SAPIEN LABS

Age of First Smartphone and Mental Wellbeing Outcomes

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Summary

There is now a well-documented trend of a progressive global decline in the mental wellbeing of each younger generation that began sometime between the years of 2010 and 2014. One prominent global change that has tracked this trend has been the advent of the smartphone which provides 24/7 access to the Internet and has changed the cognitive and social habits of users. Today's 18-24-year-olds (those born after 1998 and part of Generation Z (GenZ)) are the first generation who went through adolescence with this technology. Here we look at their mental wellbeing in relation to the age at which they first got their own smartphone or tablet to determine the cumulative impact of growing up with smartphones, a term we use going forward to mean both phones and tablets. Are those young adults who got their first smartphone at age 6 doing worse than those who didn't get one until age 13 or 18?

This study uses global data from 27,969 18–24-year-olds obtained between January and April 2023 through the Global Mind Project (formerly known as the Mental Health Million Project). The Global Mind Project is an ongoing survey of global mental wellbeing along with various lifestyle and life experience factors. It acquires data using an assessment that spans 47 elements covering a wide range of symptoms and mental capabilities on a life impact scale that are combined to provide an aggregate score -- the Mental Health Quotient or -- MHQ -- as well as dimensional scores. We compared these scores and ratings of individual elements to the reported age of first smartphone or tablet ownership among 18-24-year-olds. Key findings are as follows:

- Mental wellbeing consistently improved with older age of first ownership of a smartphone or tablet, with a steeper change in females compared to males. The percentage of females experiencing mental health challenges decreased from 74% for those who received their first smartphone at age 6, to 46% for those who received it at age 18. For males, the percentage declined from 42% at age 6 to 36% at age 18.

- Social Self, an aggregate measure of how we view ourselves and relate to others, and one of six dimensions of mental function measured, improved most dramatically with older age of first smartphone ownership in both females and males. For females, other dimensions such as Mood & Outlook and Adaptability & Resilience also improved steeply with age of smartphone acquisition.

- Problems with suicidal thoughts, feelings of aggression towards others, a sense of being detached from reality and hallucinations declined most steeply and significantly with older age of first smartphone ownership for females, and for males as well, but to a lesser degree.

- The relationship between mental wellbeing at age 18-24 and age of first smartphone acquisition remained significant, even in those with no traumatic or adverse childhood experience.

Introduction

Data from the Global Mind Project (formally known as the Mental Health Million Project) has consistently demonstrated that, across the Internet-enabled world, overall mental wellbeing is systematically lower for each younger generation (Sapien Labs 2021, 2022a, 2023a). This trend is visible across 65 countries spanning all continents and has been exacerbated by the COVID-19 pandemic. This age-based pattern of declining mental wellbeing differs from patterns before 2010. For example, in the United States, psychological wellbeing metrics were highest for young and old adults, dipping across middle-age groups leading to the concept of the U-shaped curve of happiness (Stone et al., 2010). In Latin America, young adults fared best, while other age groups fared progressively worse (Steptoe et al., 2015). In the United States and other English-speaking counties, numerous multiyear studies have also shown a steady increase in psychological distress in younger age groups in the time period after 2010 that is not seen in older generations in the United States (CDC, 2023; Keyes et al 2019; Rausch & Haidt, 2023; Twenge et al 2019).

What has changed to cause this global decline? Corresponding to this time period is the advent of the smartphone and the growing ubiquity of the Internet and social media. Today, estimates from the United States suggest that 96% of Americans age 18-29 own a smartphone, with 48% saying that they are online "almost constantly" (Pew Foundation, 2022). Smartphone ownership is also high in children and adolescents, with a 2021 report finding that 31% of 8-year-olds in the United States own a smartphone, increasing to 71% of 12-year-olds and 91% of 14-year-olds. Estimates suggest that teens aged 13-18 spend on average 8.4 hours a day on entertainment screen use, while 8–12-year-olds spend an average of 5.3 hours (Common Sense Media, 2021).

