



FAMILIES AND TECHNOLOGY

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ACKNOWLEDGEMENT

We gratefully acknowledge the feedback of Dr. Dena Al-Thani, PhD, Hamad Bin Khalifa University, who helped us to improve the report.

ABSTRACT

One of the global megatrends, technology influences how people live, develop, communicate, and work. Considering that the family is the primary nurturing institution for the youngest generations, it is essential to explore how the technology megatrend impacts families. Although technological changes represent a worldwide trend, regional differences are present and acknowledged in this report.

Families are particularly influenced by assisted reproductive technology, communication technology, assistive technology, digital interventions, telehealth, and telecommuting. These four technology-related areas impact family formation, family members' health and well-being, education, and employment in different ways, creating both risks and benefits. New ways of accessing parenthood, new forms of communication, increased access to health services, both positive and negative effects on physical and mental health, changes in education, risks related to privacy, and modifications in job activities and the balance between work and family time are some of the technology-related outcomes described in this report.

The relationship between these four technology-related areas and their outcomes can be moderated by access to technology, digital competencies, and parenting skills to oversee children's use of technology. These moderators determine how families integrate new technologies into their daily lives, facilitate the effective and responsible use of digital tools, and protect family members from technology-related risks.

To use technology effectively and positively to improve family members' lives, policymakers across the world are adopting different strategies. This report illustrates some active policies already implemented in various countries and provides policy recommendations, along with practical actions that policymakers could adopt to respond to technology-related challenges.

Keywords: Technology, families, megatrend, technological changes, family well-being, family characteristics.

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DOI: https://doi.org/10.5339/difi_2025_9789999999995



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EXECUTIVE SUMMARY

The use of technology and the internet has reached enormous dimensions globally, growing significantly over the years, especially after the COVID-19 pandemic. In 2023, data showed that there were 5.35 billion internet users and 5.04 billion social media users. On average, people spend 6.4 hours per day connected online or using technologies, with the youngest generations being the most frequent users.

Given the widespread use of technology, it is crucial to explore its impact on individuals worldwide, with a particular focus on families. Using a rapid review, this report discusses various aspects of technology and its impact on family members, highlighting the most recent findings.

To better understand how technology changes families across the world, this report recognizes that the definition of family can be challenging, as family arrangements and characteristics vary widely across countries and regions. For the purposes of this report, the family is considered an institution representing society's foundational building block—the initial environment where individuals are born, mature, develop, and acquire knowledge, emotional fulfillment, support, and a sense of identity.

Globally, families are impacted by four technology-related areas: Assisted Reproductive Technology (ART), Communication Technology, Assistive Technology, Digital Interventions and Telehealth, and Telecommuting and Remote Work.

Assisted Reproductive Technology (ART) is closely connected to rising infertility rates and is often characterized by difficulties and psychological distress for couples undergoing ART, though studies show adequate physical, cognitive, and psychological development in ART-born children. ART is changing how people transition to parenthood. Policymakers should develop structured and consistent regulations for ART and promote global access to ART, making it financially accessible and providing support for those involved.

Communication technology, which includes a variety of devices, software, and applications (e.g., smartphones, AI, gaming), allows people to communicate quickly and efficiently. Although communication technology is often used for positive purposes (e.g., work), it also brings risks, such as online exploitation, particularly for children and older individuals. Policymakers should develop strategies to protect users from online risks and establish clear regulations to create safe online environments.

Access to and deployment of **assistive technology, digital interventions, and telehealth** have grown substantially, especially after COVID-19. These technologies have the potential to provide billions of people with access to healthcare that might otherwise be inaccessible. Policymakers should consider integrating digital interventions and telehealth into existing health systems to broaden access, invest in expanding internet

availability where needed, and support individuals who require assistive technology.

Telecommuting and remote work have seen rapid growth globally. While existing evidence indicates that telecommuting generally leads to higher job satisfaction, it remains unclear whether it improves work-life balance. Policymakers should prioritize passing legislation that protects the rights of remote workers, invest in skill development and retraining programs, and strengthen social safety nets for those left behind in the transition.

Several factors influence how technology affects family members. Among these, access to technology varies globally, with different barriers limiting the use of ART, communication technology, assistive technology, and telehealth. Other moderating factors include digital competencies and parenting actions, which can facilitate or hinder effective use of technology.

Policymakers could develop common regulations for ART, promoting global and financially accessible ART and support for individuals involved. Regarding communication technology, they could implement strategies to protect children in digital spaces, build online literacy and safety, encourage collaboration across sectors for AI development, and create regulations to prevent location-tracking for wearable technology. For assistive technology, digital interventions, and telehealth, policymakers could improve access, create awareness programs, and reduce sociocultural barriers. Lastly, for telecommuting and remote work, they could address labor market disruptions, invest in lifelong skill development, bridge the digital divide, protect various forms of employment, and enhance social protection systems.

INTRODUCTION

Global megatrends are macroeconomic and geo-strategic transformative forces shaping our world and future in profound ways. They affect multiple sectors of society, economy, politics, and culture, changing how people live, receive medical treatment, work, consume, interact, and participate in their societies. In September 2020, a report for the UN's 75th Anniversary titled "Shaping the Trends of Our Time" identified four megatrends: climate change, demographic shifts, urbanization and migration, and changes in digital technologies. The UN report highlights that these megatrends are closely interconnected, meaning that changes in

one or two could influence all the others. Demographic trends, urbanization, and technological changes are inevitable processes, deeply tied to human evolution and history. On the other hand, climate change, environmental crises, and wars represent global policy failures that urgently need to be addressed. In exploring these megatrends, it is essential to understand how these transformative forces impact individuals within their families. The focus on families is crucial since they are the primary institutions responsible for procreation, nurturing, and caring for the youngest generations—the adults of the future.

Although these four megatrends are interconnected, this report will focus on technological changes over the past decade and their impact on individuals, particularly within the family system. Technology has rapidly evolved in the last ten years, becoming an integral part of daily life and affecting a wide range of areas and activities, from online payments to artificial intelligence and autonomous vehicles. The role of technology has become even more central following the COVID-19 pandemic, as it helped overcome the limitations imposed by the pandemic. Technology is already transforming the sustainability of food production, population growth, labor markets, economic and industrial productivity, and education. It has also changed how people perceive themselves and others, develop cognitive, social, and emotional skills, explore their social environments, and communicate with family, peers, and romantic partners. These technological advancements present challenges for individuals (e.g., the risks of excessive screen time for children), families (e.g., lack of parental control over internet use), and societies (e.g., the need for new privacy laws and regulations).

Today, technology is an integral part of family life, with several implications for how family members live and interact. Technological advances have increased longevity, well-being, reproduction options, communication, and job characteristics. For example, technology has introduced new ways to become parents (e.g., through reproductive technologies) and has improved aging, longevity, and life expectancy through medical interventions. This has resulted in prolonged coexistence between younger and older generations, fostering either intergenerational support or potential conflicts. Technology has also created new forms of communication between parents and children (e.g., via smartphones and Zoom), new opportunities for families dealing with clinical conditions (e.g., using screens to help children with communication disorders), and new ways to navigate work and employment (e.g., the option for parents to work from home).

The current report will explore all the aspects related to technology and its impact on family members, highlighting the most recent findings on the following technology-related topics. Specifically, this report identifies **predictors** of the technology

megatrend in families, **outcomes** of the technology megatrend for families, and **moderators** that influence the impact of the technology megatrend on families. The United Nations (2020), the Doha International Family Institute, and the Qatar Foundation (Doha International Family Institute, 2024) have identified four key areas where the technology megatrend has significantly impacted families. These areas form the focus of this report: **(1) fertility and assisted reproductive technology (ART), (2) communication technology, (3) assistive technology, digital interventions, and telehealth, and (4) telecommuting and remote working.**

Figure 1 summarizes these topics, highlighting which family members are affected and some themes the report will explore. Figure 2 presents the **predictors, outcomes, and moderators** in a conceptual model that guided this report. As mentioned earlier, **predictors** of the technology megatrend in families include increased use of ART, assistive technologies, communication technologies, and telecommuting/remote work technologies. Each of these predictors increases the integration of technology into families' daily lives.

This increased integration of technology leads to several **outcomes** that affect families, including changes in family formation, health and well-being, privacy risks, and family members' job characteristics. The extent to which these predictors drive outcomes depends on several key moderators. These **moderators** are characteristics that influence the strength of the impact of the technology megatrend on families. Key moderators include family access to technology, family members' ability to learn how to use technology, and parenting practices in the digital age.

By examining these predictors, outcomes, and moderators of the technology megatrend's influence on families, we aim to provide scientists, clinicians, and policymakers with a comprehensive understanding of how technology is impacting families globally. We conclude the report by discussing existing policies and making policy recommendations to enhance the positive effects of the technology megatrend on families.

Figure 1: Possible uses of technology within families and their implications.

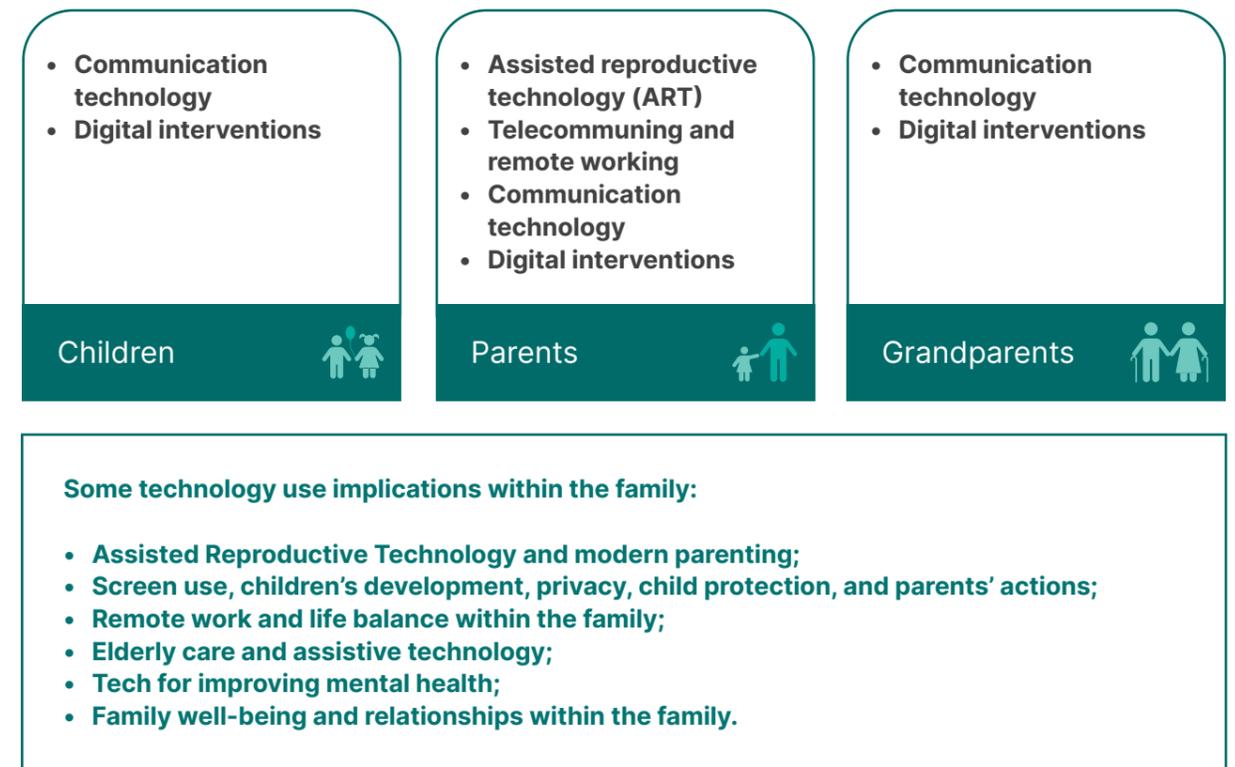
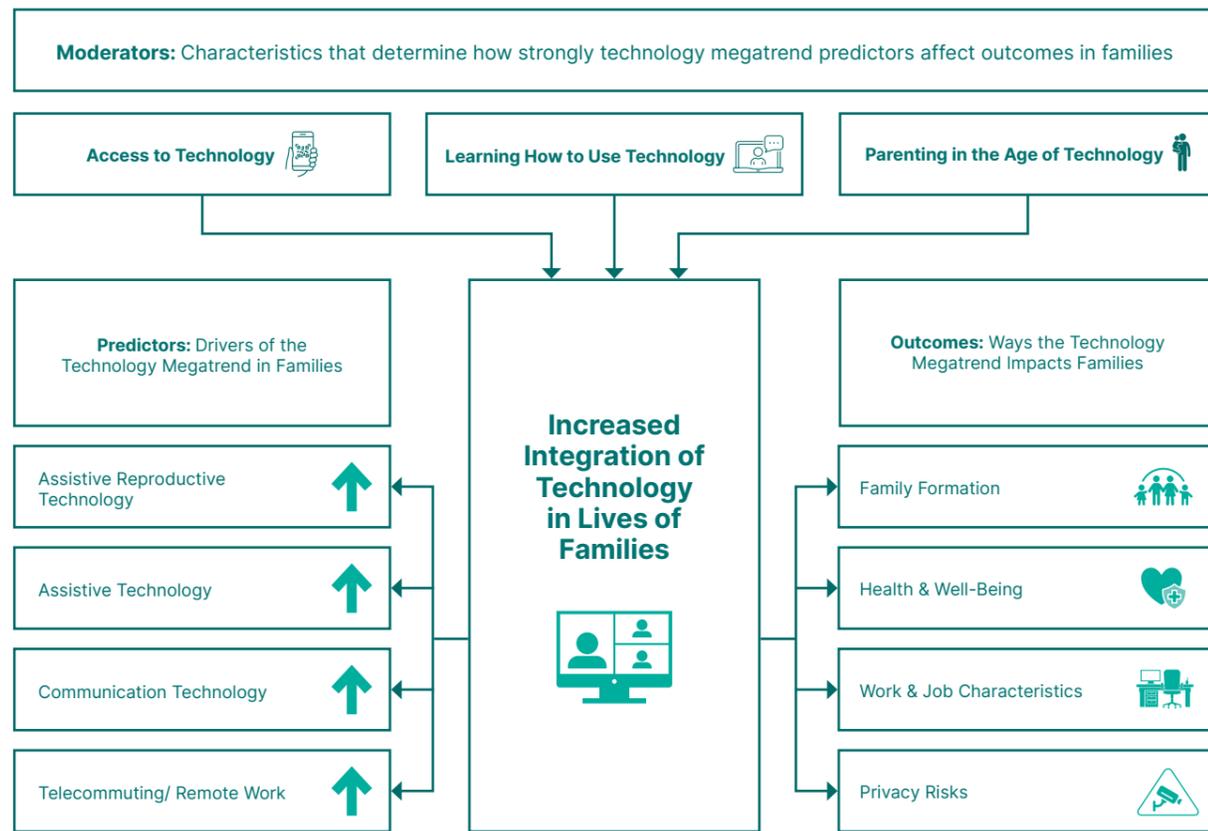


