X		X	X	X	X	X	X
<i>QI002</i>	X	X	X		X	X	X		X	X	X	X		X
<i>QI003</i>	X	X	X	X	X	X	X		X	X	X	X	X	X
<i>QI004</i>	X	X		X	X	X	X		X	X	X	X	X	X
<i>QI005</i>	X	X	X	X	X	X	X			X	X	X		X
<i>QI006</i>	X	X		X	X	X	X	X		X	X	X	X	
<i>QI007</i>	X	X	X	X		X	X	X	X	X	X	X	X	X
<i>QI008</i>	X	X		X	X	X	X	X	X	X	X	X	X	X
<i>QI009</i>	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>QI010</i>	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>QI011</i>	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>QI012</i>	X	X	X	X	X	X	X	X	X	X	X	X	X	

Barriers and Facilitators by TDF domain

Knowledge

In general, all parents reported awareness of the importance of bedtime routines. Parents were able to describe what a good bedtime routine should look like and identify all of the vital elements of a good bedtime routine that have been highlighted in the scientific literature.

"It should include brushing teeth, no sugar before bed and read a story too." (QI012)

"Reading that the school asks us to do. Spellings and settling them down in a relaxed environment before bedtime and teaching them that it's healthy to look after their teeth and that is one of the bedtime routines that, as they get older, that they should be doing." (QI011)

"I think winding down is important, especially when they're little because they're tearing about all over the place, they need some calm and start relaxing. And I think reading a story, especially when they are little, is just nice to get them used to books and learning new words and things like that." (QI008)

Through the interviews it transpired that parents were not provided with formal or official support and material before or at the early years of their children's lives resulting in some difficulties in knowing what is best to do around bedtime.

"No. It would have been good to get some advice, but no one really said anything about routines when the children were born" (QI012)

"I don't know them from the NHS or my GP" (QI005)

"And no, we've not been told anything about them" (QI007)

There were a few exemptions where parents knew about official recommendations or were given some advice when their children were younger but they could not recall exactly what they were told or who provided them with that information

“Yeah, recommendations yeah. Just that they’re relaxed and ensure their teeth are brushed. Probably a health professional told me.” (QI006)

The majority of parents (n=7) expressed a positive view about how useful an official system or point of contact where they could seek advice on bedtime routines would have been.

“If somebody could have told me how to get my kids to sleep that probably would have been really, really helpful” (QI005)

Skills

In terms of skills development, most parents reported using the same sort of routines with their own children as they had when they were children.

“Just carried on doing what I did when I was a child” (QI010)

“I think it's just something like what we did when we were children, so it's just like you sort of know. I come from a really big family and it's what our mother used to make us do, so that's what I just did with my children as well. ” (QI009)

“Our routines are just something I did from what I was used to do as a child you know. No help whatsoever about them” (QI012)

Some parents mentioned external factors that influenced the development of their bedtime routines including:

“Probably reading material that I’d picked up, with it being my first child, and choosing what I felt would work within our family, a new family routine.” (QI011)

“Because neither of my kids were good sleepers I did a lot of searching when they were babies for how do you get more sleep and bedtime routine was one of the things that I remember reading about. Yeah, so I guess from the internet and it was try and do something fairly similar and I guess we’ve amended that just on the basis of what works for me and my kids really.” (QI005)

Moreover, parents were able to identify a variety of skills and techniques they use as part of their bedtime routines. Some of them include:

“I’ll grab a story or they’ll grab something that they want to read, and we always do three books because that’s what we’ve always...and sometimes if they want an extra story then we’ll do that and then depending on how long we’ve got they’re either quite long stories or really quite short, so let’s just read them and get to sleep.” (QI005)

“So when they’re doing their teeth, we have, like, one of their favourite songs will play and obviously I will say brush your teeth for three and a half minutes, so they’ll find a song that’s three and a half minutes long, so they’ve got to brush their teeth while that song is playing, so they’ll dance while they’re brushing their teeth and then once that songs finished, their teeth are done.” (QI004)

“with my son he’ll, like, while I’m trying to settle my daughter, he’ll try and get my son to do what he’s doing and he’ll be getting him to just relax, he’ll get him to lie on the bed with him for a bit and just, you know, wind down.” (QI010)

Social/professional role/identity

Parents viewed themselves as an important role model for their children and felt a huge level of responsibility for the overall wellbeing and development of their children.

"I feel like this is the job as a parent to my child and I've done it " (QI003)

"I find it as a responsibility sometimes, yeah, when you say, okay, I've given birth to these kids. I'm responsible for them." (QI002)

"I suppose what I'm doing as a parent is trying to set them up in good habits for the rest of their lives, because the stuff that they do before they go to bed is the stuff that I do before I go to bed" (QI005)

Some parents, brought their overall, non-parental, roles and identities as professionals in the context of their responsibility towards their children.

"I'm a teacher, you know, and I'm very like my mum and I'm quite firm with my boundaries" (QI001)

Beliefs about capabilities

For some parents, their bedtime routines were generally not perceived to be difficult or challenging. However, parents identified some occasions when routines were perceived as more challenging, for example over the weekend. While a few parents felt that their bedtime routines are difficult and challenging in general.

"It's okay, I'm used to it know you know. It's been a while since I've been doing bedtimes" (QI012)

"So I guess those things do get in the way sometime and can make me very tired, but I'm pretty good on the bedtime. You know, I'm pretty good, apart from at the weekends" (QI001)

"Difficult but it's something that we're all used to, and they've done since they were younger and it's something, like I say, that I've always been consistent with but yes, it is difficult." (QI011)

“It’s hard, because a lot of the time I don’t get home from work until six, half six and then by the time I get home, they’re, like, really moody.” (QI010)

Optimism

When discussing the future, parents generally appeared confident about their ability to maintain and have good bedtime routines as their children grow older.

“No I’m not worried. I’ve not even thought about the future.” (QI009)

“I don’t feel anxious about it really, I think... I haven’t really thought about it really. I don’t know.” (QI005)

Intentions

Through the interviews it became clear that parents have the intention to actively try to achieve and maintain good bedtime routines for their children in the short and long-term future.

“Yes, I mean 100 per cent, 101 per cent really and in terms of that, it’s maintaining and being consistent and that can get tiring but that’s the length that I personally am happy to go to for them” (QI011)

“I’m hoping that with the new-born, that I’m able to get that started earlier and that will just become part of life rather than having to introduce it later” (QI006)

Beliefs about consequences

Most parents mentioned specific outcome expectations associated with problematic bedtime routines.

“If you’re brushing your teeth so this will give you a future with nothing a problem with your teeth and everything. But if you do brush correctly, in the correct way” (QI003)

“Reading will obviously help improve the reading and the English and everything. ”

(QI009)

“I was never made...most of the time if I didn’t want to brush my teeth, I didn’t have to brush my teeth, so when I was younger, I had a lot of teeth taken out through that. So I’ve told them that obviously I don’t want that for them, because obviously I went to the hospital, I had to have, like, loads of teeth took out, I think it was about 15 teeth took out, so I told them the experience that I’ve had and I told them if they don’t want that happen to them, they’ve got to do their teeth, otherwise it will happen to them” (QI004)

While others reported their overall beliefs about the future of their children and the importance of having a good bedtime routine.

“I hope that as they get older they understand that going to bed at a sensible hour when they have school the following day is important and they need the sleep. We’ll have to see what they think when it comes to it.” (QI008)

Reinforcement

Reinforcement was analysed in 2 contexts: (a) reinforcement used towards the children as part of the bedtime routine or general parenting and (b) reinforcement experienced by the parents at the end of the night and after the children were off to bed. In terms of reinforcement techniques used with the children, most parents were able to list several techniques covering both positive (reward) and negative (punishment) reinforcement.

“Because if they don’t brush their teeth, they don’t get the TV” (QI004)

“I’ve got a reward chart on the fridge, for my daughter, she normally gets a magazine, whereas my son he normally gets, like, money, he’ll get, like, four pound if he’s good all week and then he can buy whatever he wants with it, but not sweets obviously.” (QI010)

When considering reinforcement at the end of the night and after children have been put to sleep, parents were asked to consider 2 possible outcomes: one where the routine has gone smoothly and the children were off to bed with no problems and one where the parent faced resistance and a tantrum before the children went to bed. When considering the non-problematic routine, parents reported feeling relaxed and able to rest and enjoy their free time:

*“Oh I feel relieved now, that's a bit of me time, a bit of quietness now, the house is nice and quiet at that point. That's my time now with my cup of tea downstairs”
(QI009)*

“It is a nice feeling, if it's all smooth and everybody goes to bed happy and so on and you don't feel like you're on your last nerve, then, yes, of course it's a nice feeling, because then you look at these two sleeping angels and think that's lovely” (QI005)

On the contrary, when the routine was problematic, parents reported negative reinforcement such as:

“I'll be relieved that they are eventually off to bed but obviously I will be a bit annoyed and stressed” (QI012)

“When it does kick off I get proper wound up and it takes five to ten minutes to calm yourself down. You have to go off and sit on your own” (QI008)

Goals

Parents saw bedtime routines are more than just getting the children to bed, it's about spending good, quality time together and building long-lasting memories.

“You're all busy during the day, the children are at school, you're at work, so that is a really nice time to talk to the children and find out what's been going on in their day and yes, they play with each other, it's their time as well to have a bit of fun with each other” (QI011)

“I guess the goal is to get him in bed and asleep, and I would be lying if I didn’t say that. But, I really do enjoy our reading time, so I really, really like that time, so that can go on a little bit longer than I would necessarily... Just because it’s so nice, you know, and I love snuggling up with him in bed and reading.” (QI001)

Also, parents gave examples of goal priorities shifting when dealing with changing circumstances in their houses during their bedtime routines.

“On the weekend they sleep later, especially if we’ve got things planned, if we’re going out. If we’re at home and we’re not really doing anything we do try and put them to bed a little earlier, which is not as early as a week day, so nine o’clock at the latest if we’re home. On odd occasions if we have things on it will probably be a bit later” (QI007)

“Well they stay up a bit later, but they only stay up...but they still brush their teeth at the same time, they always brush their teeth” (QI004)

“They might have more than just milk! They’re allowed maybe some small snacks, it’s the weekend you know...”(QI012)

Emotions

Parents reported a mixed emotional reaction to bedtime routines with some reporting negative emotional reactions towards them.

“Calm, quite fine, like I say because we’ve stuck to the same routine. It’s not a chore; it’s a pleasurable thing to do” (QI008)

“Apprehensive is too strong a word, but I guess normally I’m just fine” (QI001)

Memory, Attention & Decision process

A high level of automation (memory) when it comes to their bedtime routines with little to no thought on what to do and how to do it was evident across parents.

“No, I don't think about it at all” (QI012)

“It's all a habit now” (QI004)

However, when tired (cognitive overload), parents reported difficulties in complying with their normal routine as well as issues around forgetting what they need to do.

“That sometimes means that I forget, because it's late, or we're both tired, or what have you, that he doesn't do it then” (QI001)

“When you're a bit tired, that's when we probably skip reading” (QI002)

“God, yes, it's hard, well it can be just because I work full time and by the end of the day I'm shattered so, yeah, because they're busy and they're five and three” (QI005)

Environment & Resources

Houses and the immediate environmental context did not present as an issue. All parents reported adequate access to all required resources (i.e. books, tooth brushes, tooth paste etc.) for achieving a good bedtime routine.

“Well the children have to share a room which makes things more difficult. It would have been nice to be able to have separate rooms for them but that's not a possibility unfortunately” (QI012)

“It doesn't make it any harder. We just tick along as normal. It doesn't impact” (QI008)

“The fact that they’re in the same room definitely helps the bedtime routine because it takes...the only argument we have is about whose bed we’re going to read stories on” (QI005)

Social influences

Peer support (social support) was important for some especially due to lack of any other available source of information.

“My sister had my nephew, there’s just nine weeks difference between my nephew and my eldest daughter. Yes, we used to talk quite frequently” (QI011)

“I know snippets of what happens in other people’s houses but only when you’re saying, oh god they’re shattered today, oh mine too. And it’s because they went to bed last night...or they went to bed late or because I got them into bed and then they didn’t go to sleep for an hour afterwards. It’s that kind of thing rather than...I don’t know the specifics of what happens within their routine.” (QI005)

While others, compared their routines to their peers (social comparisons) with some of them expressing beliefs on whose routine is better and why.

“Yeah, they were pretty similar. It is just dependent, especially when they’re babies, your family life and what fits in best.” (QI008)

“I think we are better parents.” (QI002)

For the purpose of this analysis, families were considered as one unit with 2 groups within it: the parents who are implementing the bedtime routine and the children who are the recipients of the routine. As the 2 groups interact, conflicts might arise (intergroup conflict).

*“Yes, they always resist, every night they resist at bedtime and obviously at the weekends, I’m a little bit more lenient but no I think they enjoy the bedtime routine”
(QI011)*

“I think my son’s getting older now and he kind of complains about sleeping too early. He feels that it’s too early for him to go to bed” (QI007)

“My youngest, who’s four, he’s quite fine with it. But my daughter, who’s seven, she’s starting to realize that her friends stay up later than she does playing computer games and things like that, so she’s starting to want more. But no, we are strict in what we say.” (QI008)

Behavioural regulation

In terms of self-monitoring, some parents reported not using any type of self-monitoring with regards to their bedtime routines reflecting the automated, habitual nature of the routines. However, others reported using specific self-monitoring techniques

“Yes, probably when they younger, yes that would come up quite often in terms of when they were smaller children, babies and toddlers” (QI011)

Some parents reported specific habit breaking events that led to a significant change of behaviour in the past.

“My 13-year-old, we did remove about eight teeth of hers in one day because there were tiny little holes and I think since 2009 I’ve really sort of cracked down on their brushing because of that” (QI009)

Overarching themes & Key barriers and facilitators

Across the whole dataset, overarching themes, or factors that emerged as most important in relation to bedtime routines included: (a) lack of provision of

information from respected sources, especially when children were younger and routines were being developed, (b) skills development and social support through peers, (c) parents' beliefs that looking after their children's bedtime routines is part of their parental role, their responsibility, (d) parents' self-confidence and the emotional reactions associated with bedtime routines, (e) optimism about the future with clearly defined intentions to achieve and maintain good routines for their children, (f) positive reinforcement from good bedtime routines and negative reinforcement from bad bedtime routines and (g) the level of automation and self-monitoring during bedtime routines. The key barriers and facilitators identified regarding formation, establishment and maintenance of optimal bedtime routines are summarised in table 6.3 below.