Several studies have previously investigated whether age of first smartphone ownership or use impacts mental health outcomes (Adachi et al., 2022; Dempsey et al., 2019; Dempsey et al., 2020; Sun et al., 2023), but have shown conflicting results. For example, one study investigated the impact of smartphone ownership on sadness and sleep outcomes in 263 children from 2012 to 2017 and found no statistically significant associations (Sun et al., 2023), while another study found a statistically significant and negative relationship between early mobile phone ownership and academic outcomes and mental wellbeing (Dempsey et al., 2019). Numerous studies have also looked at the impact of screen time and social media on mental health and wellbeing (Odgers, 2018; Orben et al., 2022; Orben & Przybylski, 2019; Twenge et al., 2018), reporting smaller effects for males and females combined (Orben & Przybylski, 2019) but larger effects when females are analyzed separately, and the analysis is limited to social media rather than all digital media (Twenge et al., 2020). Differences in results appear to arise from either small sample sizes, combining males and females together in analysis, or the ambiguity and complexity of self-reported internet usage patterns.

Here we look at the cumulative effect of age of first smartphone ownership on comprehensive mental health profiles in early adulthood in a global sample of 27,969 young adults between the ages of 18 and 24. Data were collected from January to April 2023 thereby reflecting a real-time readout of trends in a post-COVID era. Such large-scale and comprehensive assessment is important in order to provide a coherent view of population trends against the inherent variability arising from childhood traumas, adversities and other factors.

Mental health outcomes were determined using a comprehensive assessment that reflects the life impact of problems or symptoms spanning ten common disorder criteria as well as various mental capabilities. This comprehensive profiling enabled an examination of elements of mental wellbeing and functioning that have not been previously assessed in the context of smartphone ownership and usage, and in a way that is independent of specific disorder diagnostic criteria which are heterogeneous groupings of subsets of symptoms (Allsopp et al., 2019; Newson et al., 2021).

This assessment delivers an aggregate metric of overall mental wellbeing (the Mental Health Quotient or MHQ) that positions individuals along a spectrum from distressed to thriving and has been shown to change systematically with measures of both functional productivity and clinical burden (Newson et al., 2022). In addition, it provides aggregate metrics along six dimensions of mental function. All respondents completed the MHQ assessment together with questions about various childhood traumas and adversities and smartphone ownership, including the question "*At what age did you get your own smartphone or tablet (e.g. iPad) with Internet access that you could carry with you?* ". Here we report the relationship between the age at which an individual acquired (owned) their first Internet-enabled phone, or tablet, during childhood (ages 6 to 18), and various aspects of their mental wellbeing as a young adult. In what follows, we will say "first smartphone" for simplicity, but we mean it to include tablet ownership as well.

Importantly the dataset utilized in this report is part of an ongoing dynamic study and is an early report of global trends consistent across culturally distinct regional groups. While we only show aggregate global trends in the main section of the report, results for major regional groups (Core Anglosphere & Western Europe, Latin America, South Asia, and Africa, which represent approximately 90% of the global data) can be viewed in the Appendix and associated data tables. In addition, data tables are provided for three countries: the United States, Mexico, and India. Future reports will examine differences more granularly by country, as sufficient data on individual countries becomes available, as well as explore relationships between smartphone ownership and use and other life factors. The data represented in this report, and in the associated ongoing study, is freely available to researchers through our Researcher Hub and we invite broad participation in this investigation.

Results

Here we report aggregate population shifts in overall mental wellbeing as well as various distinct aspects of mental wellbeing with increasing age of first smartphone ownership. The global population trends shown in this report represent those where the effect sizes are largest, highly statistically significant, and, unless otherwise indicated, consistent across major regional groups represented in this data (Core Anglosphere & Western Europe, Latin America, South Asia, Africa; see Appendix 1 and associated data tables).

Mental wellbeing improved with older age of smartphone ownership

Young adults aged 18-24 who acquired their first smartphone at each older age had, on average, progressively better mental wellbeing as measured by the Mental Health Quotient or MHQ (Figure 1). This pattern was present for both biological females and males. However, while for females it was highly significant across all regions, for males the trend was only directional but not significant in South Asia.

Figure 1: Mental wellbeing in young adulthood (ages 18-24) improves with older age of first smartphone

Mental wellbeing measured by the Mental Health Quotient or MHQ increases with older age of first smartphone ownership. Correspondingly the percentage that are distressed or struggling decreases.

* Negative scores reflect 5+ clinical level symptoms and significant impact to ability to function. >100 indicates functionally succeeding/thriving.