Figure 2: A Conceptual Model of The Technology Megatrend's Impact on Families



2.1

Why Explore the Technology Megatrend? Insights from Data

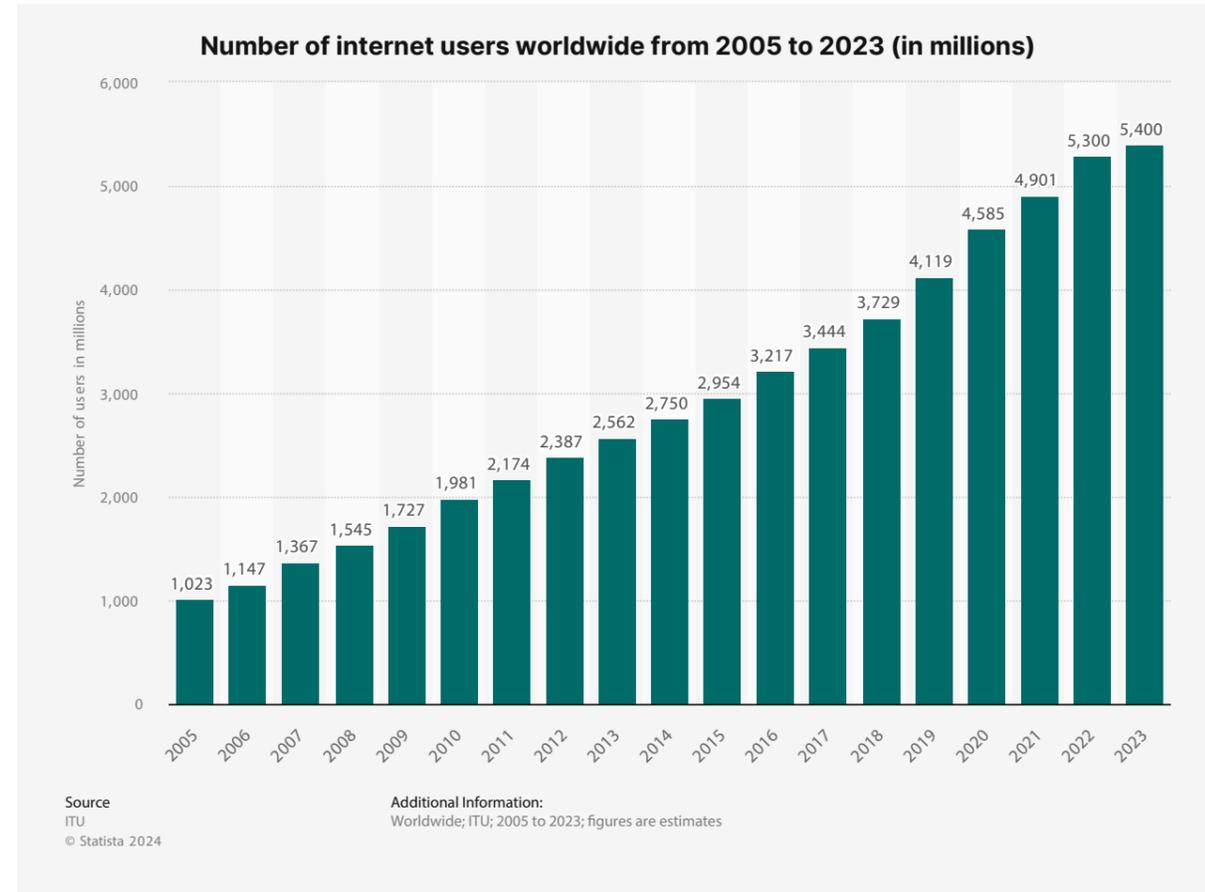
Technology and the Overall Population

The use of technology and the internet has grown exponentially worldwide, increasingly shaping the everyday lives of millions. As shown in **Figure 3**, global internet users in 2023 reached 5.35 billion, compared to just 2.56 billion ten years ago, in 2013. Social media users totaled 5.04 billion, with the most popular platforms being Facebook (3.049 billion monthly users), YouTube (2.491 billion monthly users), WhatsApp (2.883 billion monthly users), Instagram (2.000 billion monthly users), and TikTok (1.562 billion monthly users). On average, people spend 6.4 hours per day online or using technology. The primary reasons for this include seeking information, connecting with friends and family, watching videos, listening to music, staying updated with news, learning new skills, finding inspiration, and studying. In December 2023 alone, the volume of online activity was staggering: \$398 million traded in treasury bonds, 241 million emails sent, 41.6 million WhatsApp messages exchanged, 6.3 million Google searches, and 4 million Facebook posts every minute, globally.

A recent study by the Pew Research Center (2022-2023) analyzed technology and internet use across 27 countries (including Argentina, Belgium, Brazil, Canada, France, Germany, Greece, Hungary, India, Indonesia, Israel, Italy, Japan, Kenya, Malaysia, Mexico, Netherlands, Nigeria, Poland, Singapore, South Africa, South Korea, Spain, Sweden, the UK, and the US). The data shows that, in most of these countries, the majority of adults are online, although there are significant variations—for instance, 99% of adults in South Korea use the internet or own a smartphone, compared to just 57% in India.

According to Statista data for 2023, China has the largest digital population, with 73.7% of its citizens having internet access, followed by India with 48.7%. Among the top 25 countries with the largest digital populations, 44% (11 countries) are from the Asia-Pacific region, 28% (7 countries) from Western Europe and Other States (e.g., Australia, Canada, Israel, New Zealand, and the USA), 12% (3 countries) from Latin America and the Caribbean, 8% (2 countries) from Africa, and 8% (2 countries) from Eastern Europe. Northern Europe has the highest internet penetration rate (97.3%), while Southern Asia remains the most disconnected region. Additional data are presented in **Tables 1 and 2**.

Figure 3: Pattern of change in internet use worldwide in the last thirteen years.



Source: Statista 2024, <https://www.statista.com/statistics/273018/number-of-internet-users-worldwide/>

Table 1: Technology demographics by January 2024

Most time online countries	Lowest internet penetration rate countries (percentage of people not using internet)	Strongest technology surveillance countries (millions of people surveilled)
40% (n=10) Asia Pacific States	North Korea (99.9%)	China (1,439.3)
20% (n=5) Latin American and Caribbean States	Central African Republic (89.4%)	India (1,380)
16% (n=4) Eastern European States	Burundi (88.7%)	Pakistan (220.9)
16% (n=4) Western European and Other States	South Sudan (87.9%)	Brazil (212.6)
8% (n=2) African States	Niger (83.1%)	Nigeria (206.1)
	Afghanistan (81.6%)	Russia (145.9)
	Ethiopia (80.6%)	Iran (84)
	Burkina Faso (80.1%)	Thailand (69.8)
	Madagascar (79.4%)	Myanmar (54.4)
		Sudan (43.8)

Source: Statista, 2024, <https://www.statista.com/statistics/273018/number-of-internet-users-worldwide/>

Table 2: Gulf Arab States' use of the Internet by January 2024

State	Internet users*	Social media users*	Internet penetration
Bahrain	1.48	1.45	99 %
Kuwait	4.29	4.5	99 %
Oman	4.58	3.97	97.8 %
Qatar	2.70	2.60	99 %
Saudi Arabia	36.84	35.10	99 %
United Arab Emirates	9.46	10.73	99 %

* Expressed in million
Source: Datareportal, <https://datareportal.com>

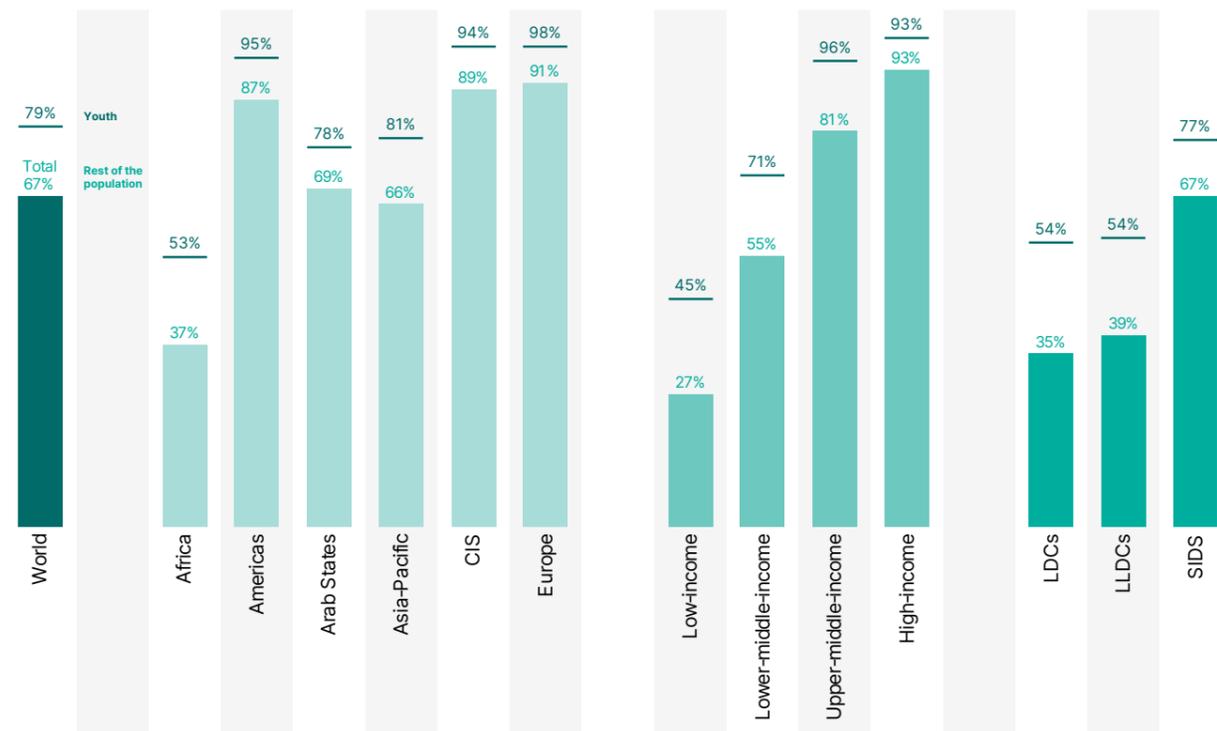
Technology and the youngest

The widespread use of the internet and technology in 2023 is particularly prevalent among younger generations. Globally, 79% of individuals aged

15 to 24 are internet users, compared to 65% among the rest of the population. This creates a 14% gap in internet usage between younger people and the broader population (see **Figure 4**).

Figure 4: Pattern of internet use worldwide by age group: The dark blue line represents the percentage of youth using the internet, while the light blue columns represent the percentage of the overall population using the internet.

Percentage of individuals using the Internet by region, 2023



Source: ITU, <https://www.itu.int/itu-d/reports/statistics/2023/10/10/ff23-internet-use/>

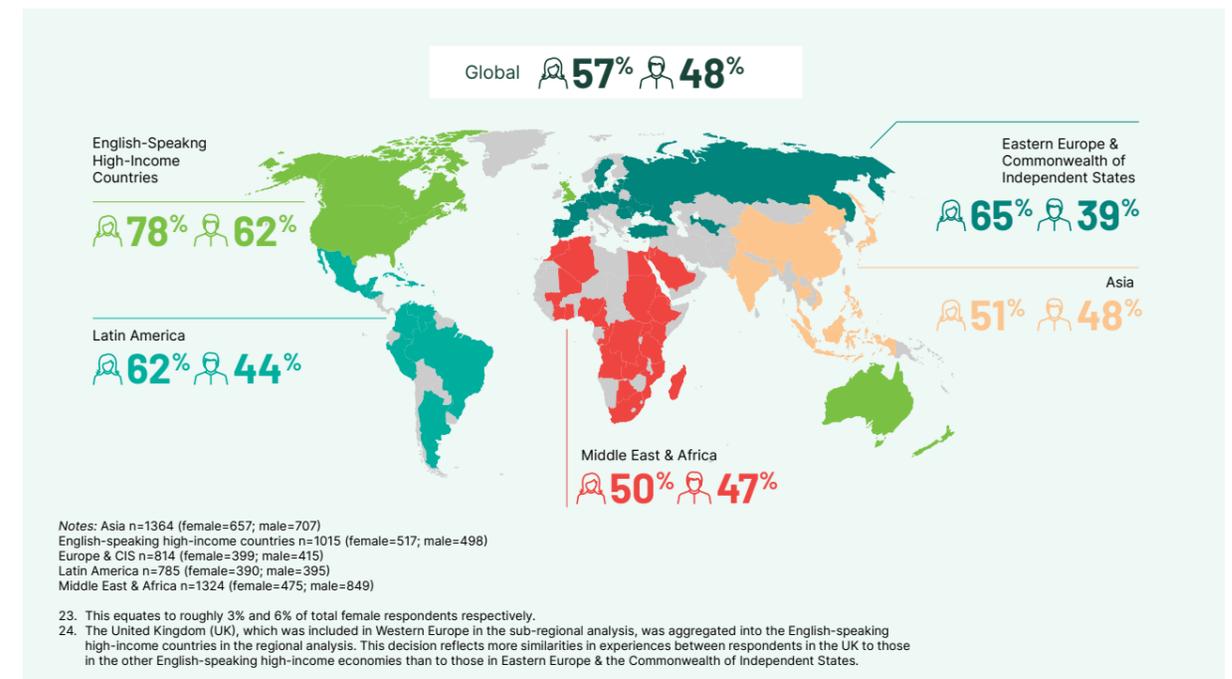
Most young people primarily use the internet to access social media, with 38% of teenagers worldwide spending more than 8 hours on social media daily, while only 6.10% spend less than an hour. Among the various platforms, the most popular among teens are Facebook, YouTube, Instagram, and TikTok, which they primarily use for entertainment (e.g., finding funny posts, memes), following trends, watching sports, gathering and sharing information (e.g., reading the news), and socializing (e.g., meeting new people).

consent), and 1.5% were victims of online solicitation or grooming (e.g., receiving unwanted sexual solicitation online).