Table 6.3. Key barriers & facilitators identified

Barrier	Facilitator
<p><i>Knowledge & Skills development</i> were two of the most important barriers identified:</p> <p>(a) The majority of parents relied primarily on what their own parents used to do when they were children. If a parent had a bad bedtime routine as a child and with no alternative information on bedtime routines available some parents were left unable to recognize what is right and what is wrong with regards to bedtime routines and most importantly, how to change their routines in a meaningful way.</p> <p>(b) Seeking information online or relying on peer support was a mechanism that some parents deployed however, for some that was not possible and the quality and trustworthiness of information might not be consistent and appropriate for all cases.</p> <p>(c) Parents seemed unaware of where/who to approach should any issues with their bedtime routine arise or when their children are first born leaving them exposed to a potentially problematic start with their bedtime routines.</p>	<p><i>Beliefs about consequences</i> and the realization from many parents that bedtime routines can have a long-term effect to their children’s overall wellbeing and development was an important facilitator.</p> <p>Awareness of consequences when combined with clearly stated intentions and strong beliefs about the parental role and responsibility can be a powerful combination that can ultimately help parents to achieve and maintain optimal bedtime routines.</p>
<p><i>Social influences and intergroup conflicts</i> - Within the family unit the interactions between parents and children were another important barrier</p>	<p><i>Social role</i> was an important facilitator for parents who wanted to provide their children with the best chances in life through, in part, their bedtime</p>

<p>for implementing good bedtime routines. The older the children, the more exposed to peer pressure and outside points of view resulting in higher frequency of arguments and conflicts within the family unit and at bedtime.</p>	<p>routines. Parents expressed deep and strong beliefs about the importance of their role in their children’s overall development and future wellbeing.</p>
<p><i>Tiredness or “cognitive overload”</i> was a significant barrier for achieving good bedtime routines especially in families with more than one child or families where the mother, as the one who’s primarily involved in bedtime routines, was working full-time.</p>	<p><i>Environment and access to resources</i> were both important facilitators for establishing and maintaining optimal bedtime routines since almost all families did not consider them as an issue. Also, all families mentioned that they are able to access all required resources in terms of toothpaste, tooth brushes, books etc. that form part of an optimal routine.</p>
<p><i>Habituation & lack of self-monitoring of routines</i> can act as barrier. Most parents reported just doing their bedtime routines as a habit with little thought. Habits are not by definition bad. It depends on what exactly the habit entails. Habits may serve to maintain and perpetuate good routines over time. However, if the bedtime routines of a family are sub-optimal, habituation of that routine with no self-reflection or time to actively think about the routine can result in a vicious cycle with the same, unhelpful and potentially harmful behaviours repeated every night.</p>	<p><i>Intention</i> is an important facilitator since almost all parents stated clear intentions to be able to have and maintain good bedtime routines for their children and especially as the children are growing older.</p>
<p><i>Lack of motivation and negative emotions</i> associated with bedtime routines are an important barrier that contribute to parents feeling incapable of achieving optimal routines in a consistent manner or making positive changes to their bedtime routines where required.</p>	<p><i>Reinforcement</i> at the end of each night, depending how the routine unfolded, can be important facilitator for achieving, and especially for maintaining, good bedtime routines.</p>

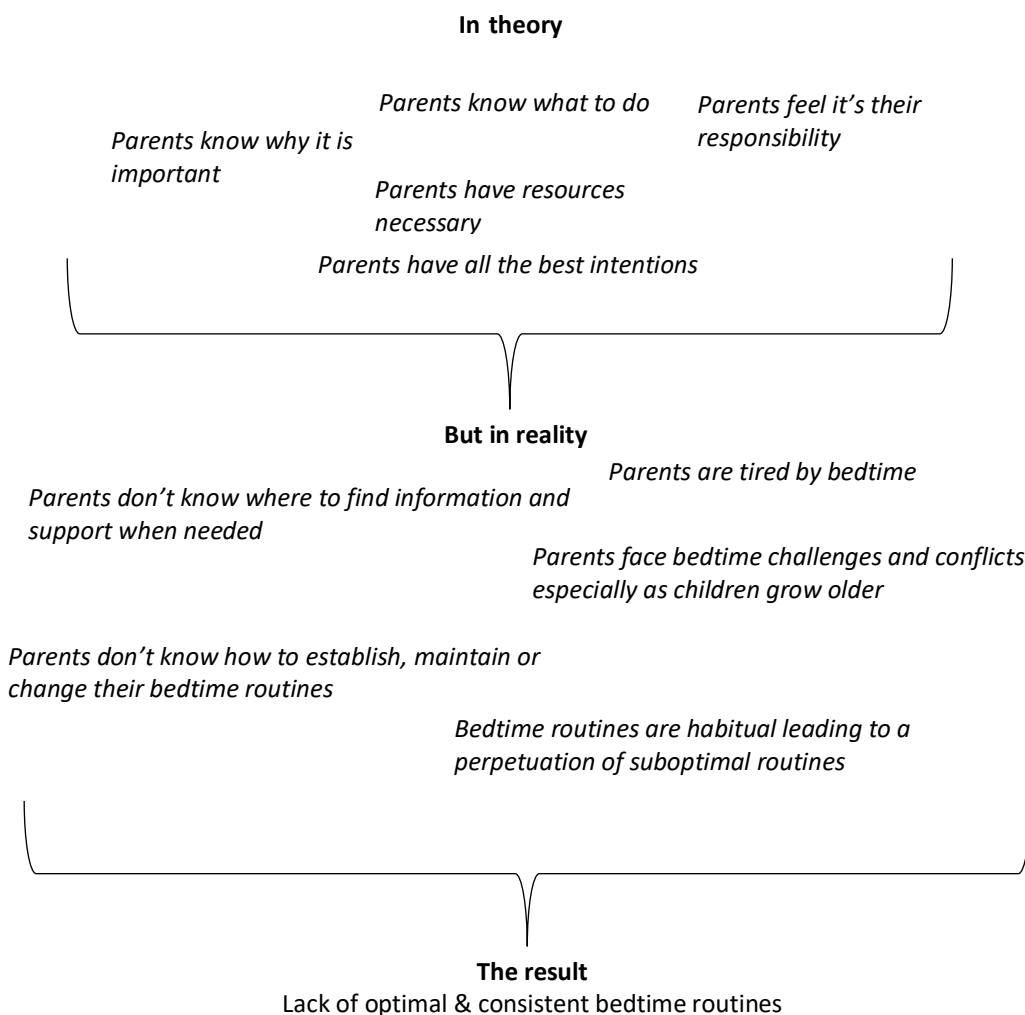
Discussion

This study examined perceived barriers to, and facilitators of, the formation, establishment and maintenance of bedtime routines in economically deprived families with young children using the TDF. Based on the results of the analysis, it is evident that many of the important ingredients required to establish and maintain optimal bedtime routines are in place: (a) parents are aware of why they need optimal bedtime routines, (b) they know what they have to do as part of an optimal routine, (c) they have the resources required, (d) they recognize the benefits of achieving good routines for themselves as well as for their children, (e) hold intentions to achieve them and (f) feel that it is their responsibility as parents to provide consistent and beneficial routines to their children. In contrast, problems in achieving optimal bedtime routines arise when: (a) parents are tired, (b) children present with more challenging behaviours bringing social comparisons and conflicts into the family unit, (c) parents seek but are unable to find information on how to change (or establish) their bedtime routines due to the lack of clearly marked, official sources of information, (d) parents heavily rely on suboptimal past experiences (what their parents used to do), (e) parents feel that routines are a habit that they cannot or would not even consider changing and (f) parents feel unmotivated. Figure 6.1 provides a visual schema for the key outcomes.

Past actions are a strong predictor of future behaviours and, people tend to stick with their behaviours unless they prove to be problematic early on (Albarracín & Wyer, 2000; Skinner, 1953; Bentler & Speckart, 1981; Ouellette & Wood, 1998). Habitual behaviours in stable contexts (like bedtime routines) have a higher likelihood of reflecting past behaviours and experiences (Triandis, 1980; Ouellette & Wood, 1998). This likelihood increases even further when little to no consideration, reflection or self-monitoring is in place to appraise critically past experiences and behaviours and their influence on current behaviours (Albarracín & Wyer, 2000). Biased scanning theory (Janis & King, 1954) and self-perception theory (Bern, 1972) suggest that when people engage in a particular behaviour (for example, when

establishing their routines) they often conduct “a biased search of memory for previously acquired knowledge that confirms the legitimacy of their actions” with “little if any conscious deliberation, simply reasoning that if they have performed the behaviour voluntarily, they must consider it to be desirable”. In the context of bedtime routines, parents might behave in a certain way that in their own opinion reflects an optimal bedtime routine based on their past experiences (heuristic behaviour) with little reflection (self-perception theory) and a biased justification for their actions (biased scanning theory). In this study, lack of appropriate provision and sources of information available to parents (especially first-time parents), appears to lead to a heavy reliance on past experiences for information about what constitutes an appropriate bedtime routine. This is then habituated with little self-monitoring and may hinder parents’ ability to formulate and maintain optimal routines.

Figure 6.1. Schematic representation of key outcomes

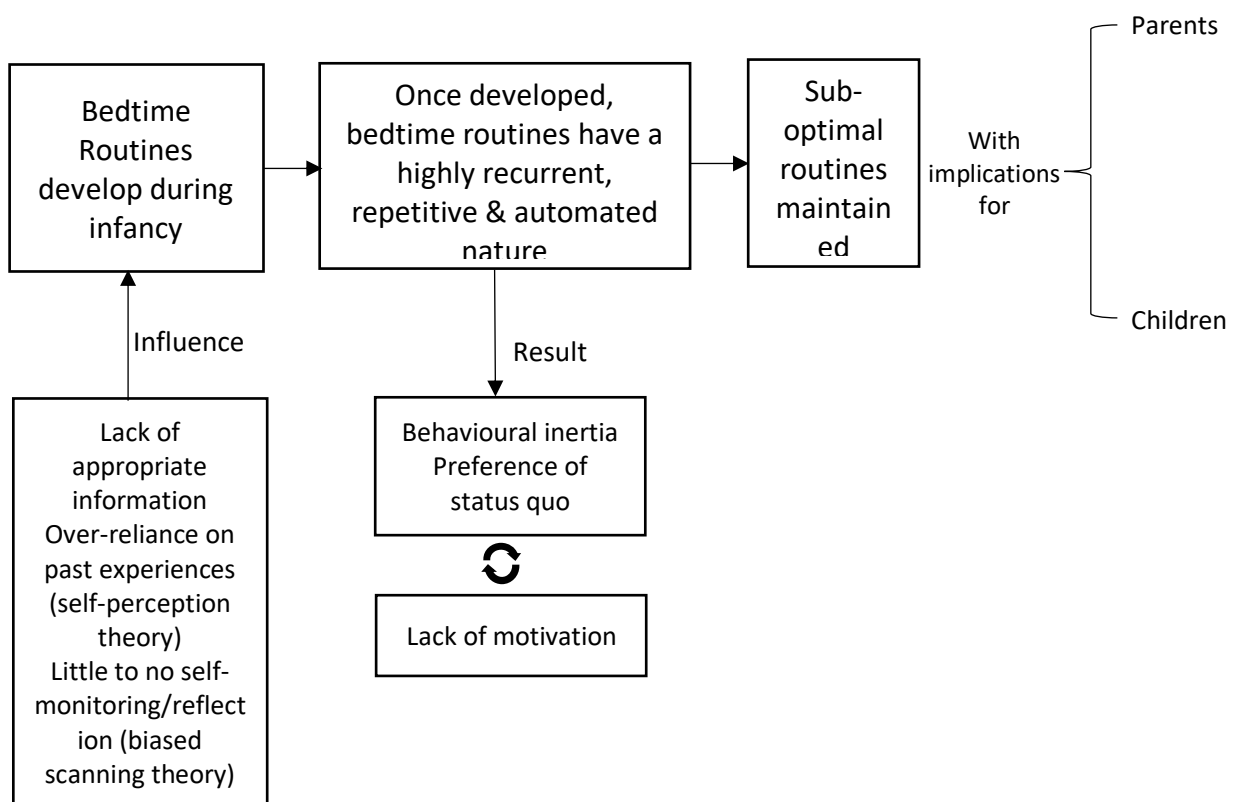


Parental tiredness/fatigue and cognitive overload acted as additional barriers to systematically and consistently achieving optimal bedtime routines even when parents knew what they needed to do and how to do it. In general, parental tiredness is a nearly universal experience (Cooklin, Giallo & Rose, 2011). Multiple child and non-child related factors contribute to parental fatigue (Dunning & Giallo, 2012). The demands of infant and toddler care combined with domestic and professional workload as well as other responsibilities result in significant levels of tiredness and fatigue for parents (Cooklin, Giallo & Rose, 2011; Dunning & Giallo, 2012). Fatigue is closely associated with parental wellbeing, parental self-efficacy, parental anxiety, parental mood, low warmth and irritability during parent-child interactions resulting in suboptimal parenting with less engagement in shared parent-child activities (Cooklin, Giallo, & Rose, 2011; McQueen & Mander, 2003). In turn, these parental difficulties and problematic parent-child interactions can result in a range of child emotional and behavioural difficulties later in life (Jones & Prinz, 2005). Bedtime routines due to their highly recurrent nature and the time of the day that they need to be implemented are particularly vulnerable to the effects of tiredness and fatigue. Addressing the effects of parental tiredness and fatigue during bedtime routines is not an easy task especially since parental fatigue is caused by a combination of factors. Existing attempts to explore interventions to reduce fatigue outside the immediate post-partum year remain limited with more studies required (Cooklin, Giallo, & Rose, 2011).

Finally, lack of motivation, negative emotions and automation of routines are another set of barriers identified in this study. These barriers can be grouped under the term “behavioural inertia” (Madrian & Shea, 2001). Behavioural inertia is a term commonly used in behavioural economics and it is associated with inaction and a tendency to remain with the status quo (Madrian & Shea, 2001). When faced with a decision, individuals tend to prefer the status quo since it provides them with comfort and a sense of familiarity (Nicolle et al., 2011). This preference for the status quo fuels a lack of motivation which in return maintains the status. Fear of change and fear of the unknown, of the possible alternatives if pursuing a different pathway is another important factor that fuels the status quo bias and behavioural inertia

(Samuelson & Zeckhauser, 1988). Behavioural inertia and status quo bias in the right context can be useful in maintaining optimal behaviours however, in cases where change would be beneficial they transform to detrimental factors perpetuating problematic behaviours (Nicolle et al., 2011). For bedtime routines, behavioural inertia is manifested in the lack of motivation and automation of routines from the parent’s perspective. Routines develop when children are in their infancy but fairly quickly, bedtime routines show signs of stability with most activities in place. If a family is lacking an optimal routine at this early stage, then the automated, highly recurrent and repetitive nature of bedtime routines overtakes the need or sense of urgency for altering and improving them. The end result, is a self-perpetuating cycle where change is not considered as a realistic prospect. Figure 6.2 provides an overview of the way these factors could potentially contribute to the formulation and maintenance of sub-optimal bedtime routines.

Figure 6.2. Formation & maintenance of sub-optimal bedtime routines based on results of TDF study on barriers and facilitators



Strengths

The use of a diverse and mostly deprived sample is the most important strength of this study. Individuals from deprived and ethnically diverse areas are routinely excluded from research with implications for a holistic understanding of how different behaviours unfold. Based on available research, information is sparse regarding the characteristics of bedtime routines and the impact of those routines on child development and wellbeing in this particular sociodemographic groups (Mindell & Williamson, 2018). Moreover, the use of a systematic theoretical framework (the TDF) in the design, implementation and analysis of interview material enabled a comprehensive, theory-based exploration of possible barriers and facilitators of good bedtime routines. Finally, the substantial agreement between coders demonstrates a high level of inter-rater reliability.

Limitations

The development of the interview schedule to reflect and capture all TDF domains might have resulted in a more rigid and structured rather than fluid and natural discussion. However, this particular possible limitation was managed through the establishment of prior good rapport that allowed for participants to feel more comfortable and express themselves in their own way. Participants were also given the freedom to discuss anything outside of the topic guide that they felt was relevant to any aspect of bedtime routines. Finally, the size of the study sample (n=12) might be considered a limitation however, recruitment followed data collection in parallel with the former concluding only when data saturation was reached.

Conclusions

Parents of young children face a series of barriers to achieving optimal bedtime routines ranging from lack of appropriate knowledge to lack of motivation and tiredness. These barriers can prove detrimental for bedtime routines with possible health, behavioural and social consequences for parents and children.

Gaining a better understanding of the determinants of optimal and suboptimal bedtime routines, is an important first step for future more in-depth examinations and potentially intervention studies. Further research is vital for this important yet under-researched area.

Summary

What do I know now?

- Parents want and try to establish good bedtime routines because they see this as part of their parental role and they believe that good bedtime routines set their children for a better future
- However, tiredness, lack of support in place and evidence-based information results in suboptimal routines that parents maintain due to lack of motivation and help in a vicious cycle

Next chapter

- Explore the possibility of an intervention around and during bedtime routines especially with regards to behavioural and developmental outcomes to expand on current reviews on interventions on bedtime routines and child sleep.

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Appendices

Appendix 6.A. Interview schedule based on the Theoretical Domains Framework

Interview schedule

0. Introduction

0.1. Briefly discuss the scope of this interview as an additional source of information in trying to get a better understanding of bedtime routines in families with young children. Discuss overall set up, including time, audio recordings etc.

1. Bedtime routines overview

1.1. Can you describe your typical bedtime routine? What time does it start and end? What does it involve? In what order? Who's involved?

2. General knowledge & skills

2.1. (KNOWLEDGE) How do you think a good bedtime routine looks like? What would be involved?

