



The role of cellular phone usage by parents in the increase in ASD occurrence: A hypothetical framework

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ABSTRACT

Over the last few decades there has been a significant worldwide increase in the diagnosis of autism spectrum disorder (ASD), the causes of which are unknown. The biggest environmental change over this decade has been the massive introduction of cellphones. Eye contact is fundamental for infants' development, and parent-infant eye contact is impaired when parents are pre occupied by cellphones. We speculate that children with a pre-existing vulnerability to autism may be adversely affected by this pattern of parental behavior.

As a first step toward exploring our hypothesis, we wished to document the extent of cellular phone usage by parents during their child's diagnostic developmental assessment. We speculated that, if under these stressful circumstances of awaiting their child's crucial assessment the parent is not fully engaged with his/her child, then in real daily activities this phenomenon is likely much more pronounced.

Of 111 developmental sessions, 73 parents (66%) engaged their phone during the assessment, between 1 and 20 times. Of 62 observations in the waiting room, 52 (83.9%) parents used their phone, 1–19 times. Nine parents (17.3%) used their phone for 10–50% of the time and 16 (30.8%) for more than 50% of the time in the waiting room. In our analysis, the rate of language/motor delays was twice more common among children of cell phone users than among non users ($p = 0.04$) as an initial support of our hypothesis.

Parents' focus and full attention toward their cellphones can adversely affect the development of joint attention in infants and may contribute to the development of autistic features among a vulnerable subgroup of infants. While more research is needed to prove causation, it would be reasonable to advise parents to decrease to minimum the usage of cellphones when interacting with their young children.

Introduction

Over the last few decades there has been a significant worldwide increase in the diagnosis of autism spectrum disorder (ASD), with numbers rising from 2 to 6/10,000 prior to the 1990s, to current estimates of up to 260/10,000 or 2.6% [1]. Presently, the cause of this dramatic increase in ASD diagnosis has not been identified. Any attempt to confront this significant increase in ASD prevalence must first identify its' causes.

One of the most noticeable environmental changes in the last few decades, almost in tandem with the rise in ASD prevalence, has been the

massive introduction of cellular phones.

The hypothesis

Normal eye contact is a fundamental element of joint attention which involves the capacity to coordinate one's own visual attention with that of another person [2]. The emergence of infant's joint attention is critical for the development of language and communication [3]. Atypical development of joint attention is strongly indicative of autism spectrum disorder (ASD) [4].

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We hypothesize that a critical environmental change concurring with ASD increase has been the massive introduction of cellular phones. This has led to major parents' distraction, starting during the baby's first days of life. By diminishing their eye contact, parents miss emerging cues sent by the baby in an attempt to establish reciprocal relationships. We surmise that this impairs the development of joint attention between babies and their care givers in a critical developmental stage, leading a subgroup of vulnerable babies to be adversely affected and develop autistic features, and possibly other developmental delays.

Evaluation of the hypothesis

While there is increasing research activity trying to identify the genetic basis of ASD, it is extremely unlikely that major genetic changes can account for the steep increase in ASD over the last 2 decades. This shifts attention toward putative environmental changes that may explain the increased prevalence of ASD. A recent systematic review and meta-analysis of environmental risk factors for ASD has summarized the published evidence supporting environmental etiologies for ASD [5]. There are several environmental factors etiologically associated with ASD that have increased in their prevalence over the last two decades. It is plausible that their cumulative effect is an important determinant in the increased prevalence of ASD. These include maternal obesity, maternal diabetes, prematurity and parents' age [5]. Exposure to toxins has been also reported to correlate with ASD diagnosis [6]. Broader diagnostic criteria, diagnosis substitution and an increase in awareness have been proposed to influence prevalence as well [1]

Eye contact is fundamental for infants' development. Eye contact is developed from birth [7], and throughout their first month infants start to become more visually alert, fixate momentarily on faces and objects, and move their eyes vertically. Eye contact represents the main mode of establishing a communicative relation among people [8–10]. Farroni et al. [7] reported that from birth, infants prefer to look at faces that engage them in a mutual gaze and that, from an early age, this contributes to the foundation for the later development of social skills. Newborns show sensitivity to eye gaze, looking longer at faces with open eyes rather than those with closed eyes, as well as at a direct gaze as opposed to an averted gaze [11]. The authors emphasized the importance of the eyes and gaze in all aspects of face processing and visual social cognition, including identity and emotion recognition.