However, going online comes with risks for children and adolescents. A report from *Disrupting Harm*—a large-scale research project on online child sexual exploitation and abuse across 13 countries in Africa and Asia—highlighted that in 2022, between 1% and 20% of children were subjected to online sexual exploitation and abuse, particularly on social media, with many not disclosing their experience to anyone. A report by the World Health Organization (2022) detailed the most common risks for children, teens, and adolescents using technologies. It revealed that 15% of children experienced cyberbullying, 11% had their digital identity stolen, 8% were subjected to non-consensual sexting or sexual extortion (e.g., having a self-made sexual image shared without

In 2022, the Internet Watch Foundation (IWF) identified 255,588 web pages containing or advertising child sexual abuse imagery. Most of these images (68%) depicted children aged 11-13, followed by 36% featuring children aged 7-10, with girls making up 96% of the victims in every age group. Additionally, in 2021, *WeProtect Global Alliance* conducted a global survey of 18-20-year-olds about their online childhood experiences. Participants were asked if they had experienced any of the following online sexual harms: (1) being sent sexually explicit content by an adult (known or unknown), (2) being asked to keep a sexually explicit online relationship with an adult secret, (3) having sexually explicit images of themselves shared without consent, or (4) being asked to perform uncomfortable sexual acts online. A significant 54% of respondents reported experiencing at least one of these harms, with incidents primarily originating from private messaging services, and the average starting age for such experiences was 12.7 years. Figure 5 shows respondents' experiences by region and gender.

Figure 5: experiences of online sexual harm by gender and world region



As for possible actions and responses to protect against online sexual harm or dangerous experiences, participants in the *WeProtect* survey reported various strategies: 59% deleted or blocked the person asking for sexual images or texts, 32% asked the person to stop contacting them, 30% changed their privacy or contact settings, 28% reported the problem online, and 23% spoke to a trusted adult or peer.

Other potential protective measures include ensuring children and adolescents have access to responsible adults who are aware of online risks and ready to help in case of harm, the ability to recognize messages or content potentially linked to dangerous sources, and awareness of harmful sexual interactions online. The protective role of parents is crucial in preventing online and digital risks for children. However, a recent survey (2021) revealed that while 84% of parents are concerned about their children's online safety and screen time, they only spend an average of 46 minutes discussing online security with them. For this reason, programs and policies are necessary to strengthen parental monitoring and control of children's online activities.

Technology and the family: an introduction

Technology is clearly a central part of everyday life for families worldwide. Although the widespread use of the internet and technology among younger populations began before the COVID-19 pandemic, lockdowns, school closures, the adoption of online learning, and reduced social contact significantly increased the amount of time young people spent online. This shift transformed traditional practices and exposed potentially problematic aspects, such as privacy risks for children using technology and the role of parents in safeguarding them.

Changes related to COVID-19 affected families globally. In the first months of 2020, an estimated 2.59 billion youths aged 0-19 were affected by the pandemic, with school closures in 193 countries impacting more than 1.59 billion students (Ridder et al., 2021). As technology became the only way to purchase food or necessary items, work, learn, and stay connected with friends and family, it shifted from being an important part of life to an essential one. People began using digital tools more intensively than ever before, often spending nearly all their time online. This shift was so significant that terms like "Zoom fatigue" and "Zoom exhaustion" emerged to describe the exhaustion caused by prolonged video conferencing and online lessons (Wiederhold, 2020).

These changes affected children, adolescents, and adults differently and required new actions from policymakers. The characteristics and evolution of technology are deeply connected to family dynamics and how families function.

METHODOLOGY

The research for this report involved a wide-ranging literature review on technology characteristics, changes, and their impact on various aspects of family life, with a specific focus on parents, children, and grandparents. We utilized a rapid review approach to prepare this report, aiming to provide readers with a comprehensive and rigorously evidence-based perspective on the topic.

We primarily selected literature from a ten-year timeframe to focus on the most relevant and recent technological changes that have significantly affected family members' lives and well-being. This period was chosen strategically, as the 2010s marked the rapid growth and widespread adoption of smartphones, which have since become integral to daily life, particularly during and after the COVID-19 pandemic, when technology was crucial for overcoming pandemic-related limitations.

The preparation of this report involved several stages. Following the primary research areas highlighted in the Info Note for the Global Conference organized by the Doha International Family Institute (DIFI) and entitled *Family and Contemporary Megatrends*, we reviewed the most relevant technology-related themes explored in the literature. Before drafting the report, we also developed a table of contents, which was reviewed by the DIFI project team. Weekly meetings were held to discuss the literature, assign tasks, and update team members, and periodic meetings with the other megatrend report teams were organized to coordinate efforts.

The rapid literature review was conducted in the following steps:

- After an initial assessment of the volume of available literature, we specifically targeted international systematic reviews published in English. We used Google Scholar, Scopus, Web of Science, and APA PsychINFO as the databases for our literature search.
- We included research papers, government reports, and grey literature in this report. For research papers, only peer-reviewed manuscripts were included, with a strong preference for systematic reviews, published between 2014 and 2024, that addressed technology and technological changes in general and in relation to family (including children, parents, and grandparents). Given the extensive literature on the effects of technology on individuals and families, we focused on reviews (systematic reviews, meta-analyses, and other literature reviews) and occasionally on single studies if they were particularly significant (e.g., highly cited works). Keywords related to technology (e.g., “Technology,” “Artificial intelligence,” “Digital interventions,” “Communication technology,” “Assisted reproductive technology”) and family health and developmental outcomes (e.g., “Health,” “Mental health,” “Child development,” “Parenting,” “Family structure”) were used in the search.

- In addition to scholarly publications, data were drawn from reports of major international organizations and surveys, including, but not limited to, the American Psychological Association (APA), European Union (EU), Gulf Cooperation Council (GCC), Pew Research Center, UNICEF, United Nations, U.S. Department of Health and Human Services, and World Health Organization (WHO).

All these steps were conducted using a methodical and scientific approach, guided by the core standards and principles of a systematic review (e.g., comprehensive search strategy, respect for original research, and intellectual property). Despite the rapid review process due to time constraints, we adhered to these principles. These methodological steps led to the creation of a preliminary draft of this report. The DIFI project team and Dr. Dena Al-Thani, PhD, from Hamad Bin Khalifa University, reviewed the initial draft and provided valuable feedback and suggestions, which were incorporated to produce the final version of the report.

CONNECTIONS

BETWEEN TECHNOLOGY AND FAMILY

2.1

Definition of technology

It is challenging to provide a single, comprehensive definition of technology. Broadly, technology can be defined as the application of scientific knowledge to the practical aims of human life and the alteration and manipulation of the human en-

vironment. It represents the study and practical use of scientific discoveries across various fields, including industry, transportation, healthcare, business, energy, and communications.

However, technology can be analyzed and defined through many different lenses, reflecting various perspectives, settings, and characteristics. It can be viewed in terms of artifacts, knowledge, applied science, and much more. Here are six definitions of technology that help illustrate its complexity (Nightingale, 2014, pp. 6-19):

1. **“Technologies are entities that produce artificial functions.”**
2. **“Technologies are entities produced by a problem-solving process that changes and transforms the world to match a preconceived idea, plan, or design, generating a desired artificial function.”**
3. **“Technologies comprise artifacts that generate artificial functions, techniques, and the broader institutional frameworks required for their operation.”**
4. **“Technology is the outcome of a distributed, co-evolutionary process where functions, knowledge, artifacts, and their environment mutually adapt to one another.”**
5. **“Technology encompasses all the knowledge, concepts, experimental processes, tangible and intangible artifacts, and broader socio-technical systems needed to recognize technical problems, and to conceptualize, formulate, research, develop, test, apply, disseminate, and maintain effective solutions as they evolve over time.”**
6. **“Technology covers the artifacts, systems, knowledge, and activities associated with the development, production, and use of artificial functions, which have been enabled by the convergence of science and industrial production and the shift from machinery to systems.”**

Although technology has played an essential role in human society since the 1760s with the invention of the steam engine, the unprecedented pace of transformations over recent decades has led to the concept of the Fourth Industrial Revolution (4IR). Coined in 2016, 4IR refers to the digital revolution that began in the 1960s and 1970s with

the advent of electronics, information technology (IT), and automated production. In recent years, however, innovation and change have accelerated dramatically.

The 4IR is characterized by a fusion of technologies that blur the boundaries between the physical, digital, and biological spheres (Philbeck & Davis, 2018). It is also distinguished by digital technologies that are self-executing, self-monitoring, and self-organizing, capable of completing predetermined and complex tasks autonomously (Philbeck & Davis, 2018). This revolution has transformed various aspects of human life and society (Philbeck & Davis, 2018).

In recent times, we have witnessed rapid advancements in big data (Kitchin, 2021), machine learning (Bini, 2018), artificial intelligence (Collins et al., 2021), the internet, and cloud computing (Sunyaev & Sunyaev, 2020). These technologies are numerous (see Table 1 for descriptions of the most relevant technologies discussed in this report) and have immense potential for future development. They are capable of directing, regulating, and controlling themselves, are easy and quick to use, and can assist users in multiple ways. For example, artificial intelligence (AI), one of the most widely discussed recent technological advancements, is characterized by its abilities in learning and adaptation, problem-solving, natural language processing, perception, automation, data handling, parallel processing, continuous learning, autonomous decision-making, and human-machine interaction.

These capabilities enable AI to perform a variety of tasks, such as analyzing images through algorithmic inspection (allowing for autonomous vehicles), translating spoken words into text (enabling speech recognition), creating computer-controlled motions of objects (permitting the construction of robots), and simulating human problem-solving behaviors (helping researchers predict intervention outcomes). AI can also model various anatomical and biomechanical functions of the human body, facilitating the development of rehabilitation devices (Barredo Arrieta et al., 2020).

Table 1. Glossary of technology and its impact on family (i.e., predictors, outcomes, moderators, and mediators).

Technology type	Definition
Artificial Intelligence (AI)	Technology that enables computers and machines to simulate human intelligence and problem-solving capabilities. AI encompasses a wide range of applications, including digital assistants (like Siri and Alexa), GPS guidance systems, autonomous vehicles, and generative AI tools such as OpenAI's ChatGPT.
Big data	Extremely large datasets with dimensions and complexities that exceed the capabilities of traditional database systems. These datasets are so vast, fast-moving, or intricate that they cannot be processed effectively using conventional methods.
Information and communication technology (ICT, also called “communication technology”)	Set of technological tools and resources used to transmit, store, create, share, exchange, or communicate information. ICT includes computers, the internet, live and recorded broadcasting technologies (e.g., television, podcasting), and telephony (e.g., fixed or mobile phones, satellite, videoconferencing).
Internet	Global computer network (a “network of networks”) based on the TCP/IP transmission standard. The internet operates independently of platform and operating system and includes the World Wide Web (WWW) and email.
Internet of things (IoT)	Internet-enabled devices that collect and share data, with potential applications in areas like smart homes, smart cities, and industrial automation.
New technologies	Digital technologies powered by the internet, which may include computing, big data, and artificial intelligence.
Robots	Programmable machines that can interact with the environment and people in autonomous or semi-autonomous ways, using sensors.
Social media	Digital platforms that allow sharing ideas and information, including text and visuals, through virtual networks and communities. Popular examples include WhatsApp, Facebook, Instagram, and TikTok.
Virtual reality (also called “metaverse”)	The use of computer modeling and simulation that enables a person to interact with an artificial 3D visual or sensory environment, often through a visor. VR allows users to interact with computer-generated environments and other users.
Wearable technology (also called “wearables”)	Electronic devices worn as accessories, embedded in clothing, implanted in the body, or tattooed on the skin. Examples include smartwatches, web-enabled glasses, and Bluetooth headsets.

Assisted reproductive technology (ART)	Fertility treatments where eggs or embryos are handled. Most ART procedures involve surgically removing eggs from a woman's ovaries, combining them with sperm, and returning them to the body or donating them. ART does not include treatments where only sperm are handled or medicines to stimulate egg production.
Assistive technology (also called "supporting technology")	Technology used by individuals with disabilities to perform tasks otherwise difficult or impossible. Examples include wheelchairs and software for communication in cases of severe disability.
Digital interventions	Technologies that improve users' mental and physical health. Examples include using virtual reality to reduce depression and anxiety in adolescents.
Sharenting	Parents sharing information, pictures, or videos of their underage children online, typically on social media.
Telecommuting (also called "remote work")	The practice of working from home using technologies to perform job duties.
Telehealth	The use of communication technologies to provide healthcare at a distance. Examples include smartphone apps to monitor health status or teleconsultations with healthcare professionals.
Cyberbullying	Acts of bullying that take place over digital devices, such as text messages, apps, social media, or content-sharing platforms. Cyberbullying involves sending, posting, or sharing negative or harmful content about someone, often causing embarrassment or humiliation.
Digital acceptance	How information gathered through digital means is perceived and interpreted by users.
Digital addiction	Also called internet addiction (IA), it refers to a behavioral inability to control internet or social media use, leading to harmful dependence on digital media and devices.
Digital divide (also known as "digital gap")	A significant gap between groups in their access to and use of technology, such as differences between older adults and younger people in everyday use of social media and smartphones.
Digital natives	People born into the digital era, who have been exposed to digital information and technology from birth. For digital natives, computers and the internet are natural components of life.
Digital literacy	A set of skills and competencies needed to perform tasks and solve problems in digital environments.
Technostress	A form of occupational stress associated with ICT (e.g., internet, mobile devices, social media). It includes anxiety or feelings of being overwhelmed due to constant technological demands and information flow.
Trafficking and exploitation	Serious crimes that exploit people's rights and dignity, often for economic gain. Technology plays a role in recruitment and exploitation, for instance through online platforms with false identities.

Note for readers: These definitions were retrieved from documents, reports, and the websites of the United Nations, European Commission, and Europol (e.g., the 2023 Technology and Innovation Report of the United Nations Conference on Trade and Development). The definition of digital addiction was sourced from Yayman and Bilgin (2020) and Aziz et al. (2024).

The widespread use of technology and the various actions it enables have prompted researchers, professionals, and policymakers to examine its benefits and risks, particularly in the context of

families. These benefits and risks are especially evident when studying how technology impacts family dynamics and well-being.