2.2. (KNOWLEDGE) You've mentioned X, Y and Z as things that would be involved in a 'good' bedtime routine – why do you think they're important / why do they matter?

2.3. (KNOWLEDGE) Are you aware of guidelines/recommendations relating to bedtime routines? If yes, what do they usually include? If yes, who/how did you come across those guidelines/recommendations? (*Hint*: midwives, health visitors, internet etc.)

Following reply to Qs.1 and 2.1/2.2/2.3, provide a quick definition of what an optimal bedtime routine should include and use a visual aid to quickly refer to with regards to all 4 main components (tooth brushing, book reading, diet & use of electronics).

2.4 (SKILLS) What skills do you think you would need in order to be able to do things involved in a good bedtime routine? (point to prompt card)

2.5. (SKILLS) Which of these skills do you think you have? Are there ones you could do with improving?

2.6. (SOCIAL IDENTITY) Who is responsible for bedtime routines in your view? (**Hint:** me as parent, parents or others?)

2.7. (SOCIAL IDENTITY) Do you think other parents have good bedtime routines? Are they like you?

2.8. (SOCIAL INFLUENCES) (If someone's involved) How do you feel about your partner's/husband's/wife's etc. involvement in your bedtime routines? Do they help or hinder your activities? (If no one's involved) Do you wish there was someone to help you with your bedtime routines? In what way someone else could be helpful for you during your bedtime routines?

2.9 (SOCIAL INFLUENCES) What do your friends / family think about your bedtime routine? Do you care what they think?

2.10 (SOCIAL INFLUENCES) What do your kids think about the different bits of this good bedtime routine (**Hint:** prompt card)? How important is it to you what they think about it?

3. Current situation

3.1. (BELIEFS CAPABILITIES) How easy or difficult is it for you to do your bedtime routine every night? Can you manage even when things are difficult?

3.2. (BELIEFS CAPABILITIES) How confident are you in completing your bedtime routine every night? (If confidence low) What would make you feel more confident? (If confidence high) What gives you confidence?

3.3. (EMOTIONS) How do you feel when you do manage to do all the things involved in your bedtime routine? What about when you don't? What words describe how you typically feel during your bedtime routines (i.e. stressed, calm, happy, sad)?

3.4 (EMOTIONS) How does the way you feel as it's coming up to bedtime influence whether or not you do the things involved in a good routine?

3.5. (MEMORY, ATTENTION & DECISION PROCESS) Are these different things (prompt card) things you do routinely, without thinking? Do they happen at a set time and in the same way every night or do you actively have to remember to do them?

3.6. (MEMORY, ATTENTION & DECISION PROCESS) Do your routines change between school days and weekends? If so, how are they different? Do you still complete all of your activities?

3.7. (MEMORY, ATTENTION & DECISION PROCESS) When you're tired or have a lot on your mind, do you try and complete all activities? If not, how do you decide which activities to leave out?

3.8. (ENVIROMENT-RESOURCES) (If employed) Do you believe that your work affects your bedtime routines? If yes, in what way?

3.9. (ENVIROMENT-RESOURCES) Are there things about your home (e.g. where the bedrooms are, need to share rooms, noise, etc.) that make your bedtime routines easier or harder?

3.10. (ENVIROMENT-RESOURCES) Do you have access to the things you need to do the 4 things outlined here (prompt card), e.g. selection of books, toothbrushes, water/milk etc? If not, in what way?

3.11. (REINFORCEMENT) When you have a good bedtime routine, what happens and how do you feel straight afterwards? What were the immediate benefits?

3.12. (REINFORCEMENT) When you have a bad bedtime routine, what happens and how do you feel straight afterwards? What were the immediate consequences?

3.13. (GOALS) What is/are your end goal(s) when starting your bedtime routines on a nightly basis?

3.14. (GOALS) Compared to other things you need / want to get done, how important is it that you do all the things listed as part of your bedtime routine?

3.15. (BEHAVIOUR REGULATION) Do you monitor your bedtime routines in any way? If yes, how do you do it? If not, do you believe that it might be useful to monitor them?

3.16. (BEHAVIOUR REGULATION) (If monitor bedtime routines) What do you do when you notice that your bedtime routines are not as good as they used to be? Do you take any actions? If yes, what?

4. Looking ahead

4.1. (BELIEFS CONSEQUENCES) Looking ahead in the future, what do you think will happen if you have a good bedtime routine in place? For you, your child, your family or in general? What will happen if you don't? Do some of these things (prompt card) matter more than other for the future?

4.2. (BELIEFS CONSEQUENCES) Do the future benefits outweigh the costs? How?

4.3. (OPTIMISM) Looking ahead, how do you feel about your upcoming bedtime routines for the days, weeks and years to come?

4.4. (OPTIMISM) Do you feel that regardless of what happens day to day, things will turn out fine in the end?

4.5. (INTENTIONS) Do you want to have a good bedtime routine? If yes, to what extent?

4.6 Do you feel ready and able to make any changes that are necessary to your existing bedtime routine?

This chapter has been submitted for publication:

Kitsaras, G., Romero, J.S., Goodwin, M., Allan, J., Kelly, M. P., & Pretty, I. A. (TBC).
Bedtime routine interventions to improve child wellbeing & family functioning: a systematic review of the literature. Systematic Reviews, (TBC).

Chapter 7

Bedtime routine interventions to improve child wellbeing & family functioning: a systematic review of the literature

Abstract

Background: Interventions acting upon bedtime routines have the potential to impact on child wellbeing and development. The majority of interventions and reviews of bedtime routines have focused solely on quality of sleep, omitting other areas important to overall wellbeing. The purpose of this review is to examine effect of interventions around bedtime routines in families with children and the effect of those interventions on child wellbeing and development as well as family functioning. **Methods:** A total of 14 studies were included in the review. Data relating to characteristics of included studies and the effect of interventions were extracted, summarised, critically analysed and narratively presented while risk of bias was assessed using the Quality Assessment Tool for Quantitative Studies and reported according to the PRISMA statement. **Results:** Included studies deployed either behavioural or educational interventions to promote optimal bedtime routines. All 14 studies showed improvements across their targeted outcomes including less tantrums, lower bedtime resistance, better child mood, higher parental competence/confidence, improved parental mood with lower stress, better parent-child relationships and improved marital satisfaction. From the 14 included studies, 5 were found to have weak likelihood of bias while 3 were found to have a strong likelihood of bias. **Conclusions:** Behavioural and educational interventions around bedtime routines in families with young children can improve outcomes relating to child wellbeing, parental socio-emotional state and overall family functioning. Improvements in those areas are associated with overall improvements in quality of life and later achievements in adulthood. Due to low number of studies and limited number of high-quality evidence additional research is necessary to expand our knowledge on bedtime routines.

This review is registered at the International Prospective Register of Systematic Reviews (PROSPERO) (CRD42017070786)

Keywords

Bedtime - child - parenting – wellbeing - development

Background

Bedtime routines are habitual family behaviours, or rituals, that each family undertakes in a recurrent fashion and, like all rituals, bedtime routines vary from one family to the next (Spagnola & Fiese, 2001). No clear guidelines exist on what constitutes an optimal bedtime routine, nor how this may differ to secure various wellbeing outcomes, but previous studies and recommendations from public bodies and organisations recognise the importance of, in the hour before bed: (a) consistency in terms of the time the child goes to bed, (b) good oral hygiene practices, (c) avoidance of food and drinks, (d) cessation of electronic device use and finally (e) book reading or book sharing (Anderson et al., 2016; Hale et al., 2009; Kelly, Kelly & Sacker, 2013; Levine, 2001; LeBourgeois et al., 2005; Mindell & Williamson, 2018; Paruthi et al., 2016; Sadeh, Tikotzy & Scher, 2010).

Previously, mainly cross sectional, and to a smaller degree longitudinal, studies have all shown important positive associations between quality of bedtime routines and key child development and wellbeing areas, as well as family functioning and parental wellbeing (Anderson et al., 2016; Hale et al., 2009; Kelly, Kelly & Sacker, 2013; Levine, 2001; LeBourgeois et al., 2005; Mindell & Williamson, 2018; Paruthi et al., 2016; Sadeh, Tikotzy & Scher, 2010). Areas where bedtime routines have shown important positive associations include quality of sleep, dental health, school performance, school readiness, cognitive development and socio-emotional development (Anderson et al., 2016; Hale et al., 2009; Kelly, Kelly & Sacker, 2013; Levine, 2001; LeBourgeois et al., 2005;). Previous studies have also reported that children with problematic bedtime routines present with higher levels of behavioural difficulties (Kelly, Kelly & Sacker, 2013). Finally, bedtime routines also have important associations with parent-child dynamics and overall family functioning (Henderson & Jordan, 2016). Research on family routines in general demonstrates the importance of parent-related as well as child-related factors (parental self-regulation, parental efficacy, parenting practices, socio-emotional wellbeing, parent-child relationship) in

allowing positive routines to be developed and established (Henderson & Jordan, 2009).

Bedtime routines are an important part of each family's schedule and emerging evidence showcases the importance of bedtime routines for child wellbeing and overall family functioning. Wellbeing is a construct encompassing many health, behavioural and social elements that are closely interlinked and interchangeable. Despite evidence around broader wellbeing and development, quality of sleep is the area that has attracted by far the most research interest (Mindell & Williamson, 2018). Moreover, the majority of the overall limited number of intervention studies around bedtime routines focus primarily on sleep outcomes omitting other areas relating to child wellbeing and development (Mindell & Williamson, 2018). Those interventional studies focusing on children's quality of sleep, resulted in significant improvements regarding sleep onset, duration of sleep, and lower number of night-wakings (Busch et al., 2017; Hill et al, 2016; Mindell et al., 2006). Two separate systematic reviews have been conducted, one as recently as 2017, on bedtime routines and children's quality of sleep with one study focusing explicitly on intervention studies (Busch et al., 2017; Mindell et al., 2006).

Despite their important contribution, the two reviews focusing on bedtime routines and quality of sleep resulted in a gap to our overall understanding on other key areas relating to child wellbeing and development including child socio-emotional, behavioural and educational development as well as overall family wellbeing and functioning. These areas constitute key elements where the establishment, deployment and maintenance of an optimal bedtime routine may be beneficial. Hence it is important for a new systematic review to examine the role of interventions around bedtime routines in families with young children beyond quality of sleep in order to progress our holistic understanding on a dynamic, common yet under-researched family activity.

The objectives of the review are to summarise, critically appraise, and present interventional studies around bedtime routines in families with children with

outcome measures focusing on: (a) child wellbeing and development (outside of quality of sleep) and (b) family functioning and parental wellbeing.

Methods

The systematic review was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Moher et al., 2015) statement as presented in Appendix A. The protocol of the review was registered at the International Prospective Register of Systematic Reviews (PROSPERO) (CRD42017070786).

Search strategy

Between August and September 2017, a systematic literature search in the following databases: PubMed, American Academy of Pediatrics (AAP) Gateway, Web of Science, PsychINFO, Embase and PsychNET was conducted. An additional search, in the same databases was conducted in early 2019 to capture additions in the literature regarding this particular topic. When necessary, specific keywords were used depending on the database. Additionally, references of selected and relevant articles were searched to capture a wider variety of studies. No restrictions regarding publication date were applied in the searches. No grey literature sources were included. The search strategy for PubMed was as follows: (“child*” [tiab] AND “bedtime” [tiab] AND “intervention” [tiab]). For PsychNET, AAP Gateway and the Web of Science the following search strategy was used: (“child” AND “bedtime” AND “intervention”). Language variants of key terms including “infants”, “toddler” and “routine” were also used when searching databases. A broad search strategy was deemed important given the limited number of available studies and the lack of clear and concise language when it comes to wellbeing and development outcomes.

Selection criteria

Inclusion criteria for studies in the review were based on the following Population, Intervention, Comparator and Outcome (PICO) tool:

(a) Population: children up to the age of 12 with no pre-existing health conditions, mental health problems or learning disabilities. Capping the age of children included in the study at 12 years of age reflects overall approaches in early childhood research originating from the Piaget's four cognitive stages of childhood development. This age cap allows us to encompass key developmental ages around prosocial, emotional and cognitive development. (b) Intervention: intervention should have occurred around bedtime routines with no restrictions regarding type of intervention or method of delivery (i.e. educational intervention, behavioural intervention etc.) (c) Comparator: in most studies, comparators included control (non-intervention groups). Due to the fragmented nature of bedtime routines where multiple activities are undertaken each night and the fact that different studies would have focused on different components/activities of bedtime routines it was not possible to establish a unique or ideal comparator that encompassed this dynamic area. (d) Outcomes: outcomes related specifically, and in some studies solely, to quality of sleep were excluded from this review. Main outcomes focused on children's wellbeing including (1) behaviour (e.g. tantrums, bedtime refusal etc.) and (2) uptake of beneficial activities (e.g. book reading/book sharing, avoidance of snacks/drinks, avoidance of electronic devices before bed etc.), Furthermore, secondary outcomes focused on parental wellbeing including (1) parents' socio-emotional state, (2) parent-child relationships and (3) parental relationships.

One additional criterion, outside the PICO tool related to the language of the studies which should be in English.

Two reviewers independently screened all titles and abstracts and subsequently all full texts of studies that appeared relevant. All discrepancies between the reviewers were discussed until a consensus was reached. Inter-

examiner agreement was calculated at the end of the coding process to examine if there were significant variations between the two independent coders.

Assessment of risk of bias

Following guidelines from the UK National Institute of Health and Care Excellence (NICE, 2014) and due to the presence of randomised and non-randomised control trials included in the review, the Quality Assessment Tool for Quantitative Studies by the Effective Public Health Practice (National Collaborating Centre for Methods and Tools, 2008) was used to assess risk of bias. A scoping exercise by the two reviewers (GK & JSL), prior to the start of the review, highlighted the benefits of using the Quality Assessment Tool for Quantitative Studies over other appraisal instruments. The Quality Assessment Tool for Quantitative Studies provides a Global Rating for likelihood of bias for each study based on a 1 (strong), 2 (moderate) and 3 (weak) with separate scores (1 to 3) for specific study design components. Studies with a weak risk of bias (score of 3) can be considered stronger evidence to support their stated conclusions than those with a high risk of bias.

Data extraction

From each study, data relating to: (a) study design, (b) sample size, (c) population characteristics, (d) type of intervention, (e) characteristics of intervention, (f) comparator, (g) assessments/measurements used and (h) effects on child wellbeing-development were extracted onto proformas. Extracted data were checked for consistency.