On average, females who acquired their first smartphone when they were younger than age 10 had MHQ scores within the negative range of the scale, indicating a clinically distressed mental health status. Correspondingly, among female respondents who acquired their first smartphone at age 6, 74% had mental wellbeing scores that fell within a distressed or struggling MHQ range. This decreased to 61% for those who acquired their first smartphone at age 10, and 52% for those who acquired their first smartphone at age 15. Altogether, even among those who acquired their first smartphone at age 18, 46% were still mentally distressed or struggling. This high percentage of distress compares to less than 14% of those age 45 and older who grew up and lived much of their younger adult life prior to Internet ubiquity.

Mental wellbeing improved with older age of smartphone ownership. On average, females who acquired their first smartphone below age 10 had MHQ scores in a clinically distressed range.

For males, the trend was not as steep as for females, and MHQ scores were higher than their female counterparts for all ages of first smartphone acquisition. For example, males who acquired their first smartphone at age 10, had an average MHQ score of 32 compared to an average MHQ score of 5 for females. Correspondingly, the percentage with scores in the range considered distressed or struggling was 43% for males and 61% for females. On average, MHQ scores were 20-25 points higher than their female counterparts for all ages of first smartphone acquisition (see scale in Figure 1). This gender gap closes slightly at older ages of first smartphone acquisition. Regional views are shown in the Appendix (Figure A1).

The Social Self dimension improves most significantly with older age of smartphone ownership

In addition to the aggregate score of mental wellbeing, the MHQ, we also looked at scores of six dimensions that describe various subthemes of mental wellbeing: *Mood & Outlook*, *Social Self*, *Adaptability & Resilience*, *Drive & Motivation*, *Cognition,* and *Mind-Body Connection*. Of these six dimensions, in both males and females, the *Social Self*, an aggregate measure of how we see ourselves and relate to others, showed the most significant and steepest improvement with older age of first smartphone ownership (Figure 2). This was highly significant across all regions for females increasing by almost 50 MHQ points from age 6 to age 18, equivalent to almost 16% of the scale. For males the corresponding increase was ~25 points and was significant in the Core Anglosphere & Western Europe and Latin America, but only directional for Africa and South Asia (though significant for India alone).

The Social Self is a metric of our positive integration in the social world. It includes various aspects such as self-image, self-confidence, the ability to form and maintain positive relationships and cooperate with others. In previous reports, we have shown that the Social Self declines most significantly with younger generations compared to other dimensions (Sapien Labs, 2022b). In addition, at the country level, the measure of Social Self correlates negatively with rates of suicide, sexual abuse, and assault (Sapien Labs, 2022a).

Figure 2: Multiple dimensions of mental wellbeing improve with older age of first smartphone

Scores for multiple dimensions of mental wellbeing significantly increased with older age of first smartphone. For females and males Social Self followed by Mood & Outlook showed the steepest effects. Adaptability & Resilience was also similarly steep for females but much weaker for males.

> ***Of the six dimensions, the Social Self, an aggregate measure of how we see ourselves and relate to others, showed the most significant and steepest improvement with older age of smartphone acquisition.***

A similar significant pattern was seen for *Mood & Outlook* for both females and males, although marginally less steep and statistically significant. For females, scores for *Adaptability & Resilience* also improved steeply and significantly with older age of first smartphone acquisition while *Drive & Motivation*, *Cognition*, and *Mind-Body Connection* also increased significantly though not as steeply, and not in all regions. These four dimensions did not significantly change for males.

Suicidal thoughts and other problems decrease with older age of smartphone ownership

The MHQ assesses 47 different elements of mental wellbeing that are aggregated altogether into the MHQ score and, in part, into each of six dimensional scores. Of these, 27 are capacities of mental

function, while 20 are problems that would be considered negative symptoms associated with various mental health disorders. While many of these problems decreased significantly with older age of first smartphone ownership, especially for females, we show here the top five. Among these, the one that decreased most steeply and significantly across all regions for both females and males was *Suicidal thoughts and intentions* (Figure 3).

On a 9-point scale where 1 was "never causes any problems", and 9 was "a constant and severe impact to the ability to function", *Suicidal thoughts and intentions* had an average global rating of 5.8 for females who acquired their first smartphone at age 6. This rating decreased systematically for increasing ages of smartphone acquisition to a rating of 3.6 for those who acquired their first smartphone at age 18. For males, average ratings were 4.1 for those who acquired their first smartphone at age 6 compared to 3.2 for those who acquired their first smartphone at age 18.