Figure 1: Benefits and risks associated with technology and technology use within the family

Assisted reproductive technology	Communication technology	Digital interventions	Telecommuting and remote working
<ul style="list-style-type: none"> • Benefits: life-changing potential for people otherwise unable to conceive. • Risks: possible neurodevelopmental disorders, complexity of feelings associated with infertility, stressing procedure. There are also open ethical, moral and financial questions, such as upper age limits, «ownership» of gametes and embryos, social egg freezing, commercialization, use in single females. 	<ul style="list-style-type: none"> • Benefits: more time spent connecting, talking, and sharing content with peers and relatives, increased emotional bonds and strengthened ties, possibility to maintain social ties and receive social support in difficult situations. • Risks: replacement of face-to-face interactions with online ones, more static activities and less time for movement, new social pressure and stress related to connecting, cyberbullying, possible online safety risks. 	<ul style="list-style-type: none"> • Benefits: new possibilities to express emotions, needs and support, option to receive interventions from different geographical regions, possibility for people living in low-resource settings to access interventions, more affordability and widespread use. • Risks: disparities in access and use of digital devices required for digital interventions, rare implementation of digital interventions in some health systems, possible replacement of non-specialist health workers. 	<ul style="list-style-type: none"> • Benefits: work flexibility and autonomy, access to employment, work-life balance, sustained employment following parenthood, more time with children, less work-related travel. • Risks: sedentary behaviors, time pressures and isolation, inability to change gender work norms, overwork, work-family conflicts, full-time work-availability, need for larger houses and increase in residential electricity demands.

The great potential of new technologies requires careful consideration to harness their positive characteristics and maximize their benefits while minimizing any adverse effects or features. Moreover, as these technologies evolve, their impact on individuals and families is also changing, necessitating research and policy regulations in this field. The need to better understand the connections between technology and families has increased after the COVID-19 pandemic, which drastically changed how people interact with and use technology, creating specific challenges that scholars and policymakers face. For instance, one significant challenge posed by new technologies is whether they can contribute to widening digital and economic inequalities: the more advanced and sophisticated the technology becomes, the greater the risk of inequalities in access to and use of technology. One example of technological inequality relates to the generational gap between those born without sophisticated technology and so-called “digital natives” (people who began using technology in early childhood). Such “digital natives” are often better equipped to interact with and derive benefits from technologies in an increasingly tech-centric world (Walker, 2021). Another example pertains to the ability of lower-income populations to access and use technologies to meet their needs. Although technology can be a valuable resource for individuals seeking solutions to problems and needs (e.g., accessing health information and receiving online

medical support), this is only possible if people can access high-speed connectivity and possess computers or smartphones—challenges that are often pronounced in low-income regions (United Nations, 2020b; United Nations ESCAP Economic and Social Commission for Asia and the Pacific, 2018). These (and other) challenges should be addressed through policies in the coming years to facilitate the positive and effective use of technology.

Considering the application, impact, and challenges of new technologies on families, specific attention should be paid to how new technologies can assist (or not) families in areas such as work, education, access to various resources like healthcare, finance, and social services, the development of social and emotional connections, relationships and support within the family, and the protection and promotion of health and quality of life for more vulnerable family members. To better understand the effects of technology on the family, it is beneficial to thoroughly explore the psychological, social, and emotional aspects that define a family and contribute to its identity, especially given that the concept of family has evolved significantly in recent years. Therefore, before delving into how the technology megatrend impacts families, we will provide an overview of the most important perspectives regarding the family that should always be considered while studying, thinking about, or working with families.

4.2

Definition of the Family and Its Most Important Characteristics

Exploring the concepts of family and attempting to answer the question, “What defines a family and distinguishes its features and characteristics?” can be challenging, as perspectives on family vary widely. Indeed, the family can be viewed as an institution, a source of identity and well-being for its members, a group of people with certain biological or legal bonds, or a dynamic system that continuously evolves in response to historical, societal, and cultural changes. The complexity of defining the family has led researchers to develop several fields of study dedicated to its exploration, primarily focusing on family structure at a given time, patterns of change over time, and the social, cultural, and economic correlates, precursors, and consequences (Smock & Schwartz, 2020).

As an institution, the family represents society’s foundational building block and encompasses procreation, nurturing, socialization, care, support, and the transmission of human values, ethical norms, and worldviews (Oladapo Mayowa, 2019). The family is the initial and primary environment in which individuals are born, mature, develop, and acquire knowledge from their experiences; it also aims to provide individuals with emotional fulfillment, support, and a sense of identity. Different definitions of family exist in various regions of the world (Few-Demo & Allen, 2020). Diverse family arrangements that satisfy human needs can form, varying widely across countries and regions. For instance, in some countries, families often consist of several generations living together and may include polygamous families, whereas in others,

the nuclear family of two parents living with their children is more common. Some families may be characterized by one parent (alone or with another partner) with children, couples without children, or two same-sex parents with children. These family configurations differ globally, and these cultural variations should be acknowledged to foster a more inclusive and respectful understanding of family definitions and characteristics worldwide.

According to family systems theory, families are more than the sum of their members. Individual family members are part of a larger system (e.g., broader family and social context) whose characteristics and changes influence the entire family’s structure and dynamics. Following the definition of Cox and Paley (2003, p. 1), “Family systems are characterized by wholeness and order (i.e., the whole is greater than the sum of its parts and has properties that cannot be understood simply from the combined characteristics of each part), hierarchical structure (i.e., a family is composed of subsystems that are systems in and of themselves), and adaptive self-organization (i.e., a family as an open, living system can adapt to change or challenges).” Finally, family systems and their members do not exist in isolation but continuously interact with different environments: according to Bronfenbrenner’s Developmental Ecology Theory, individuals belong to five different environments: the microsystem (the immediate setting where individuals live, such as family and school), mesosystem (relationships between

the agents in the microsystem), exosystem (the indirect environment, such as the neighborhood and technological changes), macrosystem (the most extensive and distal environment, such as cultural aspects and social norms), and chronosystem (environmental changes occurring over the life course, such as sociohistorical conditions; Bronfenbrenner, 1977; Crawford, 2020).

These distinctive features of the family—such as dynamic interactions with the environment, openness, and adaptability to change—could influence how modern families deal with technological transformations. As technology rapidly changes individuals' lives, scholars, professionals, and policymakers should consider multiple levels—from the individual to the chronosystem—in exploring the relationships between technology and family members.

4.3

Why Apply a Family-Oriented Vision for Technology?

The family serves as the foundation of society and a source of belonging, development, and identity for individuals. It is crucial for countries, societies, and economies that aim to flourish to adopt a family-oriented vision when exploring the megatrend of technological changes and investing in family-oriented and family-friendly policies. According to UNICEF (2019), family-friendly policies are those that provide essential resources to parents and caregivers of young children to indirectly support children in their development. This necessity arises to safeguard the family as the basic unit of society and its vulnerable members (i.e., children, adolescents, the elderly, and people living with disabilities); promote healthy, positive, and functional relationships within the family; address potential digital inequalities or injustices; and preserve family ties, values, and traditions. Moreover, investing in children means helping them build a foundation for their health, academic achievement, work, and economic success.

In a report from the United Nations' Online Expert Group Meeting (2020a), technological changes were discussed concerning their implications for families, and recommendations were made to promote family-oriented research to analyze the impacts of technological changes on the family. Furthermore, emerging issues related to the impact of new technologies, digitalization, and the digital divide on families were highlighted, emphasizing the necessity to invest in parenting education, gender roles within the family, positive parenting practices, and work-family balance. The following year, the United Nations Department of Economic and Social Affairs (UNDESA), Division for Inclusive Social Development published a report outlining policy actions that UN member states are encouraged to adopt to ensure technology's functional uses and positive impacts on families (Walker, 2021; see Table 2).

Policies to benefit overall population	Policies to benefit family members	Policies to benefit work, educational, and health contexts
<p>Ensure access to high-speed internet and devices for communication and access to the internet without inequalities for every person in every part of the world. Universal coverage of the internet should be considered a human right, given the essential role of the internet in education, communication, business and work activities, access to health systems, public services, and civic participation.</p>	<p>Support family members after the COVID-19 pandemic. Help family members develop digital literacy skills to use the internet safely.</p> <p>Improve digital security and privacy of information online to protect children and youths.</p> <p>Develop and support programs that enhance technology skills and boundary-setting for workers with families.</p> <p>Include parenting education as a key strategy for family support.</p> <p>Integrate technology into parenting education to promote the mental health of both parents and children.</p>	<p>Prepare family mental health professionals to deliver digital or technology-based services.</p> <p>Train teachers in the use of technology and internet access for delivering education, and ensure the quality of such methods.</p> <p>Utilize technology in all learning facilities to create an inclusive learning environment, with consideration for disability and gender.</p> <p>Enhance technology innovation and quality in workplaces, while prioritizing work-family balance.</p>

The UN Economic and Social Council (2022) published a report on preparations for the observance of the 30th anniversary of the International Year of the Family in 2024. The report explores the impact of new digital technologies on families, highlighting the significant effects of technology on education, health, and work-family balance, particularly following the COVID-19 pandemic. It shows that the adverse effects of the pandemic are evident in:

- Widening the gap between families with internet access and high-speed connections and those without.
- Deteriorating education outcomes, now marked by longer periods of school non-attendance, lower retention and graduation rates, poorer learning outcomes, and delayed progress in school completion.
- Worsening mental health and well-being of children, adolescents, and parents, with increased feelings of anxiety, fear of illness, depression from not being able to leave home, social withdrawal, and attention and hyperactivity disorders.
- Increasing children's risk of exploitation, early marriage, and exposure to violence, as children were asked to leave school, begin working, and start families in response to the economic crisis caused by COVID-19.

For all these reasons, it is crucial to better understand how technology and family are connected, what we already know about technology's impact on family members' lives and well-being, and what still needs to be explored to help families benefit from technological changes.

Therefore, in the chapters that follow, we explore the connections between technology and family. Specifically:

- **Chapter 3** examines the predictors of the technology megatrends' effects on families.
- **Chapter 4** explores the outcomes of the technology megatrend on families.
- **Chapter 5** looks into how specific aspects of technology and family might interact with one another (i.e., as moderators or mediators) to strengthen or weaken technology's effects on families.
- **Chapter 6** discusses existing policies that have been implemented to promote technology's functional uses and positive impacts on families.
- **Chapter 7** presents future policies and recommendations that could be implemented to further promote technology's positive impacts on families.

Throughout each of these chapters, we consider technology's impact on the contemporary family, adopting Gulf scholars' definition of family (Doha International Family Institute, 2019) and Cox and Paley's (2003) conceptualization of the family as an integrated system. We are also guided by Bioecological Theory when exploring predictors, impacts, and mediators/moderators of the technology megatrend on families (Bronfenbrenner, 2020).

With this report, we hope to further the aim set out by UNDESA, the UN Economic and Social Council, and the UN as a whole: ensuring that technological megatrends benefit families worldwide (Walker, 2021; UN Economic and Social Council, 2022).

PREDICTORS

As technology and family are strongly connected, it is important to explore the most relevant aspects of technology that impact families worldwide. These predictors are crucial for scholars and policymakers to understand how to navigate the relationship between technology and families. This chapter will focus on four predictors, or drivers, of the technology megatrend's impact on families, as identified by the United Nations (2020a, 2020b). These four predictors represent the most relevant and significant technology-related areas influencing the global use and adoption of technology,

shaping the lives of children, parents, and grandparents. The four predictors and relevant themes connected to technology are:

1. **Assisted Reproductive Technologies (ART).**
2. **Communication Technologies.**
3. **Assistive Technology, Digital Interventions, and Telehealth.**
4. **Telecommuting and Remote Work.**

Each of these predictors will be described further below.

5.1

Assisted Reproductive Technologies (ART)

Defining ART

According to the World Health Organization, assisted reproductive technologies (ART) are “all treatments or procedures that include the in vitro handling of both human oocytes and sperm or of embryos for the purpose of establishing a pregnancy. This includes, but is not limited to, in vitro fertilization and embryo transfer, gamete intrafallopian transfer, zygote intrafallopian transfer, tubal embryo transfer, gamete and embryo cryo-

preservation, oocyte and embryo donation, and gestational surrogacy. ART does not include assisted insemination (artificial insemination) using sperm from either a woman’s partner or a sperm donor” (Zegers-Hochschild et al., 2009, p. 1521).

ART refers to medical procedures involving hormonal stimulation, fertilization of oocytes in the laboratory, and embryo transfer into the uterus, aiming to initiate a pregnancy (see Table 1 for a description of the most common ART treatments).

Table 1. Most common ART treatments

ART treatment	Definition
In vitro fertilization (IVF)	The collection of oocytes, their fertilization in vitro, and the resulting embryo's transfer into the woman's uterus.
Gamete intrafallopian transfer	An ART procedure in which both gametes (oocytes and spermatozoa) are transferred to the fallopian tube.
Zygote intrafallopian transfer	A procedure in which zygote(s) is/are transferred into the fallopian tube.
Tubal embryo transfer	Transfer of embryos at a more advanced stage of development when they're transferred than with other techniques.
Gamete and embryo cryopreservation	The freezing or vitrification and storage of gametes, zygotes, embryos, or gonadal tissue.
Oocyte and embryo donation	Collection of oocytes from a donor for clinical application or research and the transfer of an embryo resulting from gametes (spermatozoa and oocytes) that did not originate from the recipient and her partner.
Gestational surrogacy	Process where one person, who did not provide the egg used in conception, carries a fetus through pregnancy and gives birth to a baby for another person or couple. The person who carries the fetus is called a «surrogate» or «gestational carrier.» The person or couple who are seeking to parent the baby or babies are called the «intended parent(s).»

Source: Zegers-Hochschild et al., 2009

In most cases, individuals use ART to address infertility, which is a medical condition and disease of the female or male reproductive system characterized by the inability to achieve pregnancy after twelve or more months of regular and unprotected sexual intercourse. Infertility can affect both women and men and may result from medical conditions (e.g., hormonal disorders), interventions (e.g., chemotherapy), environmental pollutants, or unknown causes. It can be categorized into primary infertility, where an individual has never achieved pregnancy, and secondary infertility, which occurs after at least one prior pregnancy. Infertility affects individuals' health, as defined by the World Health Organization (WHO) as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity" (World Health Organization, 1948), and represents a significant medical condition globally (Chiware et al., 2021). According to the latest WHO document (2023), which outlines infertility prevalence estimates from 1990 to 2021, infertility has become a major medical issue, with approximately one in six people experiencing infertility at some stage in their lives. Globally, 17.5% of people have experienced infertility, and 12.6% have suffered from infertility at a given point or interval (either currently or in the past). These prevalence estimates are consistent across countries and regardless of income levels.