A study by Jones and Klin has shown that eye fixation may appear to be normal at the neonatal period, but shows a marked decline by 2 to 6 months of age in those who develop ASD [12]. These observations suggest that in the first months of life, this basic mechanism of social adaptive action, eye looking, might not be immediately diminished in infants later diagnosed with ASD.

Empirical data

As a first step toward exploring our hypothesis, we wished to document the extent of cellular phone usage by parents during their child's diagnostic developmental assessment. We speculated that, if under these stressful circumstances of awaiting their child's crucial assessment the parent is not fully engaged with his/her child, then in real daily activities this phenomenon is likely much more pronounced.

Methods

The research was conducted according to the principles of the Declaration of Helsinki, and written informed consent was obtained from the parents after approval by Assuta Hospital Research Ethics Committee.

Settings

Developmental assessments were performed in two clinics, by two physicians, experts in child neurology and development (MD, NA). The duration of a typical evaluation lasts around one hour. During the meeting, the neurologist speaks with the parents, discusses their concerns and receives the child and family's medical and developmental history. Then, he/she performs a developmental assessment and physical and neurological examination. Afterwards the parents are asked by the physician (MD) to wait in the waiting room for approximately 10 min, while the physician summarizes the evaluation, subsequently discussing the results with the parents. The second neurologist (NA) gives the parents her primary impression at the end of the evaluation, and summarizes it after the parents have left the clinic (no waiting room observation).

Observations

The parents received an explanation regarding the study by the authors (MD, NA) that NG or MS will attend the meeting and observe parent-child interaction. With Ethics approval, parents were not informed of the real purpose of the study, to avoid affecting their behavior. The observers recorded how many times the parents looked at their phone, how many times they actually used it (answered a call or a message) and the duration of each phone engagement, using the app "Stop-Watch". The observations were conducted during the assessment and while the parents and their children were waiting in the waiting room. We did not film the sessions in order to avoid any change in parental behavior when in the presence of a camera.

Statistical analysis

Chi square test was used to compare proportions of cellphone use by diagnosis.

Results

114 parents agreed to allow the researchers to observe the medical developmental assessment (none refused). Three did not have cellular phones with them during the sessions.

Of 111 assessments, 73 parents (66%) made contact with their cellular phones. The rest were assigned to a separate group. It should be noted that, in three of these cases with no parental phone engagement, their children were using the phone during part of the assessment. All parents that were using the cellphones during the developmental assessments were visually engaged (looking at messages and or answering them).

Parents were engaged with their cellular phones from 1 s up to 9 min and 2 s, with a mean of 1.1 min. The average number of times parents were engaged with their phones during the assessment was 4.1 times ranging 1–20,

The percentage time parents spent on their phone during the assessments is summarized in Table 1. 15% of the parents were engaged with their phone for more than 5% of the assessment time.

63 observations of children (51 boys {81%}) and their parents were performed in the waiting area outside the assessment room. In one case, the parents did not have their phones with them and therefore are not

Table 1

Parental percentage of time of smartphone usage out of total assessment duration and total time spent in the waiting room.

% of time used on smartphone	1% or less	1–10%	Above 10%
Number of assessments (N = 73)	46 (63%)	22 (30.1%)	5 (6.9%)
Number of observations In the waiting room (N = 52)	13 (25%)	14 (26.9%)	25 (48.1%)*

* 16 parents (30.8%) spent with the phones more than 50% of the time while waiting.

Table 2
Developmental Outcomes in relation to Cellular Phone Usage.

Group	Boys Assessed N (%)	Mean child's age at assessment (months)	Language and/or Motor Delays N (%)	ASD N (%)	ADHD N (%)	Congenital Disorders (Prematurity, genetic and anomalies) N (%)
Engaged with phone n = 73 ⁺	62 (85%)	49.7	42 (57.5)**	10 (13.7)	10 (13.7)	7 (9.5)***
Not engaged with phone n = 38 ⁺	24 (63%)	42.6	11 (29)**	3 (7.9)	7 (18.4)	14 (19.2)***

The table shows that level of engagement in cellphone use was significantly higher among parents of children language/motor delay than among congenital condition.

Diagnosis given after the neurodevelopmental assessments.

ASD – Autism Spectrum Disorder, ADHD – Attention Deficit Hyperactivity Disorder.

