

## Physical Activity, Sedentary Behavior, Sleep and Screen Time of Healthy Under-Fives Attending Selected Immunization Clinics and Anganwadis of South Kerala, India

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### ABSTRACT

**Objective:** To estimate the proportion of healthy under-fives whose physical activity, sedentary behavior, sleep and screen time adhered to WHO 2019 recommendations and to identify risk factors for non-adherence.

**Methods:** A cross-sectional study was conducted among 480 healthy children (6 mo - 4 years) who attended 20 selected urban anganwadis or immunization clinics in South Kerala, India. Sociodemographic, anthropometric and outcome variables (duration of physical activity, sedentary behavior, sleep and screen time) were collected for all participants.

**Results:** Physical activity, sedentary behavior, sleep and screen time recommendations were adhered by 63.3%, 22.7%, 82.2% and 22.7% under-five children, respectively. Risk factors for inadequate physical activity were female sex, nuclear family, maternal education below college level, unskilled maternal occupation/housewife, unskilled paternal occupation and low monthly income. Risk factors for non-adherence to recommended sedentary behavior duration included joint family, paternal education college level/above, unskilled maternal occupation/housewife, unskilled paternal occupation and low monthly income.

**Conclusion:** Under-fives should reduce sedentary behaviors and screen time and spend more time on physical activities.

**Keywords:** Infant, Toddler, Obesity, Preschool, Recommendation

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### INTRODUCTION

Being overweight and obese starts in infancy and early childhood and tracks to adolescence and adulthood. In India and Kerala, 3.4% and 4% of under-fives are overweight as per National Family Health Survey (NFHS) 5 [1,2]. World Health Organization (WHO) published recommendations in 2019 on the duration of physical activity (PA), sedentary behavior (SB), sleep time (ST) and screen time (ScrT) in a 24-hour day for under-fives [3]. Paucity of evidence on PA, SB, ST and ScrT among under-fives in Kerala, where overweight and obesity are growing concerns, was the basis for this study. Our primary objective was to estimate the proportion of healthy under-fives attending the anganwadis and immunization clinics in whom PA, SB, ST and ScrT adhered to the WHO 2019 recommendations [3]. Secondly, risk factors of non-adherence were also identified.

### METHODS

After approval from the Department of Women and Child Development, Government of Kerala, and Ethics Committee, a cross-sectional study was conducted from September 2021 to August 2022. Twenty anganwadis / immunization clinics of an urban integrated family health center were randomly sampled from a total of 111 centers. All healthy children between 6 months and 4 years attending these centers were included.

The estimated prevalence (24.4%) of preschoolers meeting ScrT recommendations in Canadian Health Measures Survey was utilized to calculate the sample size [4]. With an absolute precision of 5% and a design effect of 1.5, sample size was calculated as 450.

Socio-demographic characteristics (age, sex, parental education and occupation, type of family and socio-economic status as per the modified Kuppuswamy Scale 2021) and anthropometric parameters were collected. Outcome variables were defined as follows: PA- at least 30 minutes of tummy time/ floor-based play with building blocks, dolls, balls or utensils (6 mo - 1y), at least 180 minutes of moderate to vigorous activity like crawling, walking, running, jumping, pretend play, climbing in

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through and over objects, dancing and riding wheeled toys (1-4 y); SB- not more than 1 hour restrained in a pram/high chair/ carried by caregiver (6 mo-4 y) or activities like lying down, listening to music/stories, using electronic devices and coloring; ST- both night and daytime naps of at least 12-16 hours (6 mo-1 y), 11-14 hours (1-2 y) and 10-13 hours (3-4 y); ScrT- time on television, computer or mobile devices; 0 minute (6 mo-2 y), not to exceed 1 hour (2-4 y). Overweight (above +2 Z) and obesity (above +3 Z) were defined as per WHO (2006) weight-for-height Z score charts for children aged 0-5 y. Children were grouped as 6 mo-1 y, 1-2 y, 2-3 y and 3-4 y. Outcome variables were dichotomized (adhered to recommended duration or not).

Efforts were taken to address the anticipated recall bias and subjectivity of outcome variables. To elicit the time spent on different activities, a big circle depicting a 24-hour day was drawn and shown to the caregiver. ST in hours was shaded in the circle first followed by ScrT. Time spent on feeding, bathing and carrying out other basic necessities were shaded next. Play and sedentary activities were identified and shading of circle completed.