Infertility rates have been rising in various parts of the world for multiple reasons, including delayed childbearing and lifestyle factors (e.g., poor dietary habits). Over recent decades, women have increasingly focused on their careers during early adulthood, raising the average age of first pregnancy. For example, in several European countries (e.g., Italy, Spain, and Denmark), the mean age for first-time mothers is above 30 years. Lifestyle factors such as obesity, smoking, sexually transmitted infections, and environmental pollutants also contribute to infertility (Geneva: World Health Organization, 2023; Inhorn & Patrizio, 2014; Serour & Serour, 2021; Vlasisavljevic et al., 2021). In many regions, complications from unsafe abortions, postpartum infections, pelvic tuberculosis, and unsafe sexual practices often lead to infertility (Serour & Serour, 2021).

The rising prevalence of infertility globally is strongly linked to increased demand for ART (In-

horn & Patrizio, 2014; Njagi et al., 2023; Oliveira et al., 2021; René et al., 2022; Vlasisavljevic et al., 2021). This trend necessitates a focus on how ART is changing the ways individuals and couples transition to parenthood, form families, and how children develop within these families.

ART Worldwide Use

The first child conceived through in vitro fertilization (IVF) was born in 1978 (Steptoe & Edwards, 1978). Since then, significant medical and research advancements have transformed how individuals transition to parenthood, enabling the birth of over 10 million children worldwide through ART (Pinborg et al., 2023). The number of ART-born children has steadily increased. According to the European Society of Human Reproduction and Embryology (ESHRE), there were 157,500 ART-born children in 2015, and by 2020, over 9 million children had been born through ART. These figures illustrate the widespread global use of assisted reproductive technologies.

Despite the global use of assisted reproductive technology (ART), there are disparities in how individuals and couples access ART worldwide and in our understanding of ART (e.g., causes of use, experiences, challenges, and outcomes), as research has primarily focused on North America, Oceania, and Europe. In low- and middle-income countries (LMICs), infertility and ART use are often not considered priorities, meaning that people living in these countries frequently encounter cultural, religious, and legal barriers to accessing ART. They may also face social stigma, lack adequate facilities and professionals for undergoing ART, and consequently be required to spend substantial amounts or travel to other parts of the world to become parents through assisted reproductive technologies. A recent review (Chiware et al., 2021) investigated the current availability of ART, particularly in vitro fertilization (IVF), in East Asia and the Pacific, Europe and Central Asia, Latin America and the Caribbean, the Middle East and North Africa, South Asia, and Sub-Saharan Africa. The review highlighted that high-cost ART treatments are available in these regions, requiring significant economic resources to undergo ART, which excludes a large percentage of the population. Table 2 summarizes the most relevant aspects of the review for each world region.

Table 2. Most ART-related factors in different world regions (Chiware et al., 2021)

World region	ART-related aspects
East Asia and Pacific	<ul style="list-style-type: none"> • ART is a rapidly growing business. • Most ART practices are conducted in China, Indonesia, and Thailand. • The most common barriers to accessing ART include high costs, low confidence in treatments, provider changes due to treatment failure, the number and location of clinics, and the lack of a referral system.
Europe and Central Asia	<ul style="list-style-type: none"> • In Europe, there is generally good access to ART services, and ART is highly utilized. However, there are disparities in availability, access, and funding support across different European countries. • In some countries, there is a lack of ART legislation and regulation.
Latin America and the Caribbean	<ul style="list-style-type: none"> • In some countries, there is a lack of ART legislation and regulation. • ART centers and treatments are increasing. • The most common barriers to accessing ART include high costs, long waiting times, complex scheduling processes, and the absence of specific ART legislation. • In some countries (e.g., Costa Rica, Brazil), ART services have only recently become legal.
Middle East and North Africa	<ul style="list-style-type: none"> • Iran is reported to be the only country where gamete donation and surrogacy are practiced. In Iran, almost all ART clinics are located in Tehran, operate outside of government-financed health facilities, but offer limited-cost treatments, which attract people from other EMRO countries to undergo ART in Iran. • Egypt is working to reduce ART costs and modify treatment protocols.
South Asia	<ul style="list-style-type: none"> • IVF is available in Bangladesh, India, Nepal, Pakistan, and Sri Lanka, but only India has a national registry for IVF activities. • IVF/ICSI, gamete donation, and surrogacy are established ART practices in India, available in both public and private centers. • The most common barriers to accessing ART include costs, despite efforts to reduce ART expenses.
Sub-Saharan Africa	<ul style="list-style-type: none"> • The most common barriers to accessing ART include costs, despite efforts to reduce ART expenses. • Less than %1.5 of the African population has access to ART. • South Africa is the most developed and experienced country for ART in Africa and is the only country with a national and public ART data registry. • The most common barriers to accessing ART in Africa include cost, religious concerns, public awareness, and the social acceptability of treatments.

Another recent review (Kooli, 2019) explored assisted reproductive technology in Islamic regions, highlighting the fast-growing research and development of reproductive medicine in Muslim countries. In discussing this theme, the author pointed out that in some cultures and societies, couples face social pressure to become parents as soon as possible, experiencing stigma and shame if they are unable to conceive. For these couples, accessing ART treatments to achieve pregnancies can be a solution to respond to these social pressures and avoid social rejection. However, the use of ART has prompted varying attitudes regarding its morality in different religions. The Islamic faith encourages procreation, family formation, and childbirth within the context of marriage and supports the use of medicine, science, and technology to overcome challenges and suffering. For these reasons, as the review author explains, many Islamic scholars encourage the use of ART for infertile married couples, and Muslim countries show a strong awareness of the importance of ART treatments in preserving the family unit and social cohesion. Nevertheless, several Muslim countries still need to update their ART regulations and laws to align with the most recent medical practices and guidelines (Kooli, 2019).

Literature on ART

The most widely studied aspects of ART include the psychological and social effects of infertility, the challenges connected with ART (e.g., economic cost, stress), the outcomes of ART for children (e.g., cognitive, behavioral, and psychological well-being) and parents (e.g., couple quality and well-being), and the social stigma faced by families formed through ART.

Several researchers have highlighted that infertility is associated with adverse psychological and social effects, such as feelings of guilt, shame, self-blame, and low self-esteem (Péloquin et al., 2018), psychological distress (Hasanbeygi et al., 2017), marital stress (Samadaee-Gelehkolaei et al., 2015; Schmidt, 2009), intimate partner violence (Stellar et al., 2016), loss of social status, and social consequences such as stigma and exclusion (Yokota et al., 2022). The social stigma is especially prevalent for infertile women, as in some societies, not having children is seen as the

woman's fault, leading to negative consequences such as violence from family members, marriage breakdowns, and microaggressions from others, all of which decrease quality of life. A recent review, including 28 peer-reviewed studies from various world regions (Xie et al., 2023), investigated whether social stigma affected the mental health and quality of life of infertile women. The review revealed a high prevalence of stigma among infertile women, particularly for those living in rural areas, holding traditional cultural beliefs about motherhood, lacking higher education, and not working outside the home. The stigma was linked to low levels of social support, with infertile women often hiding their condition, avoiding family or children-related conversations, and isolating themselves to reduce social interactions. This led to feelings of pain, inferiority, anxiety, and depression, which, in the long run, were associated with decreased self-esteem and self-efficacy.

A recent review of 20 peer-reviewed studies found a high prevalence of depressive symptoms in both women and men before ART treatments, with anxiety more common in women (Thanscheidt & Wischmann, 2023). Social support emerged as a protective factor in reducing depression and anxiety before ART treatments. Depression and anxiety can also arise during the ART process itself, as it is often demanding and challenging for individuals and couples socially, emotionally, and financially. ART treatments can be expensive, time-consuming, physically strenuous, and emotionally draining due to the uncertainty of the outcomes. A recent meta-synthesis (René et al., 2022) reviewed 14 qualitative studies to explore the experiences of pregnancy resulting from ART treatments. The authors highlighted four psychologically relevant themes for ART couples: (1) traveling a long and complex journey, characterized by medical exams, treatments, difficulties, uncertainties, and costs; (2) moving on with paradoxical emotions, oscillating between feelings of fragility and hope, with ART pregnancy seen as both a crisis and a new beginning; (3) struggling with an emerging identity, slowly integrating infertility and treatments into parenthood; and (4) reorganizing relationships, developing friendships with others undergoing ART and seeking emotional support from family and friends.

Finally, a widely explored theme related to ART is its impact on the physical, cognitive, and psychological development of children conceived through ART. Scholars have questioned whether ART-born children have worse health conditions than children born without ART treatments. A review of 42 peer-reviewed studies (Carneiro et al., 2024) systematically assessed the psychological adjustment of ART-born children aged between 3 and 11 years. The authors compared the psychological adjustment of ART-born children to children born without ART, examined differences

across types of ART (e.g., embryo donation, egg donation), and investigated differences across family configurations (e.g., single mothers, same-sex families).

The results showed good levels of psychological adjustment for ART-born children, who exhibited positive social and emotional development compared to both normative data and children born without ART. Moreover, the study found no significant differences across the different types of ART techniques.

5.2

COMMUNICATION TECHNOLOGIES

Defining Communication Technologies

Communication technology refers to the tools, systems, and platforms that facilitate the transmission and exchange of information between individuals or groups. Communication technology includes various devices, software, and applications, such as smartphones, tablets, computers, emails, social media, wearable devices, video conferencing, and gaming. These technological tools allow people to communicate quickly and efficiently, overcoming long distances and facilitating connections, collaboration, and the sharing of content. Thus, the common aim is transmitting, storing, creating, sharing, and exchanging information and communication. Today, communication technologies play an essential role in the everyday lives of individuals, groups, and, therefore, families. For this reason, it is important to detail the most important characteristics of communication technologies before exploring their impact on family life. In this chapter, we will focus on the most popular communication technologies, such as gaming, smartphones, tablets and computers, social media, wearable technologies, and artificial intelligence (AI), to give readers a solid theoretical perspective on how communication technology relates to family life. In the next chapter, we will explore communication technologies' specific outcomes and effects on children, parents, and grandparents.

Artificial Intelligence (AI)

Artificial intelligence (AI) has emerged as one of the most influential technologies in recent de-

acades, spreading widely and significantly impacting society. According to Forbes, the AI market is projected to reach \$407 billion by 2027, especially considering that ChatGPT had 1 million users within the first five days of being available. To better understand AI, we asked ChatGPT (an artificial intelligence language model developed by OpenAI designed to understand and generate human-like text based on the input it receives) to define itself, and we obtained this output: "Artificial Intelligence (AI) is a branch of computer science that aims to create systems capable of performing tasks that typically require human intelligence. These tasks include learning, reasoning, problem-solving, perception, natural language understanding, and interaction. AI systems are designed to interpret data, make decisions, and improve from experience. AI can be categorized into several types:

- **Narrow AI (Weak AI):** This type of AI is designed and trained for a specific task. Examples include virtual personal assistants like Siri and Alexa, image recognition systems, and recommendation algorithms used by services like Netflix and Amazon.
- **General AI (Strong AI):** This refers to a type of AI that possesses the ability to perform any intellectual task that a human can do. It implies a machine with consciousness, self-awareness, and cognitive abilities across diverse fields. General AI remains theoretical and has not been achieved yet.
- **Superintelligent AI:** This is a hypothetical form of AI that surpasses human intelligence across

all fields, including creativity, general wisdom, and social skills. It is a concept explored in futuristic and theoretical discussions about AI."

In a recent report by the *World Bank* (2024), AI's potential benefits and risks were outlined, focusing on how these are expected to affect people in different domains. These benefits and risks are as follows:

- **Benefits:** AI will drive product innovation and increase productivity by automating tasks, optimizing resource allocation, developing better and novel products, and mitigating risks. It will create new jobs, expand job opportunities, and facilitate a more inclusive hiring process. AI will enhance consumer welfare by creating personalized shopping experiences and will influence policymaking, speed up government operations, and improve core functions within government organizations. It will assist in agricultural tasks, healthcare systems, education, financial inclusion, and resilience to climate events and humanitarian emergencies.
- **Risks:** AI could replace workers, eliminate jobs, and exacerbate inequality in the labor market. It could widen the income gap between low-, middle-, and high-skilled workers, decelerating poverty reduction efforts and hindering technology diffusion. AI could also reinforce monopolies of large tech companies, complicate privacy concerns, and worsen cybersecurity and copyright issues, as well as produce misinformation.

Given AI's profound impact on businesses, health, education, and everyday life, its connection to families warrants further exploration. AI transforms industries and optimizes processes, changing job opportunities for parents. It also alters health systems, education, and daily living through medical diagnostics, personalized learning platforms, and smart home devices, influencing the lives of children, parents, and grandparents. Chapter 4 will further explore AI's specific effects on family members' lives and well-being.

Online Video Gaming

Internet gaming is a widely popular leisure activity that has rapidly developed in recent years,

becoming an integral part of the everyday lives of children, adolescents, and adults. According to Statista, 2.42 billion people play video games worldwide, and global gaming penetration in 2023 is 83.1%, with particularly high rates in countries like Indonesia, the Philippines, Turkey, Thailand, Vietnam, Saudi Arabia, India, South Africa, Mexico, Taiwan, and the UAE (ranging from 91% to 96.5%). Considering this widespread use, several studies have explored the most important characteristics of the internet and video games, as well as their positive and negative effects on the well-being and development of users. The necessity to deeply explore this theme is also connected to the fact that, for some users, online video game use can be problematic. Scholars have categorized video game-related pathological and problematic behaviors as problematic gaming behavior (PGB) and Internet Gaming Disorder (IGD). PGB is conceptualized as behaviors that impair day-to-day functioning due to video game play (Gentile et al., 2011), while IGD is part of the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5; APA, 2013) and refers to a behavioral pattern characterized by persistent and recurrent engagement with both online and offline games, leading to significant impairment or distress lasting over a 12-month period (APA, 2013). In the WHO International Classification of Diseases 11th Revision (ICD-11), gaming disorder is defined as "a pattern of gaming behavior ('digital-gaming' or 'video-gaming') characterized by impaired control over gaming, increasing priority given to gaming over other activities to the extent that gaming takes precedence over other interests and daily activities, and continuation or escalation of gaming despite the occurrence of negative consequences" (retrieved from: <https://www.who.int/news-room/questions-and-answers/item/addictive-behaviours-gaming-disorder>).

