PRESS RELEASE

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Study: Infants exposed to excessive screen time show differences in brain function beyond eight years of age

Screen time in infancy is associated with brain waves that indicate brain immaturity and poor self-regulation.

Singapore, 31 January 2023 – More children are now exposed to mobile digital devices at a young age as an avenue for entertainment and distraction. A longitudinal cohort study in Singapore has confirmed that excessive screen time during infancy is linked to detrimental outcomes in cognitive functions, which continue to be apparent after eight years of age.

The research team looked at data from 506 children who enrolled in the Growing Up in Singapore towards Healthy Outcomes (GUSTO) cohort study since birth. When the children were 12 months of age, parents were asked to report the average amount of screen time consumed on weekdays and weekends each week. Children were then classified into four groups based on screen time per day – less than one hour, one to two hours, two to four hours and more than four hours. At 18 months of age, brain activity was also collected using electroencephalography (EEG), a highly sensitive tool which tracks changes in brain activity. Besides undergoing EEG, each child participated in various cognitive ability tests that measured his or her attention span and executive functioning (sometimes referred to as self-regulation skills) at the age of nine years.

The team first examined the association between screen time and EEG brain activity. The EEG readings revealed that infants who were exposed to longer screen time had greater “low-frequency” waves, a state that correlated with lack of cognitive alertness. To find out whether screen time and the changes observed in the brain activity have any adverse outcomes during later childhood, the research team analysed all the data across three points for the same children – at 12 months, 18 months and nine years. As the duration of screen time increased, the greater the altered brain activity and more cognitive deficits were measured. Children with executive function deficits often have difficulty controlling impulses or emotions, sustaining attention, following through multi-step instructions, and persisting in a hard task.

The brain of a child grows rapidly from the time of birth until early childhood. However, the part of the brain that controls executive functioning, or the prefrontal cortex, has a more protracted development. Executive functions include the ability to sustain attention, process information and regulate emotional states, all of which are essential for learning and school performance. The advantage of this slower growth in the prefrontal cortex is that the imbuing and shaping

of executive function skills can happen across the school years until higher education. However, this same area of the brain responsible for executive functioning skills is also highly vulnerable to environmental influences over an extended period of time.

This study points to excessive screen time as one of the environmental influences that may interfere with executive function development. Prior research suggests that infants have trouble processing information on a two-dimensional screen. When watching a screen, the infant is bombarded with a stream of fast-paced movements, ongoing blinking lights and scene changes, which require ample cognitive resources to make sense of and process. The brain becomes “overwhelmed” and is unable to leave adequate resources for itself to mature in cognitive skills such as executive functions.

Researchers are also concerned that families which allow very young children to have hours of screen time often face additional challenges. These include stressors such as food or housing insecurity, and parental mood problems. More work needs to be done to understand reasons behind excessive screen time in young children. Further efforts are necessary to distinguish the direct association of infant screen use versus family factors that predispose early screen use on executive function impairments.

The study was a collaborative effort comprising researchers from the Yong Loo Lin School of Medicine, National University of Singapore (NUS Medicine), A*STAR’s Singapore Institute for Clinical Sciences (SICS), National Institute of Education, KK Women's and Children's Hospital, McGill University and Harvard Medical School. It was published in *JAMA Pediatrics* on 31 January 2023.

Lead author, Dr Evelyn Law from NUS Medicine and SICS’s Translational Neuroscience Programme, said, “The study provides compelling evidence to existing studies that our children’s screen time needs to be closely monitored, particularly during early brain development.” Dr Law is also a Consultant in the Division of Development and Behavioural Paediatrics at the Khoo Teck Puat - National University Children’s Medical Institute, National University Hospital.

Professor Chong Yap Seng, Dean of NUS Medicine and Chief Clinical Officer, SICS, added, “These findings from the GUSTO study should not be taken lightly because they have an impact on the potential development of future generations and human capital. With these results, we are one step closer towards better understanding how environmental influences can affect the health and development of children. This would allow us to make more informed decisions in improving the health and potential of every Singaporean by giving every child the best start in life.”

Professor Michael Meaney, Programme Director of the Translational Neuroscience Programme at SICS said, “In a country like Singapore, where parents work long hours and kids are exposed to frequent screen viewing, it’s important to study and understand the impact of screen time on children’s developing brains.”

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About GUSTO

Set up in 2009, GUSTO (Growing Up in Singapore Towards healthy Outcomes) is a nationwide birth cohort study involving collaborators from KK Women's and Children's Hospital (KKH), National University Health System (NUHS), National University of Singapore (NUS), and Singapore Institute for Clinical Sciences (SICS).