**Statistical analysis:** Descriptive statistics was used and analysis was done by using SPSS version 26. Association between proposed risk factors and outcome variables was analyzed with *Chi* square test and odds ratios with 95% confidence intervals were calculated for all such statistically significant risk factors.

## RESULTS

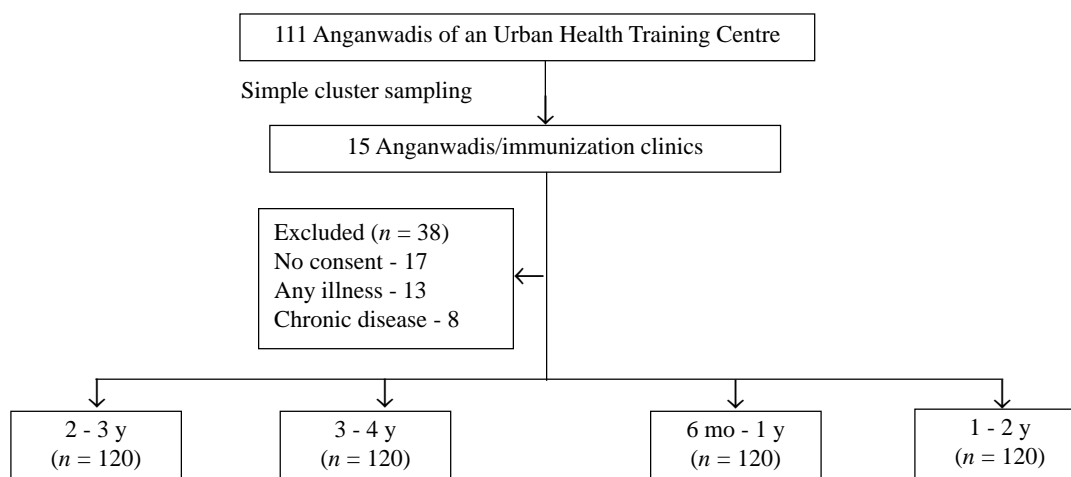
The study flow chart is depicted in **Fig. 1**. Baseline characteristics of 480 children of different age groups are given in **Table I**. Distribution of 480 healthy under-fives who adhered to the recommended duration of PA, SB, ST

and ScrT were 304 (63.3%), 109 (22.7%), 395 (82.2%) and 109 (22.7%), respectively (**Table II**). Interactive play of infants (6 months-1 year) was mostly with mother (41.5%) followed by siblings (23.3%), grandparents (22.5%) and father (12.5%); beyond infancy, interactive play was mostly with siblings (48.1%) followed by grandparents (22.1%), mothers (21.6%) and fathers (4%).

Significant risk factors of non-adherence to recommended PA were female sex ( $P = 0.005$ , OR 1.6, 95% CI 1.1-2.4), nuclear family ( $P = 0.001$ , OR 2.6, 95% CI 1.3-5.0), maternal education below college level ( $P = 0.027$ , OR 1.4, 95% CI 1.01-2.1), maternal occupation unskilled/nil ( $P = 0.001$ , OR 2.08, 95% CI 1.3-3.3) and paternal occupation unskilled/nil ( $P = 0.001$ , OR 1.8, 95% CI 1.3-2.7). Significant risk factors of non-adherence to recommended SB were joint family ( $P = 0.001$ , OR 1.8, 95% CI 1.3-2.7), maternal occupation unskilled/nil ( $P = 0.027$ , OR 1.7, 95% CI 1.01-3.0), paternal occupation unskilled/nil ( $P = 0.001$ , OR 3.2, 95% CI 2.0-5.2) and paternal education of college level and above (OR 1.8, 95% CI 1.2-2.9). Low monthly family income was a significant risk factor for non-adherence to recommended PA ( $P = 0.001$ ), SB ( $P = 0.001$ ) and ST ( $P = 0.006$ ). Obesity/overweight was associated with less than recommended ST ( $P = 0.024$ , OR 1.9, 95% CI 1.08-3.35) and more than recommended ScrT ( $P = 0.009$ , OR 2.5, 95% CI 1.24-5.36).