Similarly, *Feelings of aggression towards others* also showed a systematic decrease with older age of first smartphone from age 6 to age 18, a trend that was generally consistent across regions for both males and females, but steeper for females.

Figure 3: Ratings of top five mental health problems that decrease with older age of first smartphone

Numerous problems decreased with older age of first smartphone acquisition, with suicidal thoughts or intentions decreasing the most steeply and substantially of all problem areas.

While many mental health problems decreased with older age of first smartphone acquisition, Suicidal thoughts and intentions decreased most steeply for both males and females.

For females, also among the top five most steeply and significantly decreasing problems with older ages of first smartphone were *Sense of being detached from reality, Hallucinations,* as well as *Addictions* (which may include online addictions). Apart from *Addictions* where there was no trend in South Asia and Africa, all others were consistent across regions. For males, other problems in the top five that decreased were *Guilt & (self) blame*, *Repetitive or compulsive actions,* and *Sense of being detached from reality.* However, the decreases were small, and each were significant only in one or two regions.

It is interesting to note that the problems that changed most steeply and significantly in relation to age of smartphone acquisition do not correspond to classic symptoms of depression or anxiety, as defined by the DSM-5, such as sadness, depressed mood, and diminished interest.

The changes with age of first smartphone are independent of childhood traumas and adversities

Childhood traumas and adversities of various kinds can have a significant impact on adult mental health and have been increasing with each younger generation (Anda et al., 2006; Sapien Labs 2023b). One possibility is that the trends of improving mental wellbeing and diminishing problems with older age of first smartphone acquisition might be related to childhood traumas and adversities, whereby these experiences determine the manner of smartphone use and subsequent mental health outcomes. Conversely, it is possible that a childhood without any traumas and adversities can protect against the negative impact of smartphones. In addition to asking about the age at which an individual first owned a smartphone, each respondent also answered questions about their experience of childhood traumas and adversities including various types of abuse, assault, neglect, parental conflict and divorce, illness, death of a parent or sibling, displacement, homelessness, and financial adversity. We therefore looked to see if the trends persisted for those who indicated that they had not experienced any of these childhood traumas or adversities (Figure 4).

Figure 4: The effects of age of first smartphone ownership in the absence of life traumas or adversities

The absence of childhood traumas or adversities such as abuse, assault, neglect, parental divorce, illness and financial hardships do not protect against the trends with age of first smartphone ownership.

The trends of increasing mental wellbeing with older age of smartphone acquisition persisted among those who had not experienced any childhood trauma or adversity.

While females who did not experience any childhood trauma or adversity had significantly better overall MHQ scores for all ages of first smartphone acquisition, the trend with respect to age of first smartphone acquisition was nonetheless similarly steep and significant. This pattern was the same for ratings of *Suicidal thoughts & intentions* (shown above) as well as *Feelings of aggression towards others*, *Sense of being detached from reality,* and *Addictions*. This was also the case for males for overall mental wellbeing (MHQ scores) and *Suicidal thoughts & intentions* (not shown but can be seen in associated data tables). Thus, while a childhood without trauma and adversity did mean better mental wellbeing as an adult, it did not protect against the impact of age of first smartphone ownership.

Insights and Interpretations

This report shows that 18–24-year-olds who acquired their first smartphone (or tablet) at each older age had, on average, better mental wellbeing, and correspondingly fewer problems with *Suicidal thoughts*, *Feelings of aggression towards others* and *Sense of detachment from reality*. This points to a cumulative effect of smartphone use in childhood on outcomes in adulthood, one that is particularly prominent for females.

We acknowledge that these results reflect population trends and correlations that do not provide definitive proof of causation. However, alternative causal explanations appear unlikely. First, although children can and do advocate for smart phones at early ages, the parents or caretakers who procure and pay for the phone or device are the ultimate decision makers in the process. It is improbable that children who are destined to have these challenges are more effective advocates for earlier smartphone procurement. A more plausible alternative is that age of first smartphone is a manifestation of differing parenting styles or household circumstances which are instead the driving cause of these results. However, this alternative also appears unlikely since these trends persist across cultures with vastly different parenting styles, as well as among those who indicate no family related traumas or adversities, including parental divorce, loss of a parent or financial adversities.