Problematic and dysfunctional gaming use is significantly associated with negative psychological health outcomes, as shown in a review of 50 peer-reviewed studies (Männikkö et al., 2020). The authors highlighted the strong connection between problematic gaming use and negative health-related outcomes. Higher problematic gaming use is linked to worse socioemotional outcomes (e.g., anxiety, depression, low social skills, loneliness, neuroticism) and physical outcomes (e.g., alterations in physical functioning such as

somatization, sleep disturbances, and low levels of physical activity). Gaming disorder has also been associated with high levels of loneliness within families, poor family relationships, and less harmony with relatives. Family relationships can act as protective or risk factors for developing gaming disorders and can also be negatively affected by children's and adolescents' gaming disorders. Several studies (e.g., Bonnaire & Phan, 2017; Throuvala, 2019) have shown that poor family experiences (e.g., high conflict and low parental warmth) may constitute risk factors, leading to increased gaming involvement as children may use games to boost their perceived self-esteem and self-efficacy. Simultaneously, gaming disorders are often associated with lower social competence and poorer relationships with parents (Richard et al., 2020).

The amount of time spent playing online video games does not necessarily correlate with high PGB or IGD. In fact, additional characteristics related to video games should always be analyzed when exploring PGB and IGD. Among these characteristics, gaming motivation varies between individuals and can drive them to play to fulfill certain psychological needs. According to Yee (2006), gaming motivations can be categorized into three broad components: achievement motivation, linked to the desire for recognition, power, and status; social motivation, linked to the desire for connections and interactions with others; and immersion motivation, linked to the desire for virtual in-game experiences. These motivations are differently related to problematic gaming use, with IGD being more associated with achievement motivation than with the other two (Wang & Cheng, 2022).

The social motivation emphasizes that video games, often considered a “loner” technology, are strongly characterized by a social dimension, especially now that advances in technology allow players to use virtual reality for immersive social experiences. A review (Bowman et al., 2022) explored video games' social dimension as a predictor of positive outcomes for players' well-being, highlighting that video games can facilitate feelings of connection, sharing, coordination, and social bonds, serving also as a means of recovering from stress (by creating psychological distance and a sense of control). Additionally, video games

are known for benefits such as improving focus, multitasking abilities, and working memory, which coexist with negative effects like increased aggressive behaviors, social withdrawal, maladaptive coping strategies, and decreased self-esteem, self-efficacy, and academic achievements. For these reasons, to better understand the positive and negative effects of video games on children, adolescents, and their parents, it is often necessary to differentiate between short- and long-term perspectives and always consider multiple dimensions (Von Der Heiden et al., 2019).

Internet-Based Devices

All technological devices that can access the internet are defined as internet-based devices. They include computers, tablets, smartphones, and any text- or touch-controlled devices that can retrieve information from websites and possess applications. The most relevant characteristics of these devices are that they are widely used in everyday activities, rapidly change, are interactive, easy to use and transport, and draw information and content from the internet (Danovitch, 2019).

Today, internet-based devices are essential tools for various activities and are used by children, adolescents, and adults worldwide. Among all internet-based devices, smartphones are the most utilized due to their practicality, versatility, and portability. For this reason, numerous studies have been conducted on how internet-based devices influence individuals' lives and development, yielding mixed results. In particular, Kushlev and Leitao (2020) proposed three basic hypotheses and one integrated theory to summarize research on smartphones' effects on individuals' well-being:

- 1. Displacement Hypothesis:** Smartphones impact well-being by replacing other activities and decreasing individuals' time for essential health-related activities (e.g., sleeping, socializing, exercising).
- 2. Interference Hypothesis:** Smartphones affect well-being by interfering with concurrent activities, indicating that the time spent using smartphones is essential to consider when exploring their effects on well-being.

3. Complementarity Hypothesis: Smartphones enhance well-being by providing access to information and activities that would otherwise be inaccessible.

4. Displacement-Interference-Complementarity (D.I.C.) Theory: Smartphones can increase individuals' well-being by allowing access to information and experiences that would otherwise be unavailable. However, these positive aspects and benefits for well-being depend on users' personal characteristics, which play a crucial role in smartphone use. Individuals' current emotional status, environment, personal experiences, and other contextual factors impact how smartphones are utilized.

Moreover, distinguishing between short-term and long-term effects could be helpful in exploring the use of internet-based devices and their implications for well-being and development (Liebherr et al., 2020). The effects of smartphones on attentional processes, inhibition, and working memory were mixed in a research review (Liebherr et al., 2020). One reason for these mixed results might be that some scholars have considered screen time the most precise way to assess internet-based device usage, measuring it through self-report instruments without accounting for personal characteristics or concurrent secondary behaviors (Ellis, 2019).

Overall, internet-based devices can facilitate social interactions, making social connections more frequent and accessible while improving mental health. At the same time, they can decrease physical activity, as individuals often use these devices while remaining sedentary (Barkley et al., 2016). A review of 14 peer-reviewed studies about the connection between smartphones and sedentary habits indicated that more time spent on smartphones was related to sitting, which decreases individuals' muscle mass (Zagalaz-Sánchez et al., 2019). However, several studies have highlighted that these devices can also be used to promote physical activity by reminding individuals to move, go for a walk, or exercise (Ismail & Al-Thani, 2022).

Exposure to internet-based devices begins in early infancy and continues throughout childhood and adolescence. Although children are heavily exposed to these types of devices, they

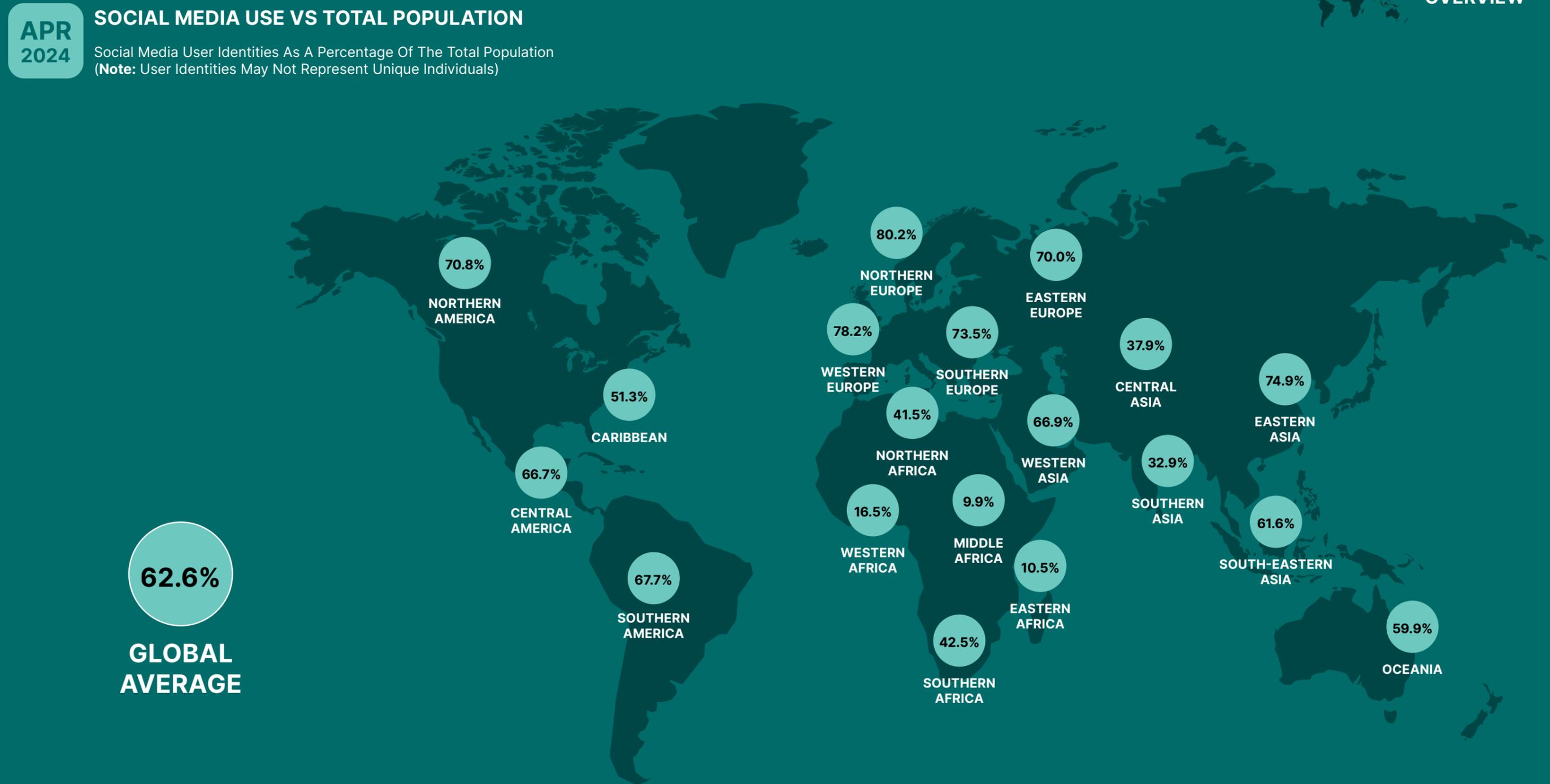
do not always fully understand their characteristics, implications, or correct usage. Children's understanding of internet-based devices involves recognizing their physical nature, inner workings, functions, and capacities (Rücker & Pinkwart, 2016). Moreover, children need to learn how to use the internet properly, including whether and how to trust it and critically evaluate internet-related information. As children develop cognitive, affective, relational, and psychological skills, they also strengthen these internet-related abilities. This dual development process involves cognitive, emotional, social, and personal characteristics influencing each other and co-occurring in explaining the relationship between internet-based devices and children's development (Danovitch, 2019; van den Heuvel et al., 2021).

Social Media

The United Nations defines “social media” as the use of internet-based platforms that facilitate interaction with others online. This includes social networking websites, instant messaging platforms, and voice applications such as WhatsApp, WeChat, Facebook, Douyin, Kuaishou, TikTok, Twitter, Instagram, LinkedIn, YouTube, Weibo, and Pinterest (UN, 2024a). Social media enables people to connect and interact regardless of their geographical location, allowing them to exchange messages, information, media, and conduct voice or video calls (UN, 2024b).

Indeed, few factors have driven the global uptake of technology as significantly as the rise of social media. In 2004, less than 1% of the world's population was connected to a social media platform. Today, an estimated 5.07 billion people—approximately 62.6% of the global population, 66.9% in the Middle East, and 41.5% in North Africa—actively use social media. Users engage with an average of 6.7 different social media platforms each month and spend about 2 hours and 20 minutes per day (equating to 14% of their waking life) on these platforms (ITU, 2023; Kemp, 2024). The proportion of social media users across various world regions is illustrated in Figure 1.

Figure 1: Proportion of Population in Each World Region that Uses Social Media (Chaffey, 2024)



Sources: kepios analysis; company advertising resources and announcements; cnnic; beta research center; ocdh.
Advisory: social media user identities may not represent unique individuals.
Notes: does not include data for syria. Regions based on the united nations geoscheme.
Comparability: source and methodology changes; base revisions. Figures for local and regional social media use rely on different datasets to global figures. See notes on data.

Note. Figure 1 Source:

<https://www.smartinsights.com/social-media-marketing/social-media-strategy/new-global-social-media-research/#:~:text=94.2%25%20of%20internet%20users%20have,in%20Middle%20and%20Eastern%20Africa>

Given social media's exploding popularity, it is fair to wonder what characteristics of social media make it so popular. The consensus among experts is that engaging in social media allows people to fulfill three basic psychological needs: competence (the feeling one can do things well), autonomy (having personal freedom to choose one's appearance and actions), and relatedness (social connection and bonding; Clark et al., 2018; Sheldon & Titova, 2023; US Surgeon General, 2023). Social media's constant accessibility contributes to its booming popularity by enabling users to create content and access news, information, and social relationships that fulfill these three needs (Clark et al., 2018; Sheldon & Titova, 2023; US Surgeon General, 2023).

Social media's ability to fulfill goals of relatedness and social connection has also shaped family interactions (Clark et al., 2018; US Surgeon General, 2023). Within families, social media can foster connectedness and cohesion (UN, 2022) and help family members who migrate away from one another stay in touch (UN, 2022). However, many scientists, clinicians, and policymakers have raised concerns that the rise and overuse of social media may contribute to increasing child and adolescent mental health problems (US Surgeon General, 2023; UN, 2024b). Although there is insufficient high-quality, longitudinal evidence to establish a direct causal link between rising social media use and mental health issues in children and adolescents, experts worldwide urge caution. They recommend that parents set limits on the age and amount of time children spend on social media (US Surgeon General, 2023; UN, 2024b). These and other outcomes of social media adoption are discussed in greater depth in Chapter 4: Technology's Impact on Mental and Physical Health. We introduce these links to family functioning here to highlight how social media is not just a driver of the technology megatrend, but also highly influential in shaping family dynamics worldwide. Below, we discuss two particular aspects of social media that cause it to serve as a predictor of the technology megatrend in families: its popularity with children and adolescents and its impact on parents through the phenomenon of "sharenting."

Social Media's Popularity Among Children and Adolescents

Social media's enormous popularity among children and adolescents is a key driver of the technology megatrend. According to the UN, 79% of people aged 15-24 use the internet (compared to 65% of the total global population; ITU, 2023). This includes 78% of people aged 15-24 in Arab states compared to 66% of all people in Arab states. Furthermore, 47.4% of people aged 16-24 say their primary reason for using the internet is to connect with family and friends (Kemp, 2024).

Systematic reviews of social media literature (including those from the MENA region; Winther et al., 2022) indicate that social media's enormous popularity among children and adolescents stems from its ability to fulfill the three basic psychological needs mentioned earlier: competence, autonomy, and relatedness (US Surgeon General, 2023; Valkenburg et al., 2022; Winther et al., 2022). These needs are especially important during adolescence, a life stage marked by fluctuations in competence and well-being (Valkenburg et al., 2022; Winther et al., 2022), with autonomy-seeking and identity formation as central developmental tasks (Lansford et al., 2021; US Surgeon General, 2023), and where social connections with peers are of paramount importance (Valkenburg et al., 2022; Winther et al., 2022). Indeed, brain development during adolescence (ages 10-19) is highly sensitive to social pressures, peer opinions, and comparisons (US Surgeon General, 2023). It is no surprise, then, that adolescents report using social media to feel more accepted, receive support during tough times, stay connected with friends, and showcase their creativity (Vogels & Gelles-Watnick, 2023).