Results

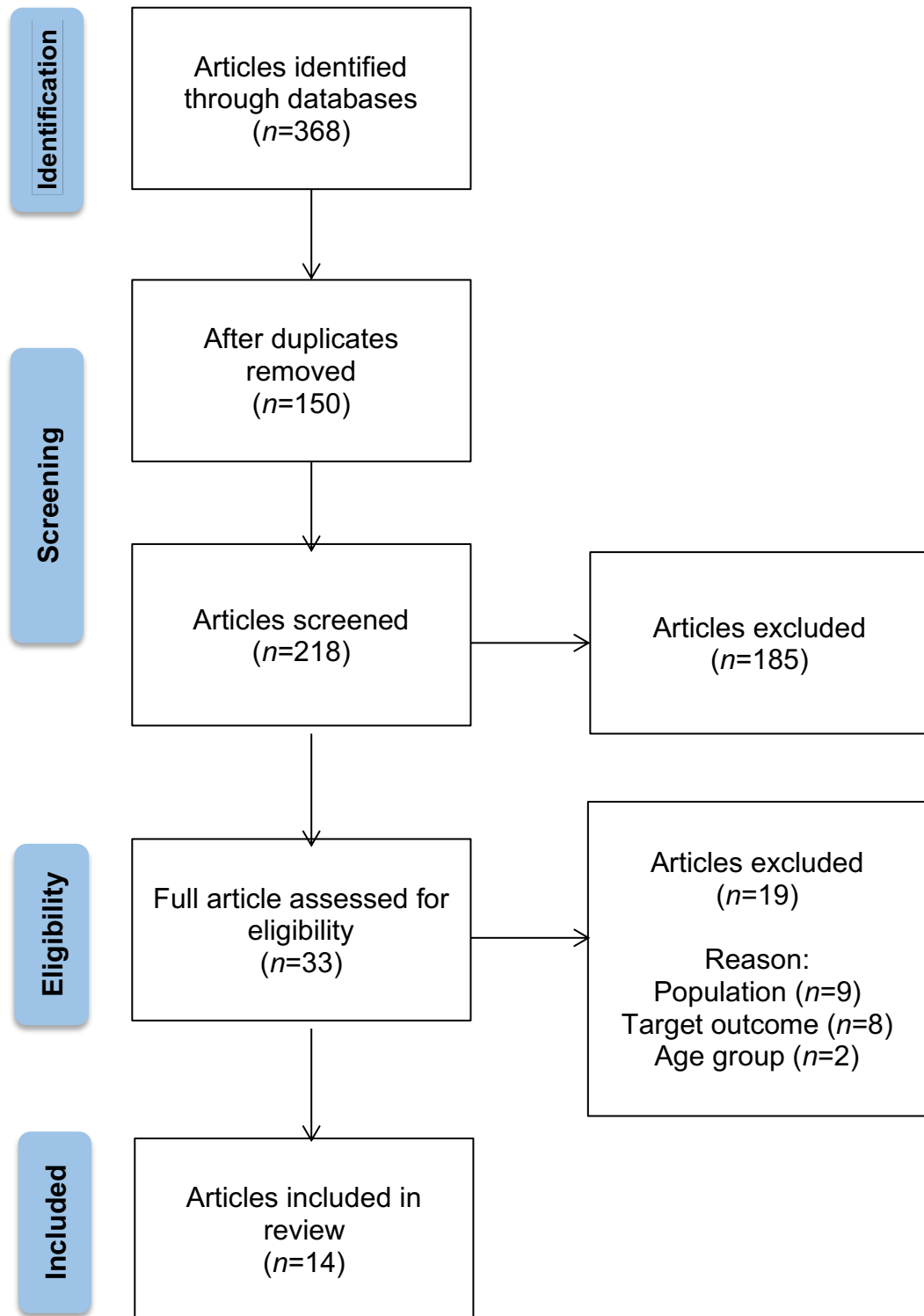
Study selection

As presented in Figure 7.1, a total of 368 studies were initially identified through extensive literature searches. After removing duplicates, a total of 218 articles were screened leading to 185 of them being excluded from the review. Finally, 33 studies were fully assessed for eligibility with 14 being included in the review. From the 19 studies excluded on the final stage, 9 of them included populations with predefined health conditions, mental health problems or learning disabilities, 8 targeted sleep-related outcomes and 2 focused on age groups outside the preferred range (i.e. 0-12 years).

Characteristics of included studies

Table 7.1 summarises the main characteristics of included studies. From the 14 studies included in the review, ten used a RCT (Adam & Rickert, 1989; Hiscock & Wake, 2002; Kerr et al., 1996; Reid et al., 1999; Mindell et al., 2009, 2011, 2016, 2017, 2018; Wolfson et al., 1992) study design and four used a cohort study design (Buchanan & Webster, 1982; Burke et al., 2004; Freeman, 2006; High et al., 1998). The total sample of all included studies was 1717 participants. In terms of socio-demographic characteristics, the majority of studies failed to report the socio-economic (n=8) and ethnic (n=9) composition of their sample. Those reporting socio-demographic characteristics showed diverse samples with inclusion of multiple ethnicities and different socio-economic levels (Adams & Rickert, 1989; Burke et al., 2004; Freeman, 2006; High et al., 1998; Mindell et al., 2009, 2011, 2017, 2018). All demographic related data and results pertain to families as a whole rather than individuals.

Figure 7.1. Flow diagram of study selection



As presented in table 7.2, a total of three studies (Adams & Rickert, 1989; Reid et al., 1999; Mindell et al., 2011) compared more than one intervention versus a control group with the remaining 10 focusing on one intervention against a control group. In terms of outcome measures, 4 studies focused on child wellbeing outcomes (Buchanan & Webster, 1989; Burke et al., 2004; Freeman, 2006; Kerr et al., 1996), 1 study on beneficial activities for child wellbeing and development by exploring book sharing/reading (High et al., 1998) and 1 study on avoidance of electronics before bed (25). A total of 8 studies focused on a combination of child wellbeing and parental wellbeing/family functioning outcome measures (Adams & Rickert, 1989; Hiscock & Wade, 2002; Reid et al., 1999; Mindell et al., 2009, 2011, 2016, 2017, 2018; Wolfson et al., 1992). Regarding types of interventions deployed, 7 of the 14 studies deployed educational interventions. These 7 studies used interventions including health education around bedtime routines, messages and information material regarding good bedtime routines as well as instructions on how to construct a good bedtime routine. Seven additional studies, utilised behavioural interventions including positive reinforcement and rewards for appropriate behaviour as well as extinction programs (through gradually reducing responses to problematic behaviour).

Regarding types of assessments for targeted outcomes, the majority of included studies (n=8) deployed non-standardised measurements including diaries, non-standardised questionnaires and occurrence of targeted outcome (Adams & Rickert, 1989; Buchanan & Webster, 1982; Burke et al., 2004; Freeman, 2006; Reid et al., 1999; Mindell et al., 2011, 2016, 2017). Four studies used only standardised assessments including questionnaires (e.g. Brief Infant Sleep Questionnaire etc.) as well as clinical scales (e.g. Edinburgh Depression Scale) (Hiscock & Wake, 2002; High et al., 1998; Mindell et al., 2009, 2018). Finally, one study used a combination of standardised and non-standardised measures (Mindell et al., 2009) and another one used purely qualitative methods (i.e. one to one interview with parents) (Kerr et al., 1996).

Effect of interventions

As presented in table 7.2, all 6 studies focusing on child wellbeing outcomes reported improvements in intervention relative to control groups. The 2 studies focusing solely on beneficial activities (i.e. book sharing/reading and avoidance of electronics) resulted in higher rates of book sharing/reading, better overall literacy rates amongst intervention group (High et al., 1998) as well as lower use of electronic devices before bed (Mindell et al., 2016). Mindel et al. (2016) showed reduced use of electronic devices before bed in the intervention group (baseline mean score = 1.91, follow-up mean score = 0.85) while High et al. (1998) showed improvements in child-centred literacy activities (odds ratio = 4.7, $p < 0.001$) and higher frequency of book sharing between intervention and control groups (intervention $M = 3.9$ ($SD = 2.6$), control $M = 2.5$ ($SD = 2.7$), $p = 0.002$).

Moreover, all four studies focusing on child-related behaviours showed improvements in occurrence of bedtime resistance, lower number of tantrums and overall improvement in bedtime refusal. In more details, Kerr et al. (1996) found 18% difference in settling difficulties between groups ($\chi^2 = 4.88$, $df = 1$, $p = 0.003$), that study also found significant differences in the number of night-wakings between the groups (46% for control group, 23% for intervention group, $p = 0.002$). Burke et al. (2004) showed a 78% average decrease in frequency of disruptive bedtime behaviours from baseline to intervention, with another 7% decrease at 3-month follow-up. Night wakings, a problem for 2 children during baseline, were not a problem during intervention and follow-up. Parents reported improved daytime behaviour for 3 of the 4 children in the study. In Freeman (2006), bedtime resistance was eliminated for all participants. Finally, Buchanan & Webster (1982) found an established, non-argumentative bedtime routine, at 6-8 week follow up, in 9 out of 12 families used in their intervention study.

Table 7.1. Summary of selected studies

Study	Design	Sample Size	Demographic characteristics		Sample Age
			Socio-economic	Ethnicity	
Adams & Rickert, 1989	RCT	36	2 Postgraduate education, 14 University education, 17 High school graduates, 3 Below high school education	34 White Caucasian & 2 Hispanic	18 to 48 months
Buchanan & Webster, 1982	Cohort	12	Not specified	Not specified	3 to 10 years
High et al., 1998	Cohort with historical control	151	Not specified	25 African American, 59 White Caucasian, 56 Hispanic & 11 other	12 to 38 months
Mindell et al., 2017	RCT	134	11 income <\$30000, 26 income \$30000-\$39999, 20 income \$40000-\$49999, 41 income \$50000-\$74999, 36 income >\$75000	Not specified	8 to 18 months
Reid et al., 1999	RCT	49	Not specified	Not specified	16 to 48 months
Kerr et al., 1996	RCT	167	Not specified	Not specified	3 months
Mindell et al., 2011	RCT	264	11 income <\$30000, 41 income \$30000-\$39999, 27 income \$40000-\$49999, 90 income \$50000-\$74999, 56 income \$75000-\$99999, 38 income <\$100000	Not specified	3 to 36 months
Mindell et al., 2016	RCT	152	Low socio-economic profiles	Not specified	2 to 12 years
Burke et al., 2004	Cohort	4	Not specified	3 White Caucasian & 1 Hispanic	2 to 7 years
Mindell et al., 2009	RCT	405	16 income <\$30000, 55 income \$30000-\$39999, 53 income \$40000-\$49999, 142 income \$50000-\$74999, 139 income <\$75000	Not specified	7 to 18 months
Hiscock & Wake, 2002	RCT	156	Not specified	Not specified	6-12 months

Wolfson et al., 1992	RCT	60	Middle-upper class (mostly managerial-professional jobs) with income above \$50000	Not specified	6-9 weeks
Freeman, 2006	Cohort	4	Not specified	4 White Caucasian	3 years
Mindell et al., 2018	RCT	123	Not specified	37 White Caucasian, 38 Black/African-American, 5 Asian, 3 Hispanic/Latino, 2 Native Hawaiian, 1 Multi-ethnic, 1 Other	3-18 months

Table 7.2. Summary of characteristics & effects of bedtime routines interventions

Study	Targeted area	Type of intervention	Intervention characteristics	Measurements	Results	Outcomes
Adams & Rickert, 1989	1. Child (behaviour) 2. Parents (parental relationship)	Behavioural (Positive routines x Graduate extinction x control)	<p>Positive routines: therapist chose ideal routines based on the time child went to bed, routine included 4 to 7 quiet activities lasting a maximum of 20 minutes; parents were instructed to praise their children during those quiet activities; if tantrum occurred, parents were instructed to put child on his/her back and firmly say "The routine is over, it is time for bed!"</p> <p>Graduate extinction: parents were instructed to ignore tantrums for specific time intervals individualised for each child according to age, interval length increased weekly. Parents were allowed to comfort their children for up to 15 seconds before leaving the room for the next interval should the child continued with the tantrum.</p>	<p>1. Dyadic Adjustment scale (for marital satisfaction)</p> <p>2. Occurrence of tantrums over 7 nights in bedtime written form</p>	<p>Significant differences in frequency in positive x graduate x control comparisons ($p < .05$) for week 2 and ($p < .001$) for weeks 3 to 6. Also significant differences in duration in positive x graduate x control comparisons ($p < .001$) across all weeks</p>	<p>1. Decrease in frequency of tantrums between interventions and control</p> <p>2. Decrease in number of tantrums between interventions and control</p> <p>3. Significant improvement on marital satisfaction between interventions and control</p> <p>4. Improvement on marital satisfaction greater for positive routines compared to graduate extinction</p>

Buchanan & Webster, 1982	1. Child (behaviour)	Behavioural (Bedtime routines program with reward system)	Each child drew a contract with the characteristics of the proposed bedtime routine with an accompanying reward monitoring sheet. Children were asked to repeat exactly the details negotiated in their "contract". Children were responsible for collecting-monitoring their rewards each morning. Star stickers were used as rewards with additional rewards such as chocolate in the case of younger children.	Number of successful bedtime routines	Descriptive analyses with additional simple comparisons with no <i>p</i> values	Successful bedtime routines established and maintained for up to 8 weeks in 9 out of 12 cases
High et al., 1998	1. Child (beneficial activities)	Educational (Book sharing with bedtime routines program)	Distribution of children's books during scheduled health-related visits alongside educational material to parents with bullet points that could help them establish a better bedtime routine with list of proposed activities that benefit the child.	1. Child-centred literacy orientation questionnaire 2. Sleep Habits Questionnaire	Child centred literacy orientation: control x intervention OR=4.7 ($p<.001$, $r^2=0.17$) book sharing: control x intervention ($p<.05$, $r^2=0.19$)	Intervention effective in promoting child-centred literacy
Mindell et al., 2017	1. Child (sleep) 2. Parents (socio-emotional wellbeing)	Educational (Bedtime routines improvement program)	Verbal and written information, after baseline, on how to construct-implement a three-step bedtime routine for a two-week period that included a bath, a massage and quiet activities.	Sleep diaries	Sleep onset latency: control x intervention ($p<.001$ for night 3, ($p<.10$) non-significant for night 14 (end of week 2) Night wakings: control x intervention ($p<.05$) for night 14 (end of week 2) Sleep duration: control x intervention ($p<.001$) for night 14 (end of week 2)	1. Rapid improvements during first 3 nights of intervention across sleep outcomes, including sleep onset latency, the frequency and duration of nighttime awakenings, sleep consolidation, maternal perceptions of bedtime ease, sleep quality and infant mood 2. No further improvements after that

					<p>Parental (maternal) perceptions for bedtime ease</p> <p>Quality of sleep: control x intervention ($p < .01$) at night 14 (end of week 2)</p>	
Reid et al., 1999	<p>1. Child (behavior) 2. Parents (socio-emotional wellbeing) 3. Parent-child relationship</p>	<p>Behavioural (Standard ignoring treatment x Graduate ignoring treatment x control)</p>	<p>Standard ignoring: parents were instructed to put children to bed after their bedtime activities, say goodnight, turn off the light, leave the room and not return. If a child woke up at night, parents were instructed to briefly check on the children, leave and not return. If a child left the bedroom, he/she was given a warning. If child left more than once, parents had to use one of the techniques to keep the child in the room (i.e. close door, child gate etc.)</p> <p>Graduate ignoring: parents were instructed to put children to bed after their bedtime activities, say goodnight, turn off the light, leave the room and not return. If a child woke up at night, parents were instructed to make a brief check after 5 mins and leave the room. Brief checks were made after 10min at 15min intervals if the child was still crying. If a child left the room, he/she was given a warning. If a child left more than once, parents were instructed to keep the door close for a short interval each time with the intervals continuously increasing.</p>	<p>1. Expectancies of Compliance and Outcome (assessed via phone calls) 2. Bedtime and night-time compliance (assessed via phone calls) 3. Bedtime and night-time stress (assessed via phone calls)</p>	<p>Better bedtimes: standard ign. x graduate ign. x control ($p < .0005$) week 3,</p> <p>Better night-time behaviours: standard ign. x graduate ign. x control ($p < .005$) week 3</p> <p>Maternal stress: standard ign. X graduate ign. X control no significant differences across groups but standard ign. resulted in lower stress around night-time during week 2 ($p = .001$) and week 3 ($p = .005$)</p>	<p>1. Significant differences in bedtime and night-time sleep problems for interventions 2. Decreased maternal stress in standard ignoring group</p>