Assuming then, that smartphones are the major factor contributing to these trends, why and how would they be doing so?

Smartphones hinder development of social skills and social bonds

The problems most significantly related to the age of first smartphone acquisition such as *Suicidal thoughts*, *Feelings of aggression towards others* and *Sense of being detached from reality*, do not together align with any particular mental disorder as defined by the DSM-5. Rather, together with the diminished Social Self with younger ages of first smartphone, we suggest that these are a distinct set of challenges and symptoms that paint a picture of *increased failure to integrate appropriately into the social fabric*.

Social behavior is complex; it involves reading and decoding nuances in facial expression, body language, tone of voice, touch, and even olfactory cues to infer intent, establish connection, and build trust. As in team sports, all this must be learned. It requires repeated 'field' practice to develop mastery, and to build the relationships that provide a sense of belonging and buffer against the adversities of life. On average, the younger one gets a smartphone in childhood, the larger percentage of one's developing life is spent in a virtual world. Given the statistics of 5 to 8 hours a day spent online during childhood, we estimate that this could displace as much as 1,000 to 2,000 hours a year that would otherwise be spent in various face-to-face social interactions, learning and mastering these important skills and building strong

relationships. The virtual world eliminates important and essential enabling sensory modalities of human social interaction and bonding and is not an equivalent substitute. It can also create a distorted sense of one's social world that exacerbates its effects.

This interpretation aligns with the findings of a diminished Social Self in each younger generation (Sapien Labs 2021, 2022a, 2023a) alongside increasingly poor family relationships and friendships (Sapien Labs, 2023a). Also consistent are findings that loneliness and social disconnection are strong predictors of suicide risk (Calati et al., 2019).

It is particularly curious that females are significantly more negatively affected than males by younger age of first smartphone acquisition. Gender differences in relation to mental health and digital media use have been reported by others, and may be due to activities carried out online (e.g. boys do more gaming, girls do more social media), as well as differences in interpersonal functioning (Twenge & Martin, 2020). However, biological underpinnings cannot be ruled out and warrant further investigation.

In conclusion

These results suggest cumulative effects of smartphones obtained in childhood on mental wellbeing, which are distinct from typical symptoms of depression or anxiety. Together, these findings also describe a progressive shift of the global population toward one that has diminished social capacity and resilience, and that harbors more frequent suicidal thoughts and feelings of aggression towards others, as the average age of first smartphone acquisition becomes younger. We urge the reader to consider the implications for the future of civil society.

We will continue to explore these trends with larger datasets for greater resolution of age and geography, seeking insight into the interactions between smartphones and other cultural and environmental factors and the differences between smartphones and tablets. However, it must also be pointed out, that definitive experimental verification linking smartphone use to specific outcomes is not possible due to the ethical considerations of forcing smartphone paradigms on children, the long time-frames of study required to observe cumulative effects, and the backdrop of a rapidly evolving Internet and technology environment. We may well wait for such insight only to the detriment of future generations.

Methods

Data acquisition

Data used in this report is from the Global Mind Project (formerly the Mental Health Million Project) and was obtained between January 1st and April 30th, 2023, from 27,969 18–24-year-olds (62% females, 36% males) that were predominantly from 41 countries across North America, Europe, Latin America, Oceania, South Asia, and Africa. These respondents completed a comprehensive mental health assessment in addition to answering a question on the age at which they acquired their first smartphone (*At what age did you get your own smartphone or tablet (e.g. iPad) with Internet access that you could carry with you?*) and a question on which of various traumas and adversities they had experienced in childhood (*Did you experience any of the following during your childhood (before age 18)? Life threatening or debilitating injury or illness; Sudden or premature death of a parent or sibling; Parental Divorce or family breakup; Prolonged physical abuse, or severe physical assault; Prolonged sexual abuse, or severe sexual assault; Physical violence in the home between family members (e.g. between parents); Cyberbullying or online abuse; Prolonged or sustained bullying in person from peers; Prolonged emotional or psychological abuse or neglect from parent/caregiver; Lived with a parent/caregiver who was an alcoholic or who regularly used street drugs; Extreme poverty leading to homelessness and/or hunger; Involvement or close witness to a war; Displacement from your home due to political, environmental or economic reasons; Serious injury, harm, or death you caused to someone else; Suffered a loss in a major fire, flood, earthquake, or natural disaster; Threatening, coercive or controlling behavior by another person; Forced family control over major life decisions (e.g. marriage); Caring for a parent or sibling with a major chronic disability or illness; Parent/Caregiver/Sibling with mental illness or who committed suicide; Parent/Caregiver/Sibling went to prison; I did not experience any of the above during my childhood*; *Prefer not to say).*