Sharenting

A specific form of social media use with several implications for family members is "sharenting." The term "sharenting" combines "parenting" and "sharing," referring to parents' practice of sharing detailed information about their underage children on social media. Sharenting includes posting pictures and videos of children, writing about

their characteristics, and, in some extreme cases, creating profiles of children and using them for commercial purposes (Blum-Ross & Livingstone, 2017). Sharenting can be viewed from two perspectives, focusing on its positive or negative aspects:

- **Positive aspects:** When done safely, sharenting allows parents to develop social and emotional connections with relatives and friends, collect memories, and share or receive social support, especially during the early years of parenthood, which can be stressful and challenging.
- **Negative aspects:** Parents often do not ask for their children's permission before sharing their information or pictures, which infringes on children's privacy and may lead to future issues. Sharenting can contribute to the cre-

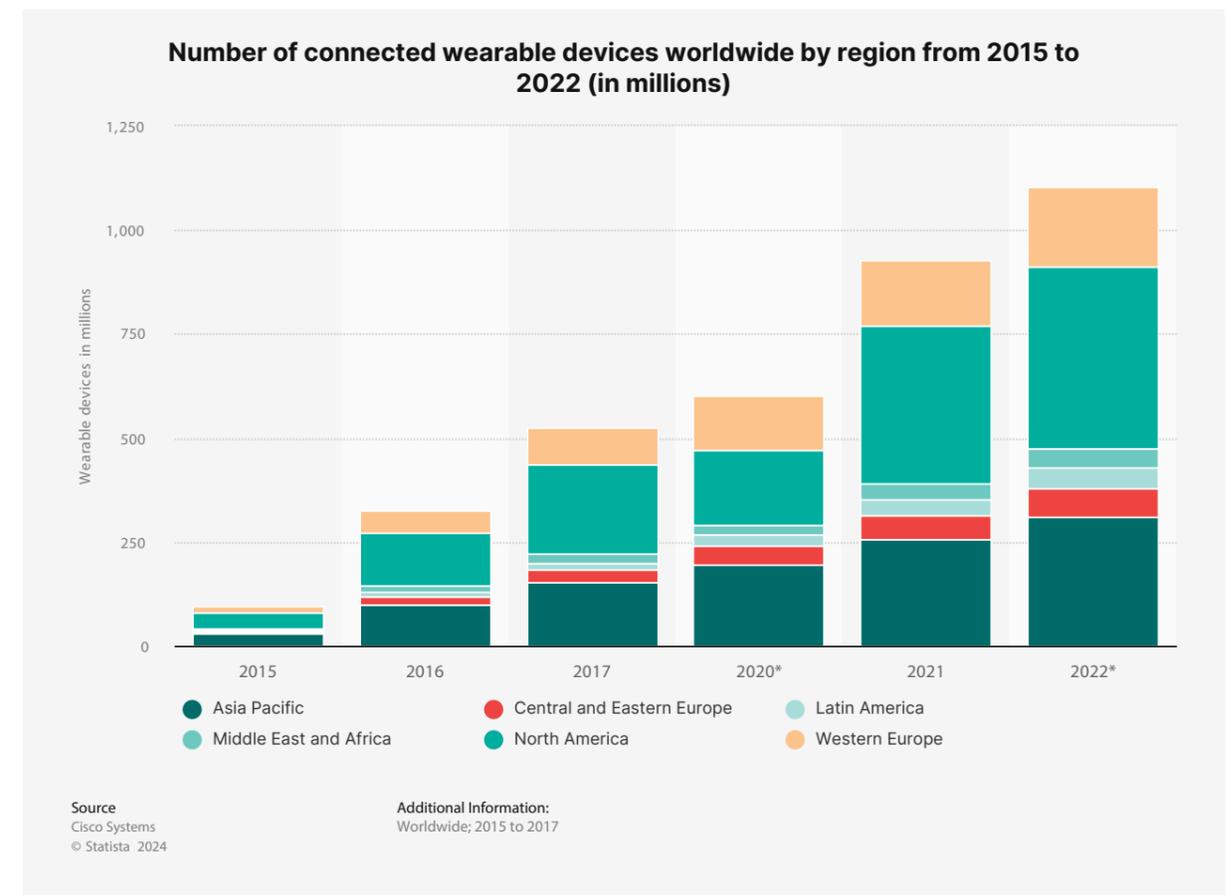
ation of a child's digital footprint from a young age, facilitate identity fraud or theft, and even lead to the misuse of children's images on inappropriate websites (Romero-Rodríguez et al., 2022).

These concerns highlight the need for clear regulations and laws to govern sharenting practices and guide parents in understanding the potential implications, ultimately aiming to protect children (Briazu et al., 2021; Fox et al., 2023).

Wearable Technology

Wearable technology is a popular and rapidly growing form of technology due to its innovation, functionality, and ease of use. From 2015 to 2022, the number of wearable device users has increased from 96.72 million to 1.105 billion worldwide, as shown in Figure 2.

Figure 2: Statistics about wearable devices users worldwide



Source: <https://www.statista.com/statistics/490231/wearable-devices-worldwide-by-region/>

Wearable technology refers to any body-attached or body-implanted smart device that tracks physiological signals for health-related purposes. All electronics and computers that can be worn or integrated into clothing are considered part of wearable technology. According to Li and colleagues (2021, p. 354), three main characteristics of wearable technology are: “being attached to or implanted within the body of the user; providing a continuous way of gathering physiological signals requiring little or no interaction from the user; and aiding beneficiaries in tracking and protecting health.”

Wearable technology has several practical applications, as it is used to track physical and mental health and can be applied for fertility and pregnancy tracking, gastrointestinal and heat-related illness detection, asthma monitoring, and measuring sports and physical activity. Due to these numerous applications, wearable technology can be helpful in various contexts, such as caring for older family members, managing chronic diseases, supporting clinical decision-making, and promoting healthier lifestyles. The wide range of wearable applications requires scholars, professionals, and policymakers to apply a transdisciplinary framework (e.g., incorporating social theories, medical and health situations, engineering, and design applications) to explore how this technology can affect families and family members worldwide.

Li and colleagues (2021) analyzed 250 peer-reviewed studies and classified wearables into three categories:

1. Wearables that collect physical data to track body motion signals, count steps, and measure body activation.
2. Wearables that collect psychological data using respiration, electrodermal activity, and electrocardiogram (ECG).
3. Wearables that collect social data, such as augmented reality glasses, that control interactions between individuals and their environment.

These three types of wearable technology can monitor healthy populations as well as people dealing with clinical diagnoses, relevant medical issues, or disabilities (Ferreira et al., 2021; Huhn et al., 2022). Despite the growing popularity and increased knowledge about the potential benefits of wearable technology, several aspects still require further exploration by researchers. For instance, how wearable technology has been utilized in underrepresented populations (e.g., LMIC populations or individuals living in low-resource environments) needs to be better understood to determine the global use and application of wearable technologies.

5.3

ASSISTIVE TECHNOLOGY, DIGITAL INTERVENTIONS, AND TELEHEALTH

Technology can be used in various ways to support individual health, particularly as a tool for people facing health problems. When technology is employed to aid with health-related issues, it is referred to as “assistive technology.” Assistive technology is an umbrella term for various technology-based applications designed to support people with permanent or temporary physical or mental difficulties or disabilities. According to the World Health Organization (WHO), assistive technology is part of health technology and can be defined as the organized application of knowledge and skills to assistive products, systems, and devices. Assistive products are any external product (e.g., devices, equipment, instruments, or software) intended to maintain, improve, and promote individuals’ functioning, independence, and well-being (World Health Organization and the United Nations Children’s Fund (UNICEF), 2022).

Various disciplines have explored assistive technology, focusing on different types of technologies, interventions, and target populations, making it a dynamic and ever-evolving field. For instance, assistive technology plays a critical role in helping children with disabilities (Judge, 2006) and also includes “gerontechnology” (i.e., the application of technology to support older adults; Micera et al., 2008) as well as digital interventions for improving the mental health of children and their caregivers (De Witte et al., 2021). WHO and UNICEF (2022) outlined some essential aspects related to assistive technology:

1. **Access to assistive technology is a fundamental human right**, as declared in the Universal Declaration of Human Rights (UDHR). Everyone has the right to full health and to use technology to achieve that condition. Therefore, states must ensure universal access to technology for health, work, education, and participation in political and social life.
2. **Assistive technology is mainly used by individuals** with impairments or functional difficulties, whether due to congenital, permanent, or temporary health conditions that challenge daily activities, as well as older adults whose functional abilities have decreased, and people with chronic conditions. The need for assistive technology spans different age groups:
 - a. **Children:** Assistive technology helps children with communication, mobility, and self-care difficulties or disabilities, enhancing their overall well-being and quality of life.
 - b. **Adults:** It supports individuals with communicable and noncommunicable diseases, such as type I diabetes, Parkinson’s disease, and long-term effects of COVID-19. It can also assist those without permanent conditions but experiencing temporary challenges, such as limited mobility or short-term psychological difficulties.

- c. **Older adults:** Assistive technology aids in physical and mental rehabilitation, enhances functional abilities, supports self-care and personal hygiene, and improves hearing, vision, memory, mobility, and social connectivity.
- **Everyday and social activities:** Promotes participation in sports, competitions, and social events, improves access to cultural places, and reduces the risks of social exclusion.
- **Socioeconomic benefits:** Reduces the risk of poverty.

4. Assistive technology benefits people across various areas, including:

- **Education:** Supports more accessible school environments for children with disabilities, or assists children with significant communication impairments in using tablets or computers.
- **Work:** Increases opportunities for employees with intellectual or physical disabilities to perform job-related tasks effectively.
- **Health:** Facilitates individuals' connections with doctors or healthcare facilities.

The definition and characteristics of assistive technology have changed significantly over the past two decades, shifting from low-tech portable devices (e.g., walking sticks) to electronic, computing, and telecommunications-dependent devices (Brownell, 2009; Doughty et al., 2007). These developments have led to the creation of two theoretical models for considering assistive technology and telehealth (i.e., the provision of health services via the internet, particularly in situations where distance is a critical factor). These models and definitions are expected to evolve continually, following rapid technological advancements (see Figures 3 and 4, source: Doughty et al., 2007).

Figure 3: The telehealth umbrella for technology

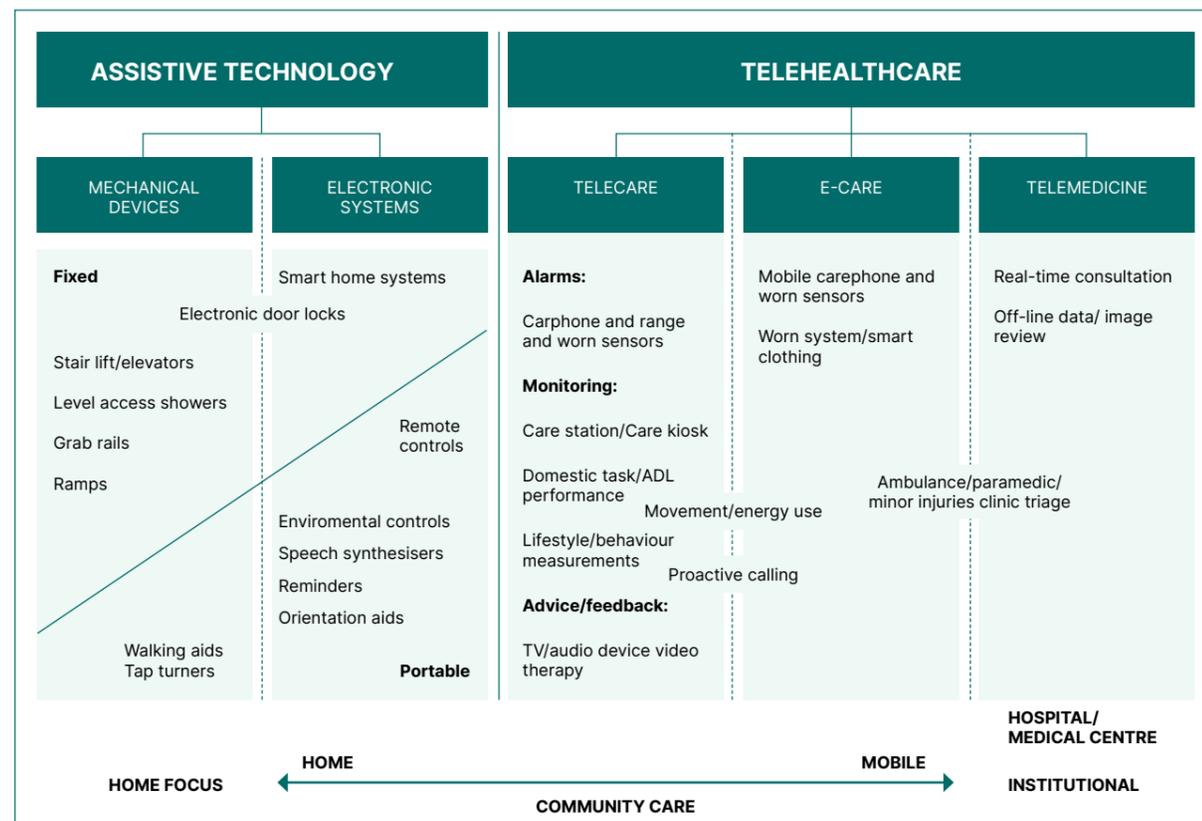
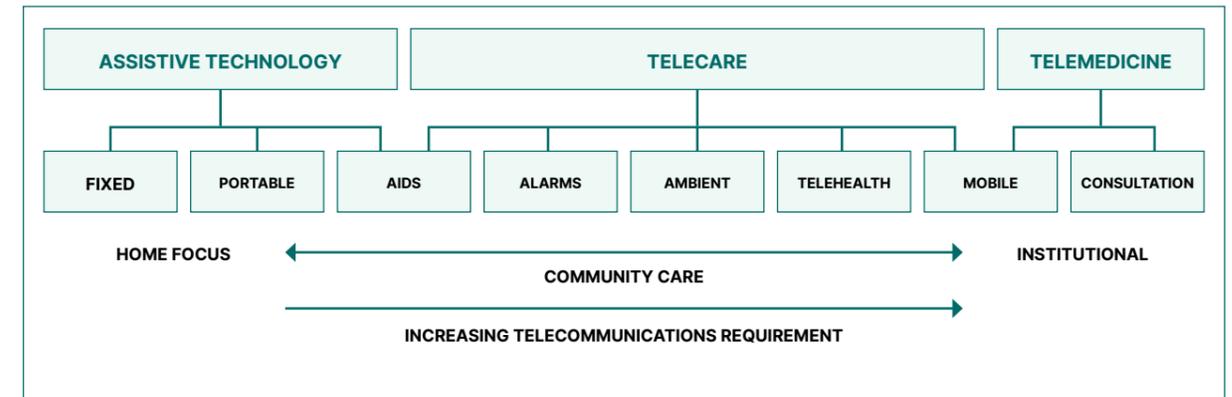


Figure 4: The continuum of care technologies centered on telecare



Telehealth can be a valuable tool for individuals to access assistive technology, as it can help reduce health inequities (Healy et al., 2023). Below, we adopt Healy et al.'s (2023) integrated model to consider how the growth of assistive technologies and telehealth has driven the technology megatrend observed over the past 30 years. We will discuss the impact of this growth on families and identify barriers to family access to assistive technologies that can be addressed by policymakers and health organizations in the future.