Kerr et al., 1996	1. Child (behaviour)	Educational (Health education on bedtime routines x control)	Parents were provided with a health education booklet focusing on settling methods and the importance of routines.	Interview on sleep behaviour	Settling difficulties: control x intervention (p=0.03) Night wakings: control x intervention (p=0.02), sleep score: control x intervention (p=0.03)	Less settling and night waking issues in the intervention group compared to control
Mindell et al., 2011	1. Child (Sleep) 2. Parents (socio-emotional wellbeing)	Educational (Internet-based intervention x Internet-based intervention with prescribed bedtime routine x control)	Internet: parents completed the customised sleep profile that gathers information on their child's sleep, compare them with children of their age and provides customised advice on how caregivers can help with their children's routines. Parents followed the advice given for weeks 2-3 after the end of the baseline week (week 1) Internet & prescribed routine: parents completed the customised sleep profile that gathers information on their child's sleep, compare them with children of their age and provides customised advice on how caregivers can help with their children's routines. Parents followed the advice given alongside a prescribed 3-step bedtime routine that included a bath, a massage and quiet activities	1. Brief Infant Sleep Questionnaire 2. Profile of Mood States 3. Pittsburgh Sleep Quality Index	Sleep onset latency: control x internet x internet + bedtime routine prescription (p<.001) Night wakings: control x internet x internet + bedtime routine prescription (<.001) Duration of sleep: control, internet x internet + bedtime routine prescription (<.001) Child's mood morning: control x internet x internet + bedtime routine prescription (p<.001) Parental (maternal) confidence: control x internet x internet +	1. Both internet-based interventions resulted in significant reductions in problematic sleep behaviours 2. Significant improvements were seen in latency to sleep onset and in number/duration of night wakings 3. Improved sleep continuity 4. Improved mothers' mood, sleep and confidence in managing children's sleep

					bedtime routine prescription (p<.001)	
Mindell et al., 2016	1. Child (Sleep & Beneficial activities)	Educational (Sleep education messages x control)	Bed delivery for children with provision of 3 basic sleep messages for parents: bedtime before 21:00, avoid all caffeine and keep electronics out of bedroom	6 sleep schedule and sleep hygiene questions	Use of electronics before bed: control x intervention (p<.001) Sleep duration: control x intervention (p<.01)	1. Decrease in use of electronics before bed in the intervention group compared to control 2. Improvements in sleep duration for intervention group
Burke et al., 2004	1. Child (behaviour)	Behavioural (Rewarding social story)	Parents were asked to read "the Sleep Fairy" at the end of their child's bedtime routine. Book includes description of a good bedtime routine with the statement that the "Fairy" will leave a treat for children who have good bedtime routines without problems. Two pages helped parent to construct bedtime routines based on clear expectations and use of reinforcements for good child behaviour	Sleep diaries	Descriptive analyses with additional simple comparisons with no p values	Decrease in occurrence of disruptive bedtime behaviour
Mindell et al., 2009	1. Child (Sleep) 2. Parents (socio-emotional wellbeing)	Educational (Bedtime routine intervention x control)	Verbal and written information, after baseline, on how to construct-implement a three-step bedtime routine for a two-week period that included a bath, a massage and quiet activities	1. Brief Infant Sleep Questionnaire 2. Profile of Mood States 3. Sleep diary	Sleep onset latency: control x intervention (p<.001) Night wakings: control x intervention (p<.001) Sleep duration: control x intervention (p<.001) Child's mood morning: control x intervention (p<.001)	1. The bedtime routine resulted in significant reductions in problematic sleep behaviours for infants and toddlers 2. Significant improvements were seen in latency to sleep onset and in number/duration of night wakings 3. Maternal mood state also significantly improved

					Parental (maternal) tension/anger/fatigue/confusion: control x intervention (p<.001),	
Hiscock & Wake, 2002	1. Child (Sleep) 2. Parents (socio-emotional wellbeing)	Behavioural (Graduate extinction x control)	Mothers attended 3 private consultations where sleep management plans were tailored to their needs. Advice included settling down activities, how to modify behaviour and use of reinforcements. Information was also provided in the form of a sheet.	1. Edinburgh depression scale 2. Maternal sleep report	Maternal depression: control x intervention (p=0.45) Reduced sleep problems: control x intervention (p=0.26)	1. Improved maternal depression at 2 months, not at 4 months follow-up 2. Reduced sleep problems
Wolfson et al., 1991	1. Child (Sleep) 2. Parents (socio-emotional wellbeing)	Educational (Education x control)	Preventive program to facilitate infant sleeping patterns. Participants met in small groups for two consecutive weekly prenatal sessions and two post birth booster sessions. During sessions they were provided with didactic information on infant sleep and specific methods assisting in establishing good sleep habits.	Sleep diary	sleep: control x intervention (p<.05) parental stress (hassles): control x intervention (p<.001) parental sense of efficacy: control x intervention (p<.001)	1. Improved infant sleep 2. Improved parent sleep 3. Improved parental competence
Freeman, 2006	1. Child (behaviour)	Behavioural (Reward system)	Parents gave the child a notecard exchangeable for one trip out of the bedroom for a short (less than 3min) specific activity. After completing the activity, child had to return the notecard and return to bed. During later phases parents were instructed to maintain the pass adding extinction	Occurrence of resistance	Descriptive analyses with additional simple comparisons with no p values	Improved bedtime resistance across all participants
Mindell et al., 2018	1. Child (Sleep)	Behavioural (massage with winding down)	Following a one-week baseline period in which the mothers followed their child's usual bedtime practices, the mothers	1. Brief Infant Sleep Questionnaire	Child sleep improvements:	1. Improved child sleep 2. Improved maternal perception of bedtime difficulties

	2. Parents (socio-emotional wellbeing)	activities x control)	were instructed to institute a nightly two-step bedtime routine for a two-week period that included a massage (using a provided massage product and instructional materials including possible massage techniques), and quiet activities (e.g., cuddling and singing lullaby)	2. Pittsburgh sleep quality index 3. Epworth sleepiness scale 4. Edinburgh postnatal depression scale 5. Brief mood introspection scale 6. Parenting stress index-short form 7. State-Trait anxiety inventory	control x intervention (p=0.006) Maternal perceptions of bedtime difficulties: control x intervention (p <0.05) Maternal perception of sleep as problem: control x intervention (p=0.013) Reduction in night waking: control x intervention (p=0.013) Overall sleep quality improvement: control x intervention (p<0.001)	3. Decreased perception by mothers of sleep as a problem 4. Improved sleep quality 5. Reduction in night wakings
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As with child wellbeing, all 8 studies focusing on combination of child wellbeing and parental wellbeing/family functioning outcome measures reported significant beneficial differences between their intervention and control groups. Findings included improved parental mood, lower levels of stress, better child-parent relationships, higher marital satisfaction, higher parental confidence and self-competence as well as better child mood, lower incidents of tantrums and bedtime resistance. In Adams & Vaughn (1989) both intervention groups showed improvements in their frequency of tantrums across the 6-weeks of the intervention as well as 3 and 6-weeks follow up (intervention week 2 $p < 0.05$, intervention weeks 3-4-5-6 $p < 0.001$ and follow up $p < 0.001$) while parents reported higher marital satisfaction ($F(2,33) = 4.36$, $p < 0.02$). Hiscock & Wake (2002) showed reduction in overall depression levels between intervention and control groups mean change - 3.7, 95% confidence interval - 4.7 to - 2.7, vs. - 2.5, - 1.7 to - 3.4, $P = 0.06$) with further reductions in the subgroup of depressed mothers with higher depression scores. In Reid et al. (1999) children in both of the treatment groups had significantly better night times than children in the control group during Weeks 1, 2, and 3 (StdI: Week 1 $F[1, 27] = 10.4$, $p = 0.002$; Week 2 $F[1, 27] = 10.1$, $p = 0.005$; Week 3 $F[1, 27] = 20.0$, $p = 0.005$; GrdI: Week 1 $F[1, 24] = 7.9$, $p = 0.005$; Week 2 $F[1, 24] = 36.3$, $p = 0.005$; Week 3 $F[1, 24] = 45.8$, $p = 0.005$). Intervention group showed better bedtimes than children in the control group during Weeks 1, 2, and 3 (StdI: Week 1 $F[1, 25] = 16.7$, $p = 0.005$; Week 2 $F[1, 25] = 55.5$, $p = 0.005$; Week 3 $F[1, 25] = 62.1$, $p = 0.005$; GrdI: Week 1 $F[1, 26] = 18.4$, $p = 0.005$; Week 2 $F[1, 26] = 44.8$, $p = 0.005$; Week 3 $F[1, 26] = 36.8$, $p = 0.005$). Finally, with regards to maternal stress Hiscock & Wake (2002) comparisons indicated that mothers in intervention group reported less bedtime stress in Week 3 than in Week 1 of treatment ($t[12] = 1.88$, $p = 0.002$) and less night time stress during Week 2 ($t[23] = 3.56$, $p = 0.001$) and Week 3 ($t[23] = 2.67$, $p = 0.005$).

Mindell et al. (2009) found lower incidences of night wakings ($F(2, 403) = 25.61$, $p < 0.001$), duration of night wakings ($F(2, 403) = 11.22$, $p < 0.001$), child's mood in the morning ($F(2, 403) = 15.39$, $p < 0.001$) and maternal perception of bedtime

routines' difficulty ($F(2,403)=34.89, p<0.001$). In a similar study, Mindell et al. (2011) found lower incidences of night-wakings ($F(2,262)=32.34, p<0.001$), duration of night wakings ($F(2,262)=29.20, p<0.001$), child's mood in the morning ($F(2,262)=12.68, p<0.001$) and maternal perception of bedtime routines' difficulty ($F(2,262)=77.90, p<0.001$). Wolfson & Lacks (1992) found higher levels of parental self-efficacy between control and intervention groups ($F(1,54)=6.33, p<0.05$) while parental stress differences between groups remained non-significant. Mindell et al. (2017) showed significant reductions over the first 3 nights in night-wakings frequency ($b= -0.12$ [95% CI $-0.17, -0.07$], $t= -4.87, p < 0.001$) with significant reductions over the remainder of the intervention period, through night 14 ($b= -0.01$ [95% CI $-0.03, -0.002$], $t= -2.27, p < 0.05$). Finally, Mindell et al. (2018) found significant changes especially with regards to child quality of sleep and night wakings $F(1,122)=5.36, p <.05$, maternal perception regarding the difficulty of bedtime routines $F(1,122)=6.85, p <.05$, morning mood $F(1,122)=5.17, p <.05$ and confidence in managing child sleep issues $F(1,122)=8.42, p <.05$.

Risk of bias assessment

Table 7.3 presents the results of the risk of bias assessment undertaken using the Quality Assessment Tool for Quantitative Studies. From the 14 studies included in the review, 5 were found to have weak likelihood of bias (score of 3 on the risk of bias assessment scale) representing a strong study design (Hiscock & Wake, 2002; Mindell et al., 2009, 2011, 2018; Wolfson et al., 1992). A total of 6 studies presented a moderate likelihood of bias due to their study design (score of 2 on the risk of bias assessment scale) (Adams & Rickett, 1989; High et al., 1998; Kerr et al., 1996; Reid et al., 1999; Mindell et al., 2016; 2017). Finally, a total of 3 studies were found to have high likelihood of bias (score of 1 on the risk of bias assessment scale) representing a weak study design (Buchanan & Webster, 1982; Burke et al., 2004; Freeman, 2006).

Inter-examiner agreement was calculated using Cohen's kappa (κ). The overall percentage of agreement was 94.7% with a $\kappa = 0.77$ representing substantial agreement between the two examiners.

Table 7.3. Assessment of risk of bias using the Quality Assessment Tool for Quantitative Studies by the Effective Public Health Practice (National Collaborating Centre for Methods and Tools, 2008) Higher scores equal less likelihood of bias. 3 = weak likelihood, 2 = moderate likelihood, 1 = strong likelihood

Study	Study components								Global Rating
	Selection Bias	Study Design	Confounders	Blinding	Data Collection	Withdrawals	Intervention Integrity	Analyses	
Adams & Rickert, 1989	2	2	3	2	2	3	2	2	2
Buchanan & Webster, 1982	1	1	1	1	1	2	1	1	1
High et al., 1998	3	2	2	3	1	1	2	2	2
Mindell et al., 2017	2	2	3	3	3	2	2	2	2
Reid et al., 1999	2	3	1	2	3	3	2	2	2
Kerr et al., 1996	2	3	2	1	3	2	2	2	2
Mindell et al., 2011	2	3	3	2	3	2	3	3	3
Mindell et al., 2016	2	2	2	1	2	2	2	2	2
Burke et al., 2004	1	1	1	1	2	2	1	1	1
Mindell et al., 2009	3	2	3	2	3	3	2	3	3
Hiscock & Wake, 2002	3	3	3	2	3	3	2	3	3

Wolfson et al., 1992	3	3	3	3	3	3	2	3	3
Freeman, 2006	1	1	2	1	1	3	2	1	1
Mindell et al., 2018	3	3	3	2	3	3	3	3	3

Discussion

This review aimed at summarising and critically appraising intervention studies around bedtime routines focusing on children's wellbeing and development outcomes (excluding quality of sleep) as well as family functioning and parental wellbeing. Generally, all included studies (n=14) showed improvements across their targeted outcomes including children's behaviour, uptake of beneficial activities such as book reading, parents' socio-emotional wellbeing and parent-child relationships.

Bedtime routine interventions & child wellbeing

Regarding the primary objective of the review, all studies focusing on child wellbeing outcomes reported significant improvements across their targeted outcome with both behavioural and educational interventions successfully improving targeted areas between intervention and control groups. More specifically, children across all intervention groups manifested fewer tantrums, lower episodes of bedtime resistance and refusal, higher uptake of book reading/sharing, lower use of electronic devices before bed as well as improved mood (Buchanan & Webster, 1989; Burke et al., 2004; Freeman, 2006; Kerr et al., 1996; High et al., 1998; Mindell et al., 2016).

Reported improvements on child-related outcomes can have an important short and long-term effect on their overall wellbeing and development. Improvements in literacy and reading (High et al., 1998) are important given their association with school readiness and a healthy attitude towards school (Duncan et al., 2007). Children who have higher levels of school readiness and a healthy attitude towards school present generally with more successful grades, are less likely to drop out of high/secondary school and will earn more as adults (Duncan et al., 2007). Avoiding the use of electronic devices the hour before bed and from an early age can also result in improved sleep, better patterns of cognitive development and when electronics are replaced with book reading, promote literacy and a healthy attitude towards learning even further (Hale et al., 2011). Finally, improvements in child-

related behaviours with lower incidents of tantrums, bedtime resistance and refusal have shown to result in better overall socio-emotional development and wellbeing for children and parents alike (Cespedes et al., 2014).

Bedtime routine interventions, parents' wellbeing & family functioning

As for the secondary objective, studies showed improvements between intervention and control groups across parent wellbeing and family functioning outcomes. Significant changes were reported for improved parental (mainly maternal) mood with lower levels of stress, higher marital satisfaction, increased parental competence and confidence as well as better parent-child relationships (1 Adams & Rickert, 1989; Hiscock & Wake, 2002; Mindell et al., 2009, 2011, 2017, 2018; Wolfson et al., 1992). Both behavioural and educational interventions targeted parents' wellbeing and family functioning outcomes with significant differences between intervention and control groups across both types of interventions. In addition to promoting a better quality of life with less stress, improved mood and higher confidence, improvements on parent-related outcomes also strengthen family functioning and support quality child-parent relationships in a constant cycle of reinforcement (Belsky, 1984).

Implications

Building on existing evidence this review has important implications for future work as well as for parents, and both educational and healthcare providers alike. In terms of future work, given the limited amount of high-quality evidence it is essential that further interventional studies are conducted in order to: (a) uncover causal mechanisms involved in the formation, implementation and maintenance of bedtime routines and (b) examine more areas associated with child wellbeing and family functioning in order to gain an even clearer understanding on the short and long-term effect of optimal bedtime routines. In addition, when more interventional studies have been completed, an inclusive review of bedtime routines and all key elements contributing to child wellbeing and development including quality of sleep

will be necessary. Such a review will allow for a comprehensive and inclusive examination of the true impact of bedtime routines on overall child wellbeing and development. With regards to parents as well as educational and healthcare providers, this review allows for a better understanding on the diverse and dynamic manners in which bedtime routines, as a recurrent family behaviour, can influence child wellbeing and development with all their possible short and long-term consequences.

Strengths & Limitations

The strengths of this review include the use of a comprehensive and transparent search strategy, independent eligibility assessment and data extraction. Another strength is the implementation of a standardised risk of bias assessment as recommended by NICE that allowed for a systematic critical appraisal of individual study components.

Regarding limitations, these include the focus on populations with no pre-existing health conditions, mental health problems or learning disabilities when selecting studies to be included in the review. Exclusion of specific population groups can potentially limit our overall understanding regarding the effects of bedtime routines interventions on a wider and diverse spectrum of young children. Finally, an important issue, and possible limitation, arising from this review is the lack of clarity on socio-demographic characteristics and the focus on predominately white samples. The majority of included studies failed to specify the socio-demographic characteristics of their sample leaving unanswered questions regarding its composition. That omission limits overall understanding of how the intervention can impact upon different socio-economic and ethnic groups. With a long-established misrepresentation of minority ethnic groups in health research (Redwood & Gill, 2013) it is crucial for studies to be able to reflect the composition of their communities whether they are diverse or homogenous (Allmark, 2004). Finally, another limitation of this review is the lack of duplicate data extraction which could have resulted in unintentional errors in the process.