The Global Mind Project acquires data from the literate Internet-enabled world through an online self-report questionnaire/assessment called the MHQ. Participants are recruited through broad targeting of populations in each age-gender group across 65+ countries in 9 languages through advertising on Facebook and Google. Individuals take the MHQ for the purpose of obtaining their mental wellbeing scores along with a detailed report offering self-help guidance. Presently ~2,000 people complete the assessment each day and are added to a dynamic database. The MHQ is freely available online, is anonymous, and takes ~15 minutes to complete.

In addition to the scored questions on mental health and function, respondents answer various demographic, lifestyle, and life experience questions. Questions relating to age of first smartphone acquisition and other aspects of Internet use were added in January 2023. The Global Mind Project database is freely available to researchers in nonprofit and government organizations for noncommercial purpose. Access can be requested here.

The Global Mind Project is a public interest project that has ethics approval from the Health Media Lab Institutional Review Board (HML IRB), an independent IRB that provides assurance for the protection of human subjects in international social and behavioral research (OHRP Institutional Review Board #00001211, Federal Wide Assurance #00001102, IORG #0000850).

The MHQ

The MHQ is a unique comprehensive assessment of mental wellbeing comprised of 47 elements of mental function including both positive assets of mental function, and problems that span the symptoms of ten major disorders (Newson & Thiagarajan, 2020).

Within the MHQ, respondents rate each of these 47 items using a 9-point life impact scale reflecting the impact on one's ability to function. For the items on a spectrum from positive to negative (spectrum items such as self-image), the rating scale is defined as follows: a 1 rating on the 9-point scale refers to *Is a real challenge and impacts my ability to function*, the 9 rating refers to *It is a real asset to my life and my performance,* and the 5 rating refers to *Sometimes I wish it was better, but it's ok*.

For the items with varying degrees of problem severity (problem items such as suicidal thoughts): the 1 rating on the 9-point scale refers to *Never causes me any problems*, the 9 rating refers to *Has a constant and severe impact on my ability to function,* and the 5 rating refers to *Sometimes causes me difficulties or distress but I can manage*. Respondents rate these elements based on their current perception of themselves.

The MHQ score is an aggregate score of mental wellbeing calculated from these 47 elements, and positions individuals on the spectrum from *Distressed* to *Thriving*, spanning a possible range of scores from −100 to +200. Negative scores indicate a mental wellbeing status that has significant negative impact on the ability to function (i.e. a status of distressed or struggling). It also provides sub-scores across 6 broad functional dimensions. The MHQ score has been demonstrated to relate systematically to functional days lost (Newson et al., 2022), and to clinical burden, such that 89% of those with scores in the distressed range had symptom profiles that aligned with at least one of 10 DSM-5 defined disorders (Newson et al., 2022).

Dimensional scores are aggregate scores constructed from subsets of the 47 items in the assessment using the same scale as the MHQ and similar principles. For instance: Social Self includes ratings of elements such as *Self-image*, *Self-worth & confidence*, *Relationships with others*, and *Social interaction & cooperation* as well as problems such as *Feeling of aggression towards others* and *Suicidal thoughts & intentions*. Mood & Outlook includes ratings of asset items such as *Stability & calmness*, *Emotional control,* and *Outlook & optimism* as well as problem items such as *Fear & Anxiety*, *Feelings of sadness, distress or hopelessness* and *Mood Swings*. Adaptability & Resilience includes ratings of items such as *Adaptability to change*, *Emotional resilience*, *Creativity & problem solving,* and *Ability to learn*.

Data exclusion criteria

Only those respondents who stated that they found the MHQ easy to understand were included in the analysis. This exclusion criterion was applied by only selecting respondents who answered "Yes" to the final question in the MHQ which asks them "Did you find this assessment easy to understand?". Also excluded were those assessments completed in under 7 minutes (the minimum time needed to read and respond to the MHQ), and those where response ratings had a standard deviation of less than 0.2, indicating that the same rating value was selected across all 47 rating items. Also excluded were those responses where the age of first smartphone access was selected as an older age than age of first smartphone ownership.