** P = 0.04.

*** P < 0.001.

* Please note that the total N also includes other reasons for assessment: behavior problems (N = 2), and typical development (N = 5).

included in the following results. The average time parents spent in the waiting room was 8 min and 15 s. Of the 62 parents with phones, 10 (16%) did not use them at all. The average number of times parents were engaged with their phone was 4.3 times, with a maximum of 19 times and a minimum of one time. The percentage of time parents used their phone while in the waiting room is presented in Table 1. Of the total of 62 observations, 25 parents (48%) used their phone for 10% or more of the time in the waiting room.

Significantly more parents of children with language and/or motor delays used their phones during the assessments ($p = 0.04$) (Table 2). Parents of children with “congenital” disorders (preterms, congenital anomalies and genetic abnormalities) used their phone significantly less ($p < 0.001$) (Table 2).

Discussion

A dramatic increase in the prevalence of autism has occurred over the past 20 years. Establishing broader diagnostic criteria, diagnosis substitution and an increase in awareness could explain only part of this major increase [1].

Since the increased prevalence of autism is well documented worldwide, we propose “social pollution” through cellular phone usage by parents as a previously unrecognized etiological factor. As a first step toward further exploring this hypothesis, it was critical to document the pervasive use of cellular phone.

We documented that more than 65% of parents use their cellular phones during their children's developmental assessments. One third of the parents used their phone more than 50% of the time while waiting with their child in the waiting area. These parents agreed to be observed on “parent-child interaction” but this notion did not prevent them from using their phones extensively. To date, on many occasions, one can observe mothers sending electronic messages or conducting phone conversations while nursing their babies, or while walking their infants in their strollers. Recent figures have shown that today's adult daily digital media usage and consumption has reached an average of 5.6 h [13]. The urge to use phones has become almost uncontrollable and often unconscious. During phone usage, parent's eyes are directed with full attention toward the phone. One of the core symptoms of autism is diminished eye contact and it is used in both screening and diagnosis [14,15]. Parents' mobile device use was common and associated with fewer interactions with children during a structured interaction task, particularly nonverbal interactions and during introduction of an unfamiliar food [16]. Parents' background television use decreased the quantity and quality of parent-child interactions [17]. High screen time in children (TV and computers), with its detrimental health effects, is an established major public health concern [18]. Multiple studies have already tried to shed light on the potential influences of screen time on child development and health [19–22], as well as the relation between parents' own screen time and their

adherence to the recommended sub-2h/day TV viewing or computer use for children [23]. Furthermore, studies have shown an association between ASD and increased TV screen exposure during infancy, suggesting audiovisual (AV) exposure in infancy as a possible contributing factor in ASD [24,25]. In one study, the researchers proposed a developmental model of ASD in which, through a process of neuroplasticity, exposure to screen-based AV input in genetically susceptible infants stimulates specialization of non-social sensory processing in the brain [26].

Our hypothesis focuses on the parents' engagement with their cell-phones and its possible influence on the development and quality of joint attention. The infants screen viewing potentially add to the harmful influence of their parents' frequent distraction by the cell-phones.

In the present study, significantly more parents of children with language and motor delays used their phones during the assessments, ($p = 0.04$) (Table 2). A similar trend was seen for the subgroup of children with ASD, however, due to its limited sample size, it did not reach statistical difference. The parents of children with congenital disorders could be served as a control group, and they used their cellular phone significantly less ($p < 0.001$) (Table 2).

Twelve months old infants typically respond to joint attention and 18-months initiation of joint attention predicts 24-months language abilities [16]. Social behaviors follow sequential emergence of eye gaze following, responding to joint attention request, and then to social manipulation, cooperative communication, group activity into collaboration, and social learning into instructed learning [27,28]. fMRI studies have recently established the neuronal network of initiation of joint attention, between the visual network and dorsal attention network, and between the visual network and posterior cingulate aspects of the default mode network [27].

Evidently, parents' eyes shifting toward their phones interrupt the cascade of joint attention. Repeated such interruptions can interfere with the development of joint attention in infants. We speculate that young children with a pre-existing vulnerability to ASD would be adversely affected by this pattern of parental behavior, leading them to develop ASD symptoms, whereas other children may be able to overcome it.

Our preliminary work is not specific enough to separate language from communication disorders. More research is needed to further explore this hypothesis, including the duration and quality of parents' eye contact during the time spent with their children. It is important to acknowledge that parental use of cellular phones does not render any benefits to an infant's development, while it may adversely affect the development of joint attention. While more research is being conducted, it would be reasonable to advise parents to decrease to minimum the usage of cellular phones when interacting with their young children.

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Disclosure

Three authors are currently employees of the Health Maintenance Organization, no other conflict of interest.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.mehy.2018.06.007>.

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