Conclusion

For every young child, their family represents the most important factor with direct and indirect associations on their development and wellbeing. Bedtime routines represent the most common and frequent family activity with most families implementing some form of bedtime routine starting roughly the hour before bed. Bedtime routines are a time when most families come closer together, parents interact with children and different activities are undertaken. That time period might represent a crucial moment during which parents can implement strategies and undertake activities that will eventually promote their children's wellbeing and overall family functioning. This review found only a limited amount of high-quality evidence from interventional studies however, all included studies resulted in significantly important improvements across wellbeing and development outcomes. Additional work is vital but with this review another small yet important step in expanding overall understanding of bedtime routines and their implications for child wellbeing and development has been achieved.

Summary

What do I know now?

- Apart from quality of sleep, bedtime routines can affect other areas associated with child wellbeing and development including behavioural development
- Bedtime routines are amendable through interventions around and during bedtime
- There is an overall lack of evidence regarding bedtime routine interventions with only a small amount of high-quality studies currently available

Next chapter

- Next chapter will outline how a bedtime routine intervention could look like by incorporating all of the relevant information and knowledge gathered so far with elements of Public Patient Involvement (PPI)

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Appendices

Appendix 7.A. PRISMA checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	5
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	5
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	5
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6

Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	5
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	6
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	NA
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	NA
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	NA
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	NA
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	8, figure 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	9-10, table 1
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	13-14, table 3
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	10-13, table 2
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	NA
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	NA
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	8
DISCUSSION			

Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	14
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	17
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	18
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	NA

This proposal has been successfully funded by MRC (MR/T002980/1) with a due start date of September 2019

CHAPTER 8

Bedtime Routines Intervention for Children (BRIC) using an automated text messaging system for behaviour change

An edited and revised version of a submitted application to the MRC Public Health Intervention Development Scheme

Preface

Prior to the commencement of the Medical Research Council (MRC) funding application, a brief Public and Patient Involvement (PPI) work was conducted to examine parental views on the proposed bedtime routine intervention. This PPI work aimed at gaining a better understanding around a proposed bedtime routines intervention using text messages. An intervention using text messages for bedtime routines was selected through a lengthy process and previous studies using text messages and text surveys for assessing bedtime routines. Parents with young children are a key dynamic audience for the future intervention. Their insight is valuable in order to create an open and productive dialogue between eventual users of the intervention and the research community. Apart from getting a better perspective on the proposed bedtime routine intervention this PPI work aimed at establishing a baseline regarding current bedtime routine characteristics and also examining issues regarding access and use of mobile phone in this specific demographic.

In total 2 focus groups were conducted in early 2019. Both groups included parents with young children up to the age of 7. There were two exclusion criteria: (a) not having children within the preferred age range and (b) not having access to a working mobile phone, not necessarily a smartphone. Parents were approached in two different settings: (a) a general dental practice that has been used in previous studies and (b) a Sure Start centre in Manchester. Due to the nature of this work as a PPI piece there was no requirement for either ethical approval or consent forms. However, participants were informed about their right to withdraw from the group at any point. Finally, participants were reimbursed in the form of a £10 shopping voucher for their time and feedback.

A focus group rather than individual interviews or paper-based feedback forms was preferred for this PPI piece. Focus groups can have limitations especially in the case where one dominant participant overshadows the rest of the group or in the case where the group does not feel comfortable in sharing their views openly.

Therefore, in order to overcome these possible limitations an interactive audience response system from Turning Point Technologies was deployed. This system allowed participants to provide real-time feedback on the questions asked during the focus group with no need to speak out in front of others. Participants needed to only use a clicker that was provided to them by the researcher and follow the clear and simply instructions on how to reply when prompted. Also, the interactive audience response system allowed for easier data collection and data analysis at the end of each group.

Each focus group included a short presentation on the rationale and need for this PPI focus group followed by a series of questions across 3 areas: (a) bedtime routines of the group, (b) access/use of mobile phones and (c) feedback on a proposed bedtime routines intervention. The last area, included questions on a hypothesised bedtime routines intervention using text messages. Participants were asked about their opinions across different aspects and the overall formulation and presentation of that intervention. A summary of the questions that participants had to answer during the focus groups is presented in Appendix A. Also, participants were asked to complete a brief socioeconomic and demographics form at the start of the group.

In total, 13 participants completed the 2 focus groups (10 in the dental practice focus group and 3 in the Sure Start centre focus group). From those 13 participants, 11 were females and only 2 were males. The mean age of the participants was 35 (SD=4.5) with a mean age of children at 4 (SD=2) and mean number of 2 children (SD=1) per participant. The majority of participants were stay at home parents (N=7) with 2 in full-time employment, 3 in part-time employment and 1 at University. The Index of Multiple Deprivation (IMD) was used to calculate level of deprivation across the sample. As expected and due to the location of both the dental practice and the Sure Start centre, there was high level of deprivation with a mean of 41.5 (SD=9.5).

Some interesting findings came to light when participants were asked about their access and use of mobile phones. All participants had access and they were

using a mobile phone however, not everyone had access/use of a smartphone (N=3). Moreover, all participants mentioned using text messages either Short Message System (SMS) text messages or text messages through Instant Messaging (IM) platforms. A lot of participants (8 out of 10 who had smartphones) stated that they ran out of data in the past with 7 out of 10 also stating that they ran out of storage space in their phones in the past. Finally, most participants were unaware of the cost of sending/receiving text messages to their phones. Regarding participants' feedback on the proposed bedtime routines intervention there was an overarching positive reception with 12 out of 13 participants mentioning their willingness to receive and use such an intervention in the future. Table 8.1. summarises key findings of this PPI work.

Table 8.1. Summary of PPI findings

Question	Replies (N)
If you were to receive the intervention, would you like it to be personalised? - Yes - No	11 2
If you were to receive the intervention, would you like links to additional reading material online or links to interesting forums etc.? - Yes - No	11 2
If you were to receive the intervention, would you like it include games-quizzes and "fun" elements? - Yes - No	3 10
If you were to receive the intervention, would you like to be sent to both parents or just yourself? Or would you like the option to choose who receives it? - One parent - Option to choose who receives it - Both	1 7 5
If you were to receive the intervention, how frequently would you like to receive the messages? - Every night - Every night at first, then less frequently - On-demand	2 5 6
If you were to receive the intervention, would you like for it to be free of charge regardless of your mobile phone provider? - Free of charge - Don't mind paying for it	10 3

Foreword

With the PPI work completed it became clear that an intervention on bedtime routines using text messages might represent an untapped opportunity for parents. Chapter 8, the penultimate chapter of the thesis, represents a bridge between the previous 8 chapters, the PhD, and future plans for research. The end of a PhD can be a daunting task for two reasons. On one hand, there is the need to bring together everything that emerged in the course of the research in the previous 3 years in a coherent thesis. On the other hand, there is the need to pursue funding and work opportunities - the crude realities of the academic and research world - after a relatively stable period. Approaching and addressing both issues simultaneously might induce stress, but it can also be an inspiring moment. Under these circumstances a wide search began at the end of the 2nd year of my PhD. That search had a sole focus: to find possible funding opportunities that build and showcase my existing and on-going work while also securing that all necessary reassurances following the end of my PhD. During that search, one particular funding scheme seemed to fit my current work very well. This was the Medical Research Council's (MRC) Public Health Intervention Development (PHIND) Scheme.

The PHIND scheme supports the early stages of developing interventions that address important UK or global public health issues. Studies funded by the scheme will develop the necessary evidence to underpin the later development and evaluation. The idea is to support projects that will develop innovative new interventions. It seeks to encourage **novel, high risk** approaches to intervention development. Complex, population level interventions, with a focus on non-health care settings and general, high risk or vulnerable populations are considered particularly suitable for this scheme. The PHIND scheme can cover up to £150,000 in funding costs for projects up to 18 months in duration.

In the pages that follow an adapted version of the full PHIND MRC application is presented. Special emphasis is given to the rationale behind the proposal, the methodology and technical details as well as the expected outcomes and steps for

progression. The full application was submitted to the MRC on 23rd of January 2019. In April 2019, this proposal was successfully approved for funding from the MRC (MR/T002980/1) with a due start date of September 2019.

Rationale

Making sure that every child is given an equal chance in life is a key priority for governments and policy makers around the globe (i.e. Head Start in the US, baby boxes in Nordic Countries and Scotland etc.) (Anderson et al., 2003; Fiese & Spagnola, 2002). Moreover, prominent expert groups, including the Lancet Early Childhood Steering Committee have emphasised the importance of investing in the health and wellbeing of young children and first-time parents with special emphasis on recurrent, nurturing behaviours (Levine, 2011). Bedtime routines are one of the most frequent and recurrent activities for families with young children (Anderson et al., 2003; Fiese & Spagnola, 2002). Bedtime routines are established gradually around the first year of a new-born's life and by the end of infancy (year 2) most families have well-established routines (Anderson et al., 2003). During bedtime routines, a series of repeated behaviours (i.e. tooth brushing, book reading, going to bed at a consistent time, dietary habits/avoiding sugary snacks etc.) take place with implications for: oral hygiene and dental health (Levine, 2011), quality of sleep (Sadeh, Tikotzky & Scher, 2010), school performance and school readiness (Hale et al., 2011), psychosocial development (Mindell & Williamson, 2018), behavioural and cognitive development (Mindell & Williamson, 2018) as well as parental socioemotional wellbeing (Mindell & Williamson, 2018) and overall family functioning (Fiese & Spagnola, 2002; Mindell & Williamson, 2018). Bedtime routines therefore are not just relevant to a single public health issue. They cover a combination of health, developmental, social and behavioural phenomena with short and long-term implications for young children, their parents, public finances and the health service. An intervention targeting first time parents of young children (ages 1-3) is especially important given the crucial link between early life experiences, later achievement and wellbeing for children as well as the importance of assisting and

supporting young parents highlighted by other publicly funded projects like Baby Boxes, Dental Checks by 1, Head Start in the USA etc. (Anderson et al., 2003; Hale et al., 2011; Mindell & Williamson, 2018).

Lack of good oral hygiene behaviours at bedtime and consumption of snacks/drinks in the hour before bed increases the likelihood of dental caries (Abanto et al., 2011). The negative impact of dental caries in young children includes chewing difficulties, sleeping difficulties, changes in behaviour (e.g. irritability), adverse psychological development (such as low self-esteem), and loss of school days with impact on school performance (Goodwin et al., 2015; PHE, 2018). Also, if left untreated, dental caries can lead to extractions under general anaesthetic with further implications for children's psychosocial wellbeing with increased pain, need for hospitalisation, increased anxiety for parents as well as public finances and public healthcare pressures (Goodwin et al., 2015). In just one financial year the NHS has spent almost £60m on preventable tooth extractions in young children (PHE, 2018) and it is the commonest reason for children to be admitted to hospital. In general, dietary habits at bedtime have shown important associations with obesity rates with snacking before bed linked to higher BMI, while those with significant dental decay are often undernourished (Anderson et al., 2016). Book reading with children as part of the bedtime routine can promote child literacy, improve school performance and enhance school readiness in young children with subsequent possible implications in later achievement and attainment (High et al., 1998). School readiness at age five is considered key for successful performance at school, reducing secondary school exclusion and higher earnings in adulthood (PHE, 2015). Finally, having a consistent, appropriate time children go to bed could aid in helping to achieve adequate numbers of hours of sleep with important consequences for psychological wellbeing, physical health, family functioning, school achievement and optimal brain development (Sadeh, Tikotzky & Scher, 2010). Therefore, an intervention focusing on bedtime routines for first time parents has the potential of having an impact all of these areas with short and long-term implications for children, parents and the society at large. Focusing on developing, establishing and maintaining optimal

bedtime routines is an important step in ensuring the best and equal chances in life for all children.

Despite growing evidence on their importance, bedtime routines remain under-researched (Hale et al., 2011). This research team [the candidate and the supervisors] completed one of the few bedtime routine-related studies in the UK with families with young children with promising results regarding the importance of bedtime routines and the incorporation of text message-based applications for families with young children (Kitsaras et al., 2018). Despite the preliminary work from this research team, a larger early phase study is now important for gaining a better and more generalizable understanding of bedtime routines in first-time parents. That better understanding will in return allow for the development of a evidence-based intervention. Existing attempts in changing bedtime routines in families with young children have either used non-automated, resource intensive approaches (High et al., 1998) or focused on selective bedtime routine behaviours rather than the entirety of the routine and its different components (Mindell & Williamson, 2018). Issues with past studies create a unique opportunity for developing a novel, automated, text message-based intervention that addresses all aspects of bedtime routines for first-time parents. However, the creation of such a novel intervention requires preliminary technical development and testing achieved through an early stage study. In effect, the proposed early phase study will act as a bridge between existing work and know-how from the research team from observational/cross-sectional studies on bedtime routines and the transformation of that knowledge and experience into a practical, evidence-based intervention that can help first-time parents.

Objectives

The objective of this public health early phase study is to develop, and pilot test an intervention to support the adoption, and maintenance of, optimal bed time routines for first time parents that will lead to measurable improvements in health, development and well-being for young children (under 5). The intervention will use real time, responsive SMS text messages that are co-designed and developed with

parents and experts. Text messages are going to be used because of the high percentage of people who own a working mobile device (93% in the UK) (OFCOM, 2016), the successful use of text message interventions targeting other health-related behaviours (von Niederhausern et al., 2017), their popularity as a means of communication in general and amongst ethnic minorities and deprived communities (Fjedsoe et al., 2009) as well as their overall low cost per participant. Text messages as an observational-data collection tool were successfully utilised by this research team in a study of bedtime routines with families with young children with extremely positive feedback on the lack of intrusiveness, ease of use and interface (Kitsaras et al., 2018). Finally, avoidance of app-based or computer-based elements is considered beneficial in reducing harm through limited screen time exposure for parents. The project is based on our earlier work using text messages to capture the details of bedtime routines and parent feedback that indicated that the messages served as useful prompts and reminders of bedtime behaviours. The main objective is underpinned by further sub-objectives that are closely linked to the work packages described within the application.

1. Gain a better understanding of the characteristics of bedtime routines (BTR) in first time parents especially with regards to barriers to establishing and maintaining optimal behaviours associated with their bedtime routines. First time parents will be in the process of slowly establishing their bedtime routines with their first child and therefore, intervening in that particular time-period can help with the establishment of optimal bedtime routines for their first child and children to come. Also, first time parents may have little experience of bedtimes with young children and hence the approach must be tailored to both learning and implementing

2. Engage with key professional stakeholders in order to gather their expert opinions on the necessity and characteristics of a BTR intervention for first time parents while also examining possible future directions especially with regards to funding and implementation of such an intervention within a population-based approach. Specifically, the engagement of local authority representatives and health and wellbeing boards tasked with prevention and who are aligned to the early

childhood years projects. Professional stakeholders will include all of those with an interest in the elements of the BTR – for example literacy and early years education, diet and obesity, oral health, social and emotional development and parenting experts.

3. Select appropriate and evidence-based techniques that can assist, promote and maintain behaviour change in the context of bedtime routines for first time parents using relevant theory and the materials and feedback sourced from both lay and professional interactions.

4. Develop an automated text messaging intervention for behaviour change ensuring that the technology leverages all of the information sourced from earlier objectives.

5. Conduct a feasibility study to examine in practice and with first time parents the intervention while also assessing its overall acceptability, practicability, effectiveness, affordability, safety & equity (APEASE).

Overall, this early phase study aims to develop a proof of concept bedtime routine intervention in families with young children. Once the concept has been tested within this particular demographic (first time parents) then, more complex, randomised and longitudinal designs could be developed and implemented.