## DISCUSSION

Twenty-four-hour movement and active play guidelines for early years by Canada [5], Australia [6] and New Zealand [7] and guidelines on screen time and digital wellness in infants and children by Indian Academy of Pediatrics (IAP) [8] were similar to that given by the World



**Fig. 1** Flow chart depicting selection of participants in the study

**Table I Baseline Characteristics of Children**

<i>Characteristics</i>		<i>6 mo - 1y (n = 120)</i>	<i>1 - 2 y (n = 120)</i>	<i>2 - 3 y (n = 120)</i>	<i>3 - 4 y (n = 120)</i>
Sex	Male	64 (53.3)	69 (57.5)	63 (52.5)	63 (52.5)
Maternal Education	College	75 (62.5)	77 (64.1)	67 (55.8)	58 (48.3)
	School / +2	45 (37.5)	43 (35.9)	53 (44.2)	62 (51.7)
Maternal Occupation	Skilled/Professional	41 (34.2)	28 (23.3)	33 (27.5)	12 (10)
	Unskilled/nil	79 (65.8)	92 (76.7)	87 (72.5)	108 (90)
Paternal Education	College	60 (50)	57 (47.5)	65 (54.2)	37 (30.8)
	School / +2	60 (50)	63 (52.5)	55 (45.8)	83 (69.2)
Paternal Occupation	Skilled/Professional	99 (82.5)	64 (53.3)	48 (40)	41 (34.2)
	Unskilled/nil	21 (17.5)	56 (46.7)	72 (60)	79 (65.8)
Socio-economic Scale <sup>a</sup>	Upper	19 (15.8)	21 (17.5)	18 (15)	6 (5)
	Upper middle	62 (51.6)	54 (45)	44 (36.6)	50 (41.6)
	Lower middle	27 (22.5)	21 (17.5)	30 (25)	54 (45)
	Upper Lower	12 (10)	22 (18.3)	26 (21.6)	10 (8.3)
	Lower	0	2 (1.6)	2 (1.6)	0
Monthly income (Rupees)	> 30,000	111 (92.5)	91 (75.8)	99 (82.5)	113 (94.1)
Nutritional status	Overweight	9 (7.5)	14 (11.6)	28 (23.3)	16 (13.3)
	Obesity	3 (2.5)	0	2 (1.6)	7 (5.8)

Values expressed as n (%); <sup>a</sup>Modified Kuppuswamy Scale 2021

Health Organization (WHO) in 2019. A cross-sectional study on 180 under-fives in a slum area of West Bengal showed that 69.4%, 70%, 84.4% and 63.3% had PA, SB, ST and ScrT as per the WHO guidelines [9]. Compared to this, the lower percentages of children meeting the SB and ScrT recommendations in our study might have been due to differing socioeconomic status. In SUNRISE Vietnam pilot study, among 103 preschoolers, 50.4%, 81.4%, and 44.7% had PA, ST and ScrT as per WHO (2019) [10]. When compared to our study population, children of SUNRISE study had less PA but adhered to ScrT recommendations more. A Canadian study on 151 babies aged 12-23 months found that 99.3%, 82.1% and 15.2% met PA, ST and ScrT as per Canadian guidelines [11]. In our study, 81.6%, 89.1% and 11.6% of babies aged 12-23 months met PA, ST and ScrT as per WHO guidelines. Compared to ours, all these studies had almost similar percentages adhering to ST recommendations. Though we expected infants to have less and toddlers and preschoolers to have more PA upon achievement of gross motor milestones, a fall in percentages adhering to recommended duration of PA was noted among children aged 6-12 months (100%), 1-2 years (81.6%), 2-3 years (44.1%) and 3-4 years (27.5%). A fall in percentages of PA, 1-2 years (100%), 2-3 years (60.6%) and 3-4 years (69.3%), were noted in the study conducted in West Bengal too [9]. Compared to our study, risk of inadequate PA was found to be more among under-fives without

siblings in slum areas of West Bengal (OR 3.5, 95%CI 1.78, 6.9) [9]. In our study, none of the infants and only 24-34% of those aged 1-4 years adhered to recommended duration of SB. Traditional practices like carrying on arms for long hours and modern practices like restraining on chairs for long hours with electronic devices were identified as SB in our setting. In West Bengal, SB was found to be more among children without sibling (OR 4.69, 95% CI 2.35, 9.36) [9]. The SUNRISE study measured SB in 1071 preschoolers (3-5-year-olds) from 19 countries and found that 56% (7.4h) of their wake time was spent sedentary [12]. Higher country income levels and higher population density appeared to be stronger drivers of observed differences in sedentary behaviors among countries [12].