It is a longitudinal study of Singaporean mothers and their offspring. Since its inception, the study has recruited 1,247 Singaporean pregnant women as volunteers. These volunteers are studied extensively during their pregnancy, and their offspring are closely followed up as they grow up. GUSTO aims to understand how conditions during pregnancy and early childhood may affect the mothers' and children's health, growth and development, as well as metabolic, neurodevelopmental and other conditions – all of which are of major public health and economic importance in Asia and around the globe. The research spans across four themes, where the results from monitoring both mother and child help in developing public health policies; clinically-valuable, testable interventions; reduce the burden of childhood obesity and non-communicable diseases, e.g. diabetes; and improve neurodevelopmental outcomes in children.

The study is supported by the National Research Foundation (NRF) under the Open Fund-Large Collaborative Grant (OF-LCG) administered by the Singapore Ministry of Health's National Medical Research Council (NMRC), and the Agency for Science, Technology and Research (A*STAR). In RIE2025, GUSTO is supported by funding from the NRF's Human Health and Potential (HHP) Domain, under the Human Potential Programme. https://www.gusto.sg/

About National University of Singapore (NUS)

The National University of Singapore (NUS) is Singapore's flagship university, which offers a global approach to education, research and entrepreneurship, with a focus on Asian perspectives and expertise. We have 16 colleges, faculties and schools across three campuses in Singapore, with more than 40,000 students from 100 countries enriching our vibrant and diverse campus community. We have also established our NUS Overseas Colleges programme in more than 15 cities around the world.

Our multidisciplinary and real-world approach to education, research and entrepreneurship enables us to work closely with industry, governments and academia to address crucial and complex issues relevant to Asia and the world. Researchers in our faculties, research centres

of excellence, corporate labs and more than 30 university-level research institutes focus on themes that include energy; environmental and urban sustainability; treatment and prevention of diseases; active ageing; advanced materials; risk management and resilience of financial systems; Asian studies; and Smart Nation capabilities such as artificial intelligence, data science, operations research and cybersecurity.

For more information on NUS, please visit www.nus.edu.sg.

About the NUS Yong Loo Lin School of Medicine (NUS Medicine)

The NUS Yong Loo Lin School of Medicine is Singapore's first and largest medical school. Our enduring mission centres on nurturing highly competent, values-driven and inspired healthcare professionals to transform the practice of medicine and improve health around the world.

Through a dynamic and future-oriented five-year curriculum that is inter-disciplinary and inter-professional in nature, our students undergo a holistic learning experience that exposes them to multiple facets of healthcare and prepares them to become visionary leaders and compassionate doctors and nurses of tomorrow. Since the School's founding in 1905, more than 12,000 graduates have passed through our doors.

In our pursuit of health for all, our strategic research programmes focus on innovative, cutting-edge biomedical research with collaborators around the world to deliver high impact solutions to benefit human lives.

The School is the oldest institution of higher learning in the National University of Singapore and a founding institutional member of the National University Health System. It is one of the leading medical schools in Asia and ranks among the best in the world (Times Higher Education World University Rankings 2023 by subject and the Quacquarelli Symonds (QS) World University Rankings by subject 2022).

For more information about NUS Medicine, please visit https://medicine.nus.edu.sg/.

About the Singapore Institute for Clinical Sciences (SICS)

Founded in 2007, the Singapore Institute for Clinical Sciences' (SICS) mission is to promote health and human capacity in Singapore, Asia and globally. The first institute within the Agency for Science, Technology and Research (A*STAR) to focus on clinical sciences and translational research, SICS posits that health has its origins in good beginnings and continued interactions between our physiological makeup and environment.

To fulfil our vision of building gateways and an evidence base for positive health, our institute strongly promotes clinical research that supports the understanding of metabolism, neuroscience and how they impact human development. To take our research into the real world, we launched seminal nationwide birth cohort studies such as Growing Up in Singapore Towards healthy Outcomes (GUSTO) and Singapore PREconception Study of long-Term maternal and child Outcomes (S-PRESTO). By paving the way for scientific research to make a difference to the social and economic fabric of our communities, we are committed to 'Changing Tomorrow's Health, Today'. www.a-star.edu.sg/sics

About the Agency for Science, Technology and Research (A*STAR)

The Agency for Science, Technology and Research (A*STAR) is Singapore's lead public sector R&D agency. Through open innovation, we collaborate with our partners in both the public and private sectors to benefit the economy and society. As a Science and Technology Organisation, A*STAR bridges the gap between academia and industry. Our research creates economic growth and jobs for Singapore, and enhances lives by improving societal outcomes in healthcare, urban living, and sustainability. A*STAR plays a key role in nurturing scientific talent and leaders for the wider research community and industry. A*STAR's R&D activities span biomedical sciences to physical sciences and engineering, with research entities primarily located in Biopolis and Fusionopolis. For ongoing news, visit www.a-star.edu.sg.

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