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Abstract

Background: Little information is available on the movement behaviours of infants, despite evidence that these are important for development. The release of new Australian 24-hour Movement Guidelines provides an opportunity to document the current state of movement behaviours in infants relative to these guidelines. The aim of this study was to report the prevalence of 4 month old Australian infants meeting the 24-hour Movement Guidelines, individually, and in combination, and to describe associations with individual characteristics.

Methods: Maternal report baseline data from the Melbourne Infant Feeding, Activity and Nutrition Trial Program were used to determine prevalence of infants meeting physical activity (30 min of tummy time per day), sedentary behaviour (no more than 1 h at a time kept restrained; zero screen time), and sleep guidelines (14–17 h for 0–3 month olds or 12–

providing care to infants
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Background

In recent years, there has been increasing interest in the promotion of healthy behaviours from an early age, including physical activity, sedentary behaviour and sleep. This has largely come as a result of a growing body of evidence suggesting that these behaviours are important for children's health. Recent systematic reviews have shown that greater amounts of physical activity, limited time spent in sedentary behaviours, and optimal sleep duration are independently associated with positive physical, psychosocial and cognitive health outcomes in early childhood [1–3]. Further, the combined effect of sufficient engagement in each of these behaviours appears to provide optimal outcomes for both children and youth [4, 5]. For these reasons, 24-h movement guidelines for the early years have recently been developed within Canada and Australia, with a focus on these health behaviours in three age groups: infants (birth – <1 year), toddlers (1–2 years) and preschool children (3–5 years) [6, 7].

Despite the recognised importance of promoting healthy behaviours from birth, most research conducted to date in

aimed to prevent obesity and obesity-promoting behaviours (spanning diet, physical activity and sedentary behaviours) during early childhood. The trial has been described in detail elsewhere [19, 20]. For the purposes of this paper, only details relating to recruitment and baseline assessments (prior to the intervention) are presented.

The Melbourne InFANT Program recruited from 14 local government areas (LGAs) randomly selected from all those within a 60 km radius of Deakin University's Burwood campus, located in Melbourne, Victoria, Australia (population 4 million). Within participating LGAs, 50% of first-time parents' groups (rounded to the next even number to allow 1:1 randomisation for the trial) were randomly approached for participation in the study ($n = 62$ groups). First-time parents' groups are formed and facilitated by the universal Maternal and Child Health service within Victoria, Australia. They are predominantly attended by mothers and in this study all participants were mothers. Where a group declined or did not meet inclusion criteria (minimum of eight within a group consenting to participate, or six in low socioeconomic areas) the next group on the randomly generated list was approached.

Approval to conduct the Melbourne InFANT Program was granted by Deakin University's Human Research Ethics Committee (EC 175–2007).

Measures

For each of the infant behaviours assessed, corresponding to the 24-h Movement Guidelines, mothers reported the number of hours and minutes spent engaged in the behaviour on an average day via a written questionnaire, purposely developed for the study. Two-week test-retest reliability in a separate sample of 66 mothers with infants 1–5 months of age indicated variability in the reliability of reporting infant movement behaviours but that the majority of the items (6/10) demonstrated intra-class correlations (ICC) in the moderate to excellent range (i.e. $ICC > 0.40$) [21].

Infant physical activity

Physical activity was assessed as average daily tummy time ($ICC = 0.25$). Infants were classified as meeting the physical activity guideline if they were reported to have

months or older) were excluded to limit the developmental range of the sample. Frequencies were used to describe characteristics of the sample and to describe the proportion of infants (all and stratified by sex) meeting each of the separate and the combined guidelines, respectively. Differences between the proportion of boys and girls meeting each of the guidelines were assessed using chi-squared tests and given identified differences all further analyses were stratified by sex. Logistic regression models were used to assess the odds of meeting the separate guidelines by infant and maternal characteristics (i.e., infant temperamental ease, hours per week infant is cared for by someone other than his/her parents, and maternal education). Odds of meeting the combined guidelines were not examined by infant and maternal characteristics due to the low proportion meeting the combined guidelines. Regression analyses were stratified by infant sex and adjusted for infant age and clustering by unit of recruitment (first-time parents' group). All analyses were conducted in Stata Version 14.0 (Stata-Corp Texas, USA).

Results

A total of 542 participants (86% response) took part in the Melbourne InFANT Program. The analytic sample for this paper was 455 participants. Infant and family characteristics are presented in Table 1. Briefly, infants had a mean age of 3.6 months (SD = 1.0) and just over half were boys. Mothers had a mean age of 32.6 years (SD = 4.2).

Table 2 reports the proportion of boys and girls meeting each of the guidelines. Around 30% of infants overall met the physical activity (tummy time) guideline, and similarly the screen time guideline. Just under 60% of infants met the restraint and sleep guidelines. For the sleep guideline, which contains a range rather than a threshold, 21.5% of those infants who did not meet the guideline were reported to have too much sleep (above the upper limit of the range) and 78.5% were reported to have too little sleep. Few infants met none of the guidelines ($n = 42$; 9.3%). Similarly few met all of the combined guidelines ($n = 16$; 3.5%). The majority of infants met either one ($n = 150$; 33.1%) or two ($n = 164$; 36.2%) of the four guidelines.

A higher proportion of girls than boys met each of the guidelines; however, this difference was only significant for screen time. A higher proportion of girls than boys also met three (23.4% versus 13.1%, $p = 0.004$) and all four of the combined guidelines (5.7% versus 1.6%, $p = 0.02$), with a lower proportion of girls meeting 2 guidelines (30.1% versus 41.4%, $p = 0.01$) and no sex difference for the proportion meeting one or none of the guidelines. Infant age (range 0.4 to 6.6 months; continuous variable) was positively associated with meeting the

Table 1 Infant and maternal characteristics, $n = 455$

Characteristic	Mean (SD) or %
INFANTS	
Age (mo), mean (SD)	3.6 (1.0)
Male (%)	54.1

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physical activity guideline for both boys (OR 1.46, 95% CI 1.08, 1.96) and girls (OR 1.46, 95% CI 1.09, 1.96) and with meeting the sleep guidelines for boys only (OR 1.64, 95% CI 1.22, 2.22). Infant age was inversely associated with meeting the screen time guideline for girls only (OR 0.70, 95% CI 0.52, 0.98).

Few associations were seen between maternal and infant characteristics and meeting each of the guidelines. No associations were observed for infant temperamental

ease, or the amount of time the infant is typically cared for by someone else during the week. The only characteristic associated with odds of meeting any of the guidelines was maternal education and for girls only. Girls had significantly higher odds of meeting the screen time guideline if their mother had a high level of education compared to girls whose mother had a low level of education (OR 3.24, 95% CI 1.22, 8.59). Additionally, girls had significantly higher odds of meeting the sleep guideline if their mother had an intermediate (OR 2.44, 95% CI 1.01, 5.88) or high (OR 4.30, 95% CI 1.95, 9.46) level of education compared to girls whose mother had a low level of education.

Discussion

With the release of new Australian 24-hour Movement Guidelines for the Early Years it is timely to assess how many children meet the guidelines, and provide a baseline for public health monitoring. Little research exists that de-

Sufficient sleep is an integral requirement for growth and development [26, 27] and is a new component included in the movement guidelines. In this study, around 60% of infants met the guidelines appropriate for their age. Interestingly approximately one quarter of those who did not meet guidelines were reported to spend more time sleeping than recommended, with the re-

regard to these behaviours. The release of new guidelines will assist in efforts to optimise movement behaviours in infants by providing a platform for those working with families of young children from which unified advice and support can be provided.

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