Data analysis and statistics

Average MHQ scores, dimensional scores, and average ratings for each of the 47 problems and mental capabilities assessed, were calculated separately for females and males for each age of first smartphone acquisition for the global data in its entirety (27,969 18-24-year-olds, 17,406 females, 10,050 males). These same averages were also calculated for four regional groupings: Core Anglosphere & Western Europe (*N* = 2,268 females, 1,269 males), Latin America (*N* = 7,061 females, 4,541 males), South Asia (*N*= 2,956 females, 1,360 males) and Africa (*N*= 3,325 females, 1,795 males). Global averages are shown in the main report while regional averages are shown in the Appendix.

Graphs show average values for each age of first smartphone acquisition or ownership from age 6 to age 18 joined together into a line. Data shown in this report reflect global trends with the largest magnitudes and most significant p-values (typically <0.001) determined by multiple statistical assessments of trends as described below, that are also generally significant across multiple regions.

All data and statistics associated with the graphs are shown in the associated data tables. While we do not provide a country wise break-up due to the insufficiency of data across all ages of smartphone acquisition for each country/language group, we show trend statistics for three individual countries (United States, India, and Mexico) in the associated data tables. A country wise analysis and comparison will be possible by the year's end as more data becomes available.

Associated data tables show

1. Sample sizes as well as averages and standard deviations for the MHQ, each dimensional score, and ratings of each of the 47 elements

2. Bonferroni corrected p-values using a standard t-test between each age of smartphone acquisition for each of the scores and ratings in the associated statistical tables

3. Population trend statistics (including slopes, R^2 values, and p-values of the mean trends) calculated

using multiple methods of trend estimation including the Thiel-Sen estimator, linear regression using the ordinary least squares (OLS) method, as well as logarithmic fits using the least squares (OLS) method, and

4. Pearson's correlations of the raw data and associated p-values.

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Appendix

Here we provide a graphical view of the trends shown in this report for each of four regional groupings: the Core Anglosphere & Western Europe, Latin America, South Asia, and Africa. Countries contributing to 98%+ of the data associated with these regions are shown in the following table:

Regional Group	Languages	Countries Represented
Core Anglosphere + Western Europe	English, French, German, Spanish, European Portuguese	United States, Canada, United Kingdom, Australia, New Zealand, Germany, France, Belgium, Spain and Portugal
Latin America	Spanish, Brazilian Portuguese	Argentina, Brazil, Colombia, Chile, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Paraguay, Peru, Uruguay, Venezuela
South Asia	English, Hindi	India, Bangladesh, Pakistan
Africa	English, Swahili, French, Arabic	Nigeria, South Africa, Tanzania, Kenya, DR Congo, Mozambique, Angola, Côte d'Ivoire, Cameroon, Egypt, Algeria, Morocco

Regional trends are shown relative to the global average for each of the graphs presented in the report. *N* values and trend statistics can be seen in the associated data tables. South Asia had insufficient data for ages of first smartphone < 12 (< 20 records across bins for females and males which was < 1% of the sample). These age points are therefore excluded for this region.

For females, trends of overall mental wellbeing (*MHQ*), *Social Self* and the top five problem areas of *Suicidal thoughts*, *Feelings of aggression towards others*, *Sense of being detached from reality*, *Hallucinations* and *Addictions* were all directionally highly consistent across regional groups.

For males, the trends were generally weaker at a global level and were consistent for overall *MHQ* and *Social Self* for the Core Anglosphere & Western Europe as well as Latin America but less apparent for South Asia and Africa. However, the key problems of *Suicidal thoughts* and *Feelings of aggression towards others* were directionally consistent across regions, though weakest for South Asia.

Figure A1: Regional mental wellbeing scores as measured by the Mental Health Quotient or MHQ by age of first smartphone in 18-24 year olds

Figure A2: Social Self scores by age of first smartphone in females 18-24

Figure A3.1 (part 1): Regional ratings of problems by age of first smartphone in females 18-24

Figure A3.1 (part 2): Regional ratings of problems by age of first smartphone in females 18-24

Figure A3.2: Regional ratings of problems by age of first smartphone in males 18-24