Beyond infancy, ScrT recommendations were followed in less than 15%. An observational study conducted among 369 Indian children aged 15-18 months showed that 99.7% were exposed to screen-based media [13]. A systematic review among under-fives revealed that burden of ScrT was 21-98% in the middle-income compared to 10-93% in the high-income countries [14]. Associated factors and correlates of ScrT were explained using a socio-ecological model consisting of socio-cultural environment (neighborhood, government regulations, season), child-care media environment (access, regulation), caretaker-related and child-related

## WHAT THIS STUDY ADDS?

- The proportion of healthy under-fives whose duration of physical activity, sedentary behavior, sleep and screen time adhered to WHO 2019 recommendations were 63.3%, 22.7%, 82.2% and 22.7% respectively.
- Infants, toddlers and preschoolers should be encouraged to reduce SB and ScrT and spend more time on moderate/vigorous PA.

**Table II Adherence of Children (age-wise) to Recommended Duration of Physical Activity, Sedentary Behavior, Sleep Time and Screen Time as per WHO Guidelines 2019**

	6 mo-1y (n = 120)	1- 2 y (n = 120)	2- 3 y (n = 120)	3- 4 y (n = 120)
PA (minutes)	150 (100, 200); 120 (100)	255 (202, 325); 98 (81.6)	167 (146, 240); 53 (44.1)	130 (67, 190); 33 (27.5)
SB (minutes)	180 (120, 225); 0 (0)	105 (75, 150); 29 (24.1)	90 (30, 127); 41 (34.1)	90 (41, 150); 39 (32.5)
ST (hours)	13 (11.6, 14); 90 (75)	12 (12, 14); 107 (89.1)	12 (11, 13); 105 (87.5)	11 (10, 12); 93 (77.5)
ScrT (minutes)	0 (0, 30); 63 (52.5)	90 (30, 120); 14 (11.6)	105 (60, 180); 15 (12.5)	120 (60, 210); 17 (14.1)

Values expressed as median (IQR), n (%). Physical Activity (PA), Sedentary Behavior (SB), Sleep Time (ST) and Screen Time (ScrT)

factors (demographic, behavioral, biological) [14]. In our setting, ST recommendations were adhered by 75% of infants and 77.5-89.1% of children aged 1-4 years. A meta-analysis (including studies conducted before 2019) looked into the associations of ScrT, SB, PA with ST among under-fives and found that ScrT was negatively correlated with ST (pooled correlation coefficient -0.09, 95% CI -0.17, -0.01;  $I^2 = 90\%$ ,  $P = 0.04$ ) [15]. The systematic review included original articles from North America ( $n = 10$ ), Europe ( $n = 7$ ), Australia ( $n = 5$ ) and Asia ( $n = 8$ ) [15]. The proportion of overweight among our participants (13.9%) was three times more than that from NFHS-5 (4%); burden stood highest among 2-3-year-olds. Overweight/ obesity was significantly associated with non-adherence to recommended duration of ST and ScrT; temporality could not be identified.

Our study had a few limitations. Though planned in 2019-20, we conducted the study during the post-COVID-19 lockdown phase (2021-22) after re-opening of anganwadis. Results have to be interpreted in this unique context. The global effect of COVID-19 on PA, SB, ST and ScrT among 948 preschoolers residing in 14 countries showed that PA and ScrT levels of children from low and middle-income countries have been less impacted than from high-income countries [16]. Subjective nature of parental reporting and possible recall bias were anticipated as a limitation. Hence, questions were asked in multiple ways and answers interpreted by a single interviewer logically. The strength of our study includes community setting and single interviewer.

Our results of under-fives attending urban anganwadis

and immunization clinics are generalizable to similar Indian community settings. Awareness of parents, caregivers and community health care workers on recommended duration of PA, SB, ST and ScrT is a very strong felt need. Infants, toddlers and preschoolers should be encouraged to reduce SB and ScrT and spend more time on moderate/vigorous PA.

**Ethics clearance:** IEC, Human Ethics Committee, Medical College, Thiruvananthapuram, Kerala; No. 05/38/2021 MCT, dated May 19, 2021.

**Contributors:** STP: Executed the idea, substantial contribution to design, data collection, drafted the manuscript and did final approval; Questions related to the accuracy or integrity of the work were appropriately investigated and resolved; PS: Conceived the idea, devised the protocol, data analysis and approved the manuscript after revising for important intellectual content; AK: Refined the idea, approved the protocol, interpreted the data and approved for final submission.

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