2. Proposed methodology

The early phase study will include 2 work packages (WP) over an 18-month period. User and stakeholder engagement will be in the core of each WP. Proposed timeframes have been adjusted based on prior experience recruiting and collecting data with similar demographics (Fjeldsoe et al., 2009). Figure 8.1 provides a summary flowchart of all work packages. Table 8.2 provides an estimated timetable for this study.

2.a. Work packages

WP 1 (months 1-9) will focus on defining and developing the intervention. WP 1 will consist of 3 sub-packages: (WP1.1) will identify barriers and facilitators for establishing and maintaining good bedtime routines. Semi-structured interviews will be used, the interview schedule will be developed using the Theoretical Domains Framework (TDF, Cane et al., 2012), a framework which summarises 84 possible determinants of behaviour into 14 overarching “theoretical domains”. Structuring the interviews around the TDF domains will ensure comprehensive exploration of all possible determinants of suboptimal bedtime routines, therefore helping to identify the best targets for change in our subsequent intervention. WP1.1 will aim for 20 interviews with first-time parents with young children (under 5) from diverse sociodemographic background. Participants will be recruited from non-healthcare settings aiming at educational and workplace settings (e.g. Sure Start Centres, pre-schools, University staff) as well as through relevant parents’ groups and forums. Exclusion criteria will include: inability to comprehend English, not having a working mobile phone and not being first-time parents. Interviews will be conducted either in person or by telephone to minimise disruption and allow for a better participant experience. Interviews are expected, based on previous experience, to last about 30-45 minutes. Data analysis will follow a deductive approach where each response will be mapped into TDF domains in order to inform the selection of appropriate Behaviour Change Techniques (BCTs). BCTs are the ‘active ingredients’ within an intervention designed to produce a change in behaviour. Appropriate BCTs will be selected using the Behavioural Change Wheel (BCW; Michie et al., 2011), a theory-based framework designed to guide intervention development in a structured, systematic and evidence-based way. Use of the TDF in the interviews will lead to a holistic understanding of the targeted behaviour in terms of the BCW/COM-B models.

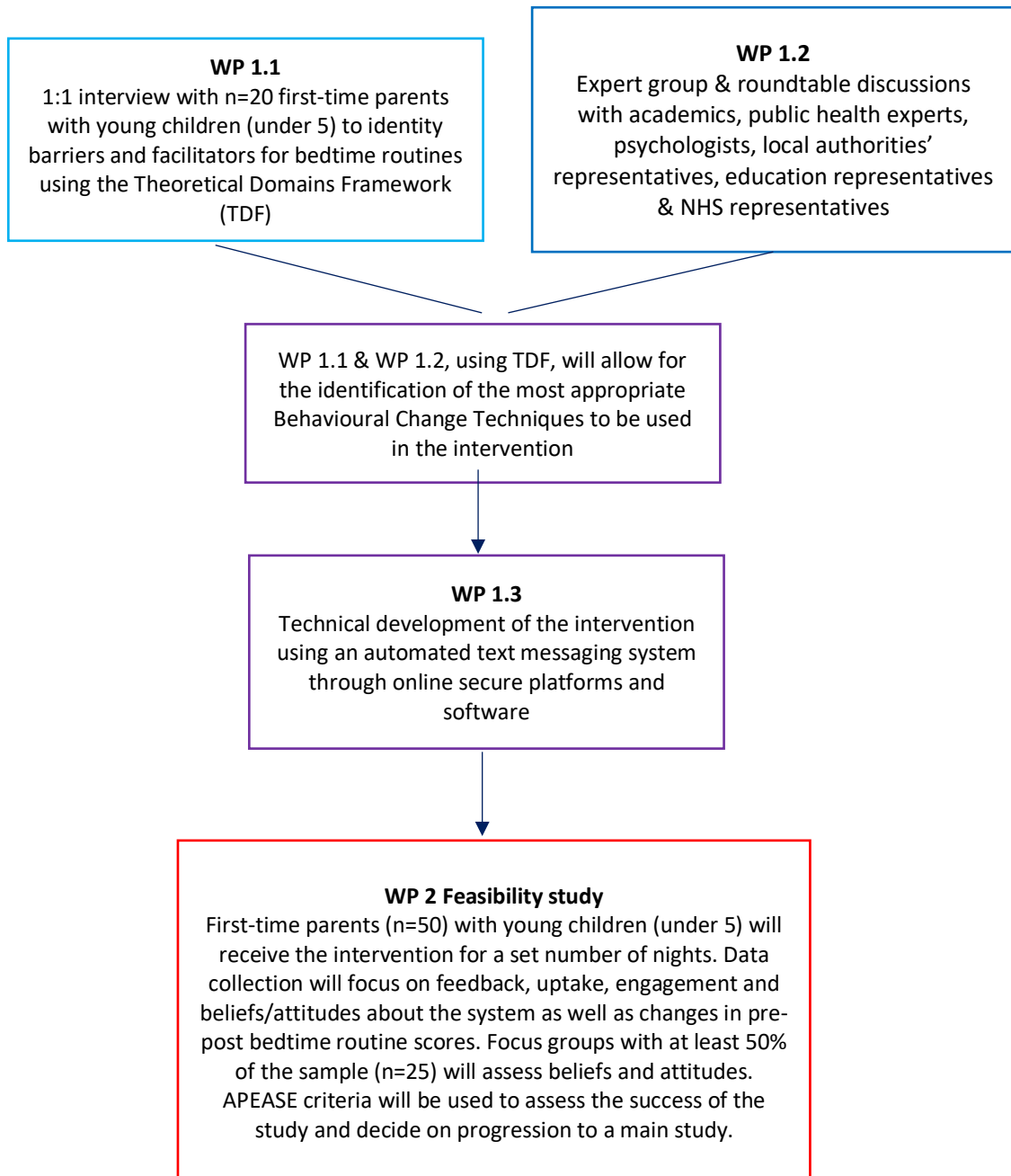
(WP1.2) will include an expert group of key stakeholders, academics and researchers. Prof Michael P. Kelly (University of Cambridge) former director of Public Health for NICE has agreed to chair the expert workshop. The expert group will be

hosted in Manchester over a full-day which will include presentations on the proposed intervention and roundtable discussions about what the intervention will look like, and who it will be delivered to and funded by in practice. WP1.3 will involve the technical development of the system used to deliver the intervention. All technical aspects of intervention delivery will be conducted via secure software and platforms. Through those platforms the content of the text messages, based on the work in WP1.1 & WP1.2 will be created. Use of online secure platforms guarantees flexibility in terms of re-adjusting and altering the intervention based on feedback at a later stage. Text messages will be kept free of charge for all participants through the activation of a “short-code” to limit barriers to participation.

WP 2 (months 10-18) will include an uncontrolled quantitative and qualitative feasibility study using the text message-based bedtime routines intervention. The sample in WP 2 will consist of 50 first-time parents with young children (under 5). Exclusion criteria will include inability to comprehend English, no access to working mobile phone and not being a first-time parent. Parents will receive the intervention for a set amount of time (the amount of time in days/weeks will be determined by the work in WP1.1). Text messages will be personalised to individual participants (i.e. first names). As with WP1.1, recruitment will focus on non-healthcare settings. WP 2 will evaluate the intervention using the APEASE criteria ((a) Acceptability, (b) Practicability, (c) Effectiveness, (d) Affordability, (e) Safety and (f) Equity). APEASE criteria will be assessed through insight data regarding retention rates, response rates, user engagement, number/type of problems encountered, cost per participant, user feedback, preliminary changes in bedtime routine score pre and post intervention, user beliefs and attitudes towards the system. Feedback will be collected anonymously at the end of the study. Pre-post intervention bedtime routines scores will be assessed using a bedtime routine score per participant as in (Kitsaras et al., 2018). Beliefs and attitudes towards the system will be examined through focus groups. Based on previous work conducted by the same research team with similar families with young children, it is expected that at least 50% of parents (n=25) invited will participate in those focus groups. Focus groups will include semi-structured questions on their experience of the intervention, their beliefs and

attitudes as well as their recommendations for future changes in the system. Focus groups will be held at locations convenient to the sample. Focus groups are expected to last 1 hour. Data analysis will follow a thematic approach where key and overarching themes alongside frequency counts of responses will be collected.

Figure 8.1. Flowchart of proposed early phase study



2.b. Resources required

The total budget for the early phase study stands at £183,075.58 with MRC's 80% contribution at £146,462.06. The majority of the proposed budget (FCE £63,530.00) covers a necessary full-time researcher (GK) who will manage all day-to-day aspects of the study including data collection and analysis. Both IAP and JA account for a significant amount of the budget (10% FTE) allowing for their expertise in their respected fields to be utilised in this project. Moreover, £3,223.00 FCE is dedicated for the qualitative pieces (1:1 interviews & focus groups) that hold a key role in the development of the intervention as well as in assessing its success. The technical development of the intervention will require approximately £1,500.00 (FCE), an amount that will allow for the creation and implementation of a novel, complex yet automated and user-friendly text message-based intervention. The expert group, will only require £827.00 FCE presenting a good value for money. Finally, compensation for participants' time (£1,200.00 FCE) is deemed important in ensuring good recruitment and retention rates.

2.c. Ethical considerations

Ethical considerations include working with first-time parents and their children as part of this project while technical considerations include data and information management through the use of the software and the automated text-messaging system. Regarding the former, proposed activities have limited risk of causing harm to participants or their children. There will be no invasive processes associated with the early phase study. Children will not be actively involved in the early phase study since their parents will be the ones receiving the text message behaviour change intervention. All aspects of the study will be designed in a way that minimises intrusiveness and keeps overall time requirements and commitment to a minimum. Also, the use of text messages instead of app-based or online approaches minimises risk of extensive screen time exposure. Participants will be made aware of study requirements and time commitment during recruitment and informed consent

will be sought from all participants at the time of recruitment. There will be an easy and automated process of opting out of the study at any time should they require to do so. All information relating to the study will be managed through the use of unique participants IDs. IDs will be issued during recruitment and used throughout the rest of the study. Hard copies of documents relating to the study (i.e. consent forms) will be electronically coded in password-protected, secure files and original hard copies will be stored separately, securely stored in locked cabinets at the University.

Technical considerations relating to data and information management will be dealt with through the use of secure platforms and secure UK-based servers. Through the use of secure systems throughout the study there will be minimum risk of data breach that could lead to identifiable information becoming available. The system used to develop and deliver the text messages will only maintain first names and mobile numbers (both necessary for successful delivery and personalisation of the intervention) but that information will be held securely for the duration of the study and subsequently be removed from the software. All elements of the study will be fully approved by the University ethics committee with a detailed Research Data Management Plan (that is already in place at DMP Online, reference number 34665) prior to commencement.

3.a. Expected outcomes

The expected outcomes for the intervention include both short-term/process outcomes as well as core/long-term health, behavioural and cost-saving outcomes. Short-term and process outcomes include: (a) improvement in bedtime routines for first time parents including achieving and maintain all important elements of an optimal routine (tooth brushing, book reading, avoidance of sugary snacks etc.), (b) improvement on quality of sleep for young children through a better routine, (c) less behavioural difficulties around bedtime (e.g. tantrums, resistance), (d) better parent-child interactions and (e) improved parent and children's socioemotional state. Core/long-term outcomes include: (a) lower incidence of early childhood dental caries, (b) stability of caries lesions with lower risk of severe caries, (c) appropriate

readiness for school (school readiness), (d) better long-term school attainment, (e) stable BMI scores, (f) establishment of good sleep hygiene that achieves recommended hours of sleep every night and (g) cost-saving on public finances and the health service through reduced hospitalisations, dental extractions, lower school dropouts, better school attainment, less behavioural and socioemotional difficulties.

Table 8.2. GANTT chart for Work Packages (WP) 1&2, including WP1.1, WP1.2 & WP1.3

**Time estimates are based on previous quantitative and qualitative work by the same research team on observation studies with the same demographic (parents with young children)*

Item	Months																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Preparatory work	█																	
WP 1.1 recruitment		█	█	█														
WP 1.1 interviews			█	█	█													
WP 1.1 data analysis					█	█												
WP 1.2 expert group		█	█															
WP 1.3 development						█	█	█										
WP 1.4 incorporation of BCTs								█										
WP 2 Recruitment									█	█	█	█						
WP 2 Data collection-Intervention									█	█	█	█						
WP 2 Focus groups												█	█	█	█			
WP 2 Data analysis																█	█	█
WP 2 Write up																		█

3.b. Beneficiaries

In general, bedtime routines remain a niche area of research with relatively few studies conducted about them. Research on bedtime routines has focused primarily on their link to quality of sleep with recent studies expanding on their implications for other areas of wellbeing and development. Bedtime routines encompass a wealth of different activities ranging from oral health hygiene practices (tooth brushing) to diet and social behaviours. Due to their multi-faceted nature, bedtime routines are an area of interest that spans numerous scientific and disciplinary boundaries. Bedtime routines include elements which are relevant to psychology, education, public health, dentistry, developmental studies and behavioural science. Due to links between activities undertaken as part of bedtime routines (i.e. tooth brushing, dietary habits, book reading etc.) and beneficial development and wellbeing outcomes; bedtime routines can be an area of interest for policy makers and health economists. In this early phase study, the inter-disciplinary nature of bedtime routines is reflected in the team's expertise ranging from psychology to public health and dentistry. New insights into bedtime routines can promote inter-disciplinary work through increased awareness of this recurrent, dynamic behaviour and its health, wellbeing and developmental consequences. Also, as this early phase study aims to develop a behaviour change intervention for bedtime routines in first time parents, valuable lessons can be learnt and communicated with regards to the examination, understanding and changing of human behaviour, especially one of a recurrent and dynamic nature and its relationship to health outcomes.

Due to the diverse range of outcomes associated with good bedtime routines, beneficiaries from this early phase study include: (a) first-time parents and parents with young children in general, (b) academics and researchers in public health, dental public health, psychology, behaviour change, digital health interventions, health policy, education and child wellbeing, (c) NHS and non-NHS practitioners especially GPs, dentists and the wider oral health team, nurses, health visitors, child health specialists, (d) charities, trusts, local-regional-national level organisations specialising

in child development-wellbeing (e.g. Children's society), specific bedtime routines activities (e.g. Book Trust for book reading before bed) or the health of public in general (e.g. Public Health England) and (e) education bodies, schools and practitioners (e.g. Education Endowment Foundation).

The majority of listed individuals, groups and organisations will benefit from general awareness of the outcomes and the innovative methodology of this early phase study. First-time parents and parents in general can benefit from increased awareness of the importance of bedtime routines, the constituent parts of a good bedtime routine and the importance of establishing a good bedtime routine from an early age. This benefit can be immediate for participating first-time parents. Non-participating parents can be reached and will benefit either directly (through the communication plan) or indirectly through the overall increased awareness and sharing of information between the research team and the wider public. Academics, researchers, policy makers and organisations can benefit from this early phase study especially its novel and innovative methodology when tackling their own research projects focusing on either human behaviour or similar populations. Also, researchers and academics working with deprived and ethnically diverse samples can gain valuable information due to the inclusion of such populations in this early phase study. Should this early phase study show promising results then a larger and more comprehensive study may produce positive differences in bedtime routines in first-time parents with short and long-term benefits for their children, parents themselves as well as public finances and the health service. These benefits can emerge from possible lower incidents of dental problems in children (i.e. fewer dental caries, less need for treatment, fewer hospitalisations, fewer dental extractions etc.), better quality of sleep, higher school readiness and school attainment with fewer school drop-outs later in life etc. Finally, with regards to the research team, it is expected that the Co-I and RCo-I will gain invaluable experience in organising, managing and executing an innovative study with benefits translating to future opportunities and career development.

4. Moving forward

4.a. Communication plan

The proposed communication plan for this early phase study attempts to capture the dynamic and multi-faceted nature of bedtime routines and the diverse audiences who will be interested in the study results. The communication plan aims to: (a) raise awareness around bedtime routines and their importance for child development-wellbeing, (b) improve understanding of the development, maintenance and change of bedtime routines, (c) create a connection between research outputs, the research community and the wider public and (d) win trust and secure advocacy regarding future research, development and funding of interventions around bedtime routines as well as utilisation of such interventions from users (i.e. parents).

To achieve these goals, at the end of the early phase study, it is proposed that a peer-reviewed article will be published that will summarise key findings of the feasibility study and also present the technical details relating to the development of the text messaging system. That publication will be in an open access journal allowing easy access for researchers, academics and the wider public. Moreover, all participants in both work packages and experts involved in the early phase feasibility study will be offered updates on the progress of the study including a summary of key findings at the end of the study. Additionally, special interest groups and key stakeholders including charities (e.g. "Book Trust" and their campaign for bedtime reading), national organisations and bodies (e.g. Public Health England and their Baby Teeth Do Matter and Dental Checks by 1 campaigns) as well as other groups (e.g. Centre for Behaviour Change and the Digital Health Hub at UCL and their particular interest in behaviour change and digital behaviour change interventions) will be informed of the outcomes of this study through newsletters and direct communications. Also, an informative, short video presentation summarising the early phase feasibility study and its key findings will be created and shared on social media (especially Twitter and Facebook) and online platforms (such as YouTube etc.) to raise awareness and reach a different demographic (young adults and parents)

who might be more inclined to access, visit and view such social media platforms. Sharing and promotion of that video communication can be achieved through the official social media accounts of the University of Manchester and the University of Aberdeen. Finally, MRC itself will be a key partner in further communicating and disseminating the outcomes of this early phase study through articles sent to the MRC's blog and updates sent to the press office at MRC.

4.b. Final intervention

The final intervention will include text messages at bedtime for first-time parents with young children (under 5) designed to prompt, alter, reinforce and maintain optimal bedtime routines that achieve all necessary components (i.e. tooth brushing, reading a book etc.). Text messages will include evidence-based Behaviour Change Techniques identified from the early phase study. The intervention will be aimed at first-time parents with young children (under 5) from all sociodemographic/ethnic backgrounds. Text messages will be kept free for all participating families to ensure equal chances for participation. To achieve the expected outcomes the intervention will be delivered for a set period of time with the actual duration to be specified during the early phase study. Longer duration will allow for the necessary observations in terms of behaviour change, behaviour maintenance and impact on core outcomes. Ultimately, the intervention will be automated with only minimal human resources required apart from registering parents. Due to its limited human resources requirement, low cost per participant and automated nature, provision and funding of the intervention can potentially fall under local authorities' oral health promotion budget, local research networks (LRN) or as part of health visitor's baby health and development checks if rolled out in future.

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Chapter 9
Where next?
A space for discussion & reflection

Discussion

At the beginning of this thesis, a total of 6 questions were asked regarding bedtime routines. These questions included: (a) what constitutes an overly good or optimal bedtime routine, (b) what do parents currently do with regards to their bedtime routines, (c) how do bedtime routines affect child wellbeing and development, (d) ways of establishing such routines, (e) how to maintain a good routine or change a problematic one and finally, (e) how can we help parents with their bedtime routines. Through a 3-year period and following the completion of 2 quantitative research studies with 250 participants, 1 qualitative study with 12 participants, 2 Public and Patient Involvement pieces of work, a systematic review and an application for further funding to the Medical Research Council these questions finally have some answers.

What constitutes a good or optimal bedtime routine? This question has proven the most challenging to answer since available research and current guidelines and advice from respected bodies have failed to reach a universally accepted definition. Through an extensive literature review and the systematic review completed as part of this work an optimal bedtime routine: (a) remains, or should remain consistent during weekdays and the weekend, (b) incorporates a series of interactive, adaptive activities and parent-child interactions including hygiene behaviours such as tooth brushing, good dietary habits before bed, literacy-related activities such as book reading and avoidance of extensive use and exposure to electronic devices and (c) starts early in the infant's life.

What do parents currently do with regards to their bedtime routines? Available information on prevalence and characteristics of bedtime routines in families with young children remained skewed towards ethnic White, less deprived people living in the US. Little was known about the bedtime routines of deprived families and families of minority ethnic groups in the UK. Through the examination of bedtime routines across diverse and predominately deprived samples more information became available on what parents of young children do around their

bedtime routines. This information was captured through an innovative approach that tried to uncover nightly changes in bedtime routines. We know now that there are no differences in the prevalence and characteristics of bedtime routines across different ethnic groups and any differences in the quality of their routines can be attributed to other demographic or individual factors. Also, we now know, that despite best intentions, there are variations in the consistency of activities that each family undertakes. Finally, and for the first time, there was initial evidence to support the existence of a weekend effect where bedtime routines appear to degrade over the weekend before resuming their optimal statuses.

How do bedtime routines affect child wellbeing and development? Child wellbeing and development is an area that incorporates a range of outcomes stretching from health, psychological, behavioural, social and cognitive development. Within these outcomes, past research on bedtime routines has heavily focused on child quality of sleep with a clear relationship between suboptimal bedtime routines and poorer sleep outcomes. Results from the two research studies that were completed over the 3-year period progressed our understanding of other key child wellbeing and development areas. Suboptimal bedtime routines showed associations with poorer school readiness and lower levels of executive functioning. Moreover, suboptimal bedtime routines that failed to include consistent oral hygiene behaviours and followed a poor bedtime diet also showed associations with higher incidence of dental caries. These findings are only preliminary and require further exploration with more robust methodological designs however, they provide some important evidence regarding the likely importance of bedtime routines for overall child development and wellbeing.

How do parents establish their bedtime routines and how do they maintain or change their routines? Little is known regarding the exact factors associated with the initial formation and further development and establishment of bedtime routines. Through an extensive, evidence-based qualitative approach and with results from one of the research studies, we examined both barriers and facilitators that lead to the establishment of bedtime routines. What became clear from this

piece of work is that parents know that bedtime routines are an important part of their child's development and wellbeing and they try their best to achieve optimal bedtime routines. However, factors such as cognitive tiredness at the end of the day, lack of support mechanisms and lack of motivation to change their routines when those are suboptimal contribute to both the creation and the maintenance of problematic bedtime routines. Moreover, there was some initial evidence that showed the important role of executive functioning especially inhibition/attention, working memory and cognitive flexibility.

How can we help parents with their bedtime routines? This was the final question of the foreword and the natural end of the thesis. Through each chapter of the thesis another piece of information was added to the greater picture of understanding bedtime routines in families with young children. All these pieces together aimed at enhancing our current, limited understanding on this dynamic and highly recurrent activity. Developing an intervention focusing on any behaviour that can have health and development implications requires careful consideration of all possible factors that surround that behaviour. Through a systematic approach, bedtime routines were carefully examined before arriving at the proposed intervention. This intervention, as presented on Chapter 8, represents an accumulation of the knowledge and wealth of information and evidence generated through the completion of the past 3 years of work. The intervention is aimed at first-time parents to allow for initial proof-of-concept before progressing to more advanced and complicated study designs that focus on more complicated family schemes. In keeping with the systematic and stepped approach, the intervention itself maintains an evidence-based approach where information from one stage will inform and influence the next.

At the start of this thesis, 6 key questions were asked. All of them aimed at a different aspect of bedtime routines in families with young children. Following the completion of a series of studies there are now initial, yet important findings surrounding bedtime routines. Bedtimes routines are essentially a set of behaviours, and behaviours are as complex and diverse as the person behind them. Human

behaviour has been extensively studied and multiple attempts have been made in an endless chase to provide answers for specific behaviours as well as frameworks by which behaviours could be better studied and understood. We are now at the start of the process to better understand bedtime routines. This PhD through a progressed understanding of this complex, dynamic and recurrent family activity has, hopefully, provided us with a head start in this undertaking!

Implications

The past 3 years have produced a lot of findings and data relating to bedtime routine characteristics, methods of assessing bedtime routines and by extension dynamic behaviours and the impact of bedtime routines on child wellbeing and development. Due to the relative descriptive and exploratory nature of these findings implications for research, policy and clinical practice area somewhat limited. One important implication of this piece of work is with regards to the assessment and intervention properties of text messages and text surveys for dynamic behaviours. As extensively discussed before (chapter 2), text surveys and text messages can allow for low-cost and user-friendly approaches for the assessment of behaviours and for interventions around behaviour change to be developed and incorporated into routine research projects and clinical practice. Text messages and surveys were found to be non-intrusive and low-cost yet they produced a lot of quality data that led to an in-depth examination of bedtime routines. Lessons learnt from this piece of work and steps undertaken to solve the issue of assessing dynamic behaviours can provide a valuable insight for future projects not limited to bedtime routines but spanning different fields.

Another clear implication arising from these pieces of work relates back to the development of an intervention around bedtime routines that could potentially shed light on policy, clinical and real-life implications. The MRC-funded project, could provide proof-of-concept for the importance of a low-cost, user-friendly intervention around bedtime routines that can then lead to greater, more robust and longitudinal projects in this area. Also, the incorporation of a strong stakeholder piece as part of

the MRC-funded project can help uncover preliminary, yet important evidence on policy and long-term implications. Despite some limitations, the exploratory nature of this work allowed for the examination and the consideration of more general and fundamental questions relating back to bedtime routines as a whole. Some initial questions are summarised below, “big questions”.

Big questions

At the moment, the available literature around bedtime routines is both extensive and limited. Extensive when it comes to the exploration of the relationship between bedtime routines and quality of sleep for children, adolescents and adults yet limited outside sleep. As previously presented and discussed (chapter 7), there are robust systematic reviews on both exploratory and intervention studies on bedtime routines and sleep. Even though bedtime routines are vital for sleep and sleep by extension is a salient component of overall health and wellbeing bedtime routines have much far reaching implications for children and family functioning. Bedtime routines are the single point in time when parents and children will definitely interact with one another even if that interaction is limited to a few minutes. Bedtime routines are a well-defined period in time when different activities spanning health, development and wellbeing come into play. We know that bedtime routines are common, probably one of the most common family activities, but yet there is little understanding on the fine details. Having spent 3 years on this area of research and with recent evidence from prominent researchers in the area (see Jodi Mindell and systematic review Mindell & Williamson, 2018) we now know that there are some key, big questions that need answering when it comes to bedtime routines. Some of these questions include:

- What is the absolute minimum effort that a parent and family can do to achieve optimal bedtime routines even if that is not consistent every night? In other words, if a family has a routine in place for half of the days in a week is that enough? Where is the threshold that will tip a family into optimal routines and how easy or difficult is it to achieve that?

- When do bedtime routines start to formulate and what factors affect that early formulation and later establishment of routines? How long does it take for a routine to shift from optimal to problematic and vice-versa?
- What are the differences in bedtime routines across different socio-economic groups especially between rural and urban areas, different ethnic groups, different age of children and different countries?
- How do routines look in non-traditional, non-nuclear families and what is happening when a child spends time between different households and parents as in the case of divorce or separated parents?
- What are the long-term implications of bedtime routines and the different activities associated with bedtime routines for child wellbeing and development, family functioning, parental wellbeing and the wider society?
- Who, how and when should intervene in order to achieve optimal bedtime routines? Is it a one-off intervention and for how long does it need to be sustained before routines change to optimal?
- What is an optimal bedtime routine, why is there no current consensus and how can we arrive at a widely accepted and utilised definition of what is a good bedtime routine?

The list of questions can go on forever since bedtime routines is still a niche area of research in its infant years. This PhD has, hopefully, started the conversation and efforts to address some of these questions. The MRC-funded project might take this a step forward by systematically addressing and providing evidence for issues relating to the formation and change of behaviours around bedtime routines. Greater collaborative work across different fields and researchers is necessary to overcome

some of the research silos currently observed in this area with some researchers focusing solely on bedtime routines and sleep rather than expanding their foci on other areas of wellbeing and development as well as a better and more systematic examination of the formation and cross-cultural differences of bedtime routines.

Reflections

Three or so years ago, while working in a secure forensic psychology unit in the outskirts of Birmingham I was offered an interview for this PhD. I did my interview via Skype during my lunch break since phones and personal computers were not allowed in the facility. I was offered a place in this PhD within a few hours. In the months that followed, I rejected my place a total of 2 times before being offered it again and again. Rejecting my offer was not due to lack of interest in the topic or an anticipation of something better, it was merely due to the fact that I had just started that forensic position and I wanted to give it a good try before moving to the next thing. Nevertheless, the persistence of the team at Manchester on one hand and the harsh realities of forensic clinical psychology in a highly controlled, secure environment Monday to Friday led to one of the best decisions of my life so far; finally accepting the offer to start my PhD at the Dental Health Unit.

Coming from a purely psychology at first and later clinical psychology background, dental public health seemed like an odd career move. Especially undertaking a 3-year full-time PhD in this area. However odd at first, dental health and dentistry were a huge interest of mine ever since I was asked to step in as a dentist assistant in a solidarity clinic looking after refugees, migrants and unemployed people at the peak of the Greek debt crisis. In that facility I was volunteering as a psychologist, following my graduation, but I quickly found myself assisting the dentist volunteers due to the increasing number of patients and the lack of resources. In that context, my initial interest in dentistry and the link between dental conditions and manifestations of wider demographic, psychological and general health problems started to grow. I never wanted to become a dentist, despite my interest in dental conditions. From that point onwards, I wanted to find a way of

combining my psychology background with dental as well as physical health in both an individual and public basis.

Surprisingly at first, but exciting ever since, this PhD managed to successfully bundle my psychology background and dental health interest in an appealing manner that allowed me to enhance my current knowledge while developing new skills. Throughout the duration of my PhD, my research skills were exponentially enhanced including skills on protocol writing, ethics applications, study design, recruitment, data management and data analysis alongside presentations at academic conferences and writing of academic articles for publication. Also, existing qualitative skills were further developed through a series of qualitative pieces of work linked directly and indirectly to my PhD. Skills on the development and completion of systematic reviews were introduced for the first time and put into practice during my PhD. Finally, experience with funding applications was obtained through my participation in a total of 6 applications to NIHR, MRC, Global Challenges Research Fund UKRI and the Wellcome Trust.

Apart from research skills, I was able to capitalise on a wealth of opportunities including teaching as a teaching assistant in psychology with a special emphasis on behaviour change and health psychology modules, qualitative researcher at the LEGACY R2 project between the University of Manchester and 5 other academic institutions in the UK, systematic review coder for a British Academy study on mathematic anxiety and honorary research assistant at the Support through Mobile Messaging and digital health Technology for Diabetes (SUMMIT-D) project. Moreover, over the last 3-years and through the active and on-going support from my supervisory team, I was able to develop and establish a dental volunteering project overseas in Uganda with a team of dental undergraduate students and myself having travelled there in 2017 and 2018 with the team now entering its third year. Alongside my PhD, and with the encouragement of my supervisors, I started and currently completing a Master's in Public Health (MPH) alongside my PhD to allow for the necessary theoretical knowledge and understanding around public health more

broadly. Finally, through my supervisory team I was able to explore and undertake work and networking with key industry contacts in oral health.

All these areas of involvement presented their own challenges. Different skills including time management, people's and communication skills, public speaking, receiving and reflecting on feedback had to be put to the test when dealing with different elements in each area of my involvement. Even though there was no major obstacle or major setback, each stage of the PhD and each area that I was involved with presented with unique learning opportunities. Dealing with young children presented its own challenges especially considering my limited prior engagement with that specific population. However, patience and good communication with the child's parent were key in order to overcome any issues that arose.

One of the biggest successes of my PhD was not just the introduction and enhancement of research skills but the introduction of a different approach and thinking process regarding the application of psychology into dental public health and dentistry. During my PhD it became increasingly clear that there is a growing need for psychology input into dentistry and dental public health especially in the form of behaviour change. This was an area largely unknown to me. This PhD, through my research work and series of meetings and discussions over the past 3-years, created an initial interest in this area and later on a passion to tap into the potential of behaviour change in dentistry.

The past 3 years have been an interesting, widely positive with some expected and unexpected difficulties journey. It is a journey that taught me a lot on a personal and professional level. Through this journey I met some amazing people, learnt a lot of life as well as academic and research skills and even got to travel to some incredible places. This journey would have never been possible and my experience could have been completely different if it wasn't for my supervisory team that allowed me to explore a lot of different things while learning something valuable from each experience. These past 3 years gave me a taste for what is to come and I am more than excited about the future!