Growth in Assistive Technology, Digital Interventions, and Telehealth

In 2022, the World Health Organization and UNICEF released a comprehensive report documenting the increasing global need for assistive technology. This report is based on meta-analytic findings and survey data from over 70 countries, including 330,000 direct responses from individ-

uals across 29 countries (WHO & UNICEF, 2022). It revealed that over 2.5 billion people (1 in 3 globally) currently need at least one assistive technology product, with that figure estimated to rise to 3.5 billion by 2050. Furthermore, the report indicates that access to assistive technologies has substantially increased worldwide over the past 20 years, underscoring its role as a driver of the technology megatrend (WHO & UNICEF, 2022).

However, access to these necessary assistive technologies still lags significantly behind demand in every nation surveyed. Table 3 (reproduced from the WHO & UNICEF, 2022 report) illustrates this trend, showing that even in countries at the very high end of the Human Development Index—nations characterized by high levels of health, wealth, and education—more than 1 in 10 people who need assistive technology are unable to obtain it.

Table 3: Prevalence of Need for and Access to Assistive Technology in Nations at Low, Medium, High, and Very High Levels of Human Development

Classification (number of countries)	Prevalence of need for assistive products including spectacles (median and range)	Access to assistive products including spectacles (median and range)
Low (7)	14.4% (9.9% -27.2%)	10.7% (2.6%-17.1%)
Medium (9)	20.5% (13.4% -30.6%)	33.2% (15.7%-65.3%)
High (9)	26.1% (15.1% -40.3%)	64.6% (35.4% -80.2%)
Very high (4)	55.6% (34.6%-68.9%)	87.7% (54.7%-89.8%)
Classification (number of countries)	Prevalence of need for assistive products excluding spectacles (median and range)	Access to assistive products excluding spectacles (median and range)
Low (7)	8.2% (4.8% -19.6%)	7.6% (2.1% -13.8%)
Medium (9)	11.8% (4.6%-18.1%)	21.4% (9.1%-31.6%)
High (9)	8.7% (4.9% -12.1%)	52.4% (16.8% -60.9%)
Very high (4)	16.6% (8.4%-17.9%)	79.3% (40.2% -83.5%)

Notes: HDI classifications are based on HDI fixed cut-off points, which are derived from the quartiles of distributions of the component indicators. The cut off-points are HDI of less than 0.550 for low human development, 0.550-0.699 for medium human development, 0.700-0.799 for high human development and 0.800 or greater for very high human development (<https://hdr.undp.org/en/content/human-development-report-2020-readers-guide>, accessed 20 April 2022).

Moreover, the need for assistive technology is prevalent across all age groups. The WHO and UNICEF estimate that 9.7% of children under 18, 28.7% of individuals aged 18-59, and 68.7% of those over 60 worldwide require some form of assistive technology. Unfortunately, there is currently no comprehensive WHO or UN review of the global prevalence of access to or need for digital interventions or telehealth services. Consequently, we cannot estimate the growth of telehealth services globally with the same statistical certainty. However, evidence from systematic reviews of health claims in various countries indicates that telehealth services for families and children have expanded exponentially over the past 20 years (OECD, 2023; Omboni et al., 2022). This growth was significantly accelerated by the COVID-19 pandemic, which necessitated a shift to telehealth for many medical visits to prevent the spread of the virus (OECD, 2023; Omboni et al., 2022). During this period, a systematic review of telehealth in OECD nations characterized telehealth services as “skyrocketing.” For instance, in

Costa Rica, telehealth visits surged from virtually zero to over 33% of total consultations during this time (OECD, 2023). Similarly, a scoping review found that telemedicine services increased in every world region, although the extent of telehealth’s integration into care varies significantly by region (Omboni et al., 2022). More precise estimates of telehealth service utilization from different regions are needed to understand how thoroughly telehealth has been integrated into national health systems (Omboni et al., 2022).

Notably, Qatar is a leader in adopting telehealth services in the Arab region (Waheed et al., 2024). The Qatar Ministry of Public Health has introduced telehealth in collaboration with Qatar’s E-Health and Data Management Strategy, providing these services free of charge within its public healthcare system (Waheed et al., 2024). As a result, approximately 60% of healthcare providers in Qatar offer telehealth services, and a centralized digital platform launched during the COVID-19 pandemic managed over 490,000 healthcare-re-

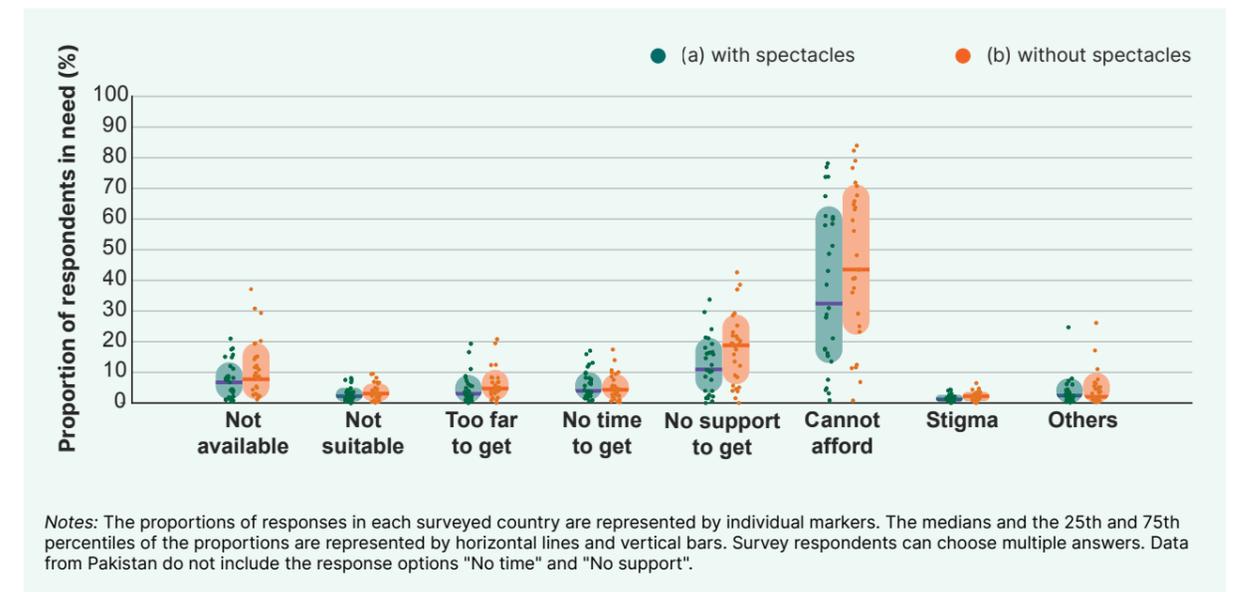
lated calls, with 67% answered effectively (Waheed et al., 2024). Telehealth services are increasingly accessible to families worldwide, and Qatar is among the nations leading the integration of these services into its healthcare system.

Barriers to Accessing Assistive Technology, Digital Interventions, and Telehealth

The WHO and UNICEF (2022) have identified three primary barriers preventing families from accessing assistive technology globally. These barriers, in order of prevalence, are: 1) families cannot afford the assistive technology; 2) families lack support in obtaining the technology; and 3) the tech-

nology is not available. Figure 4 (source: WHO & UNICEF, 2022) shows the proportion of respondents who endorsed these and other barriers to accessing assistive technologies. Additionally, the second most common method of affording assistive technologies, after out-of-pocket spending, is seeking economic support from friends and family (25% of respondents; WHO & UNICEF, 2022). Thus, at least one family member is likely to need access to assistive technology (WHO & UNICEF, 2022), and families, along with the economic support they provide, serve as a primary solution to the most significant barrier to accessing these technologies: lack of affordability.

Figure 5: Top Barriers to Accessing Assistive Technologies Worldwide



Barriers to telehealth treatment worldwide have not been as systematically studied as those for assistive technology. However, existing scoping reviews identify barriers similar to those encountered in the uptake of assistive technology. Specifically, lack of access to telehealth services due to economic factors or inadequate technology, along with the failure to integrate telehealth services into national healthcare systems, are two significant barriers to greater telehealth access globally (Omboni et al., 2022). Additionally, older individuals in Qatar may face challenges accessing digital interventions and telehealth due to the absence of technological training, lack of direct assistance with technology, and resistance to using digital tools (Al Thani et al., 2021).

Expert recommendations further highlight the role of families in promoting the uptake of both assistive technology (WHO & UNICEF, 2022) and telehealth (Omboni et al., 2022). These recommendations include: 1) enacting specific legislation and funding mechanisms to provide financial aid to families needing access to assistive technology and telehealth services, and 2) actively involving users of assistive technology and their families in the repair, maintenance, and adaptation of these technologies, as well as in the uptake of telehealth (WHO & UNICEF, 2022; Omboni et al., 2022). These policy recommendations will be elaborated upon further in Chapters 6 and 7, which will discuss existing and future policy solutions to enhance the technology megatrend.

5.4

TELECOMMUTING AND REMOTE WORK

Telecommuting and remote work are broadly defined as flexible working arrangements that allow employees to work from locations other than their offices, such as their homes (UN, 2024c). These arrangements often involve the use of telephones, the internet, and videoconferencing to perform job tasks (UN, 2024c).

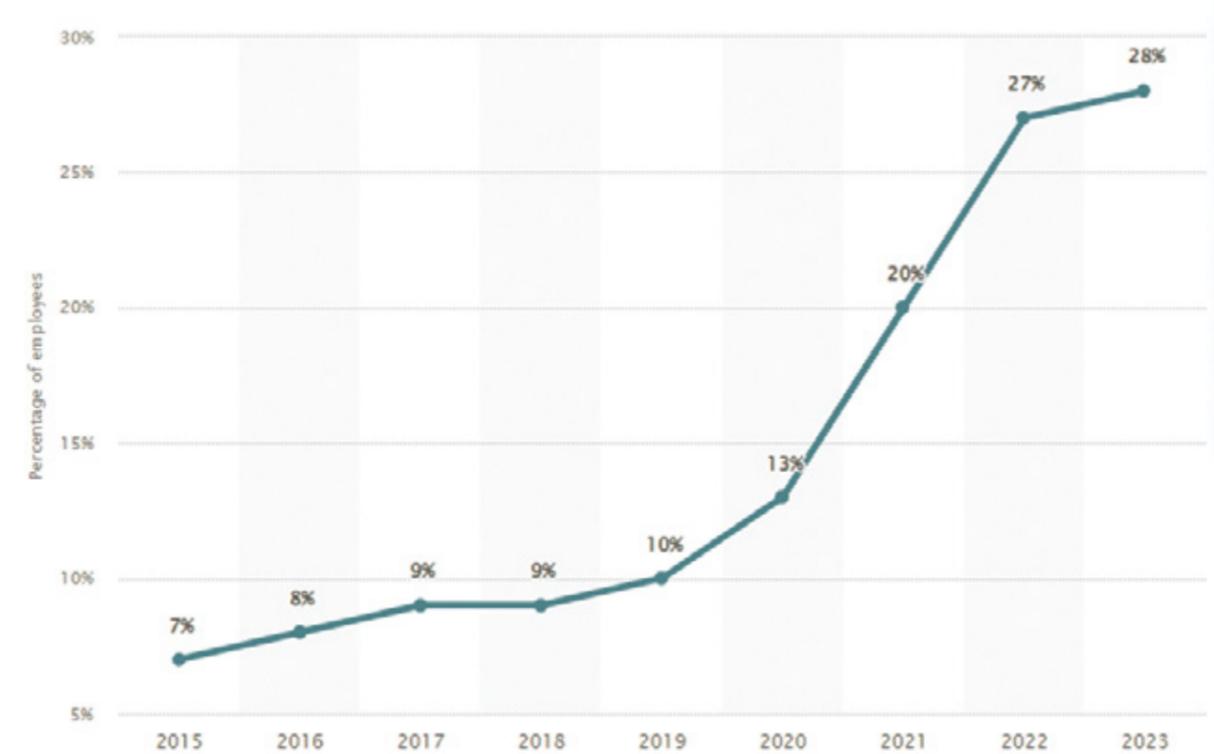
The Trend Toward Increasing Telecommuting and Remote Work Worldwide

As access to the internet and communication technologies has expanded globally (ITU, 2023), opportunities for telecommuting and remote work have increased as well (UNDP, 2021). This expansion has also opened new avenues for workers to start their own digital businesses (UNDP, 2021) and engage in the gig economy—a labor market characterized by short-term contracts or freelance work, often mediated by technology, such as rideshare apps like Uber and accommodation platforms like Airbnb (UNDP, 2021). Consequently, telecommuting and remote work present new opportunities for work-life balance and economic prosperity for families, but they also introduce potential threats to work-life balance and the risk of exploitation (UNDP, 2021). The implications of

this evolving nature of work are discussed further in Chapter 6.

The adoption rate of telecommuting and remote work practices has increased exponentially since the onset of the COVID-19 pandemic (Aksoy et al., 2023; Sherif, 2024; UNDP, 2021). Most nations implemented lockdown measures during the pandemic, preventing many employees from working in person and accelerating the shift toward telecommuting and remote work setups (UNDP, 2021). Exact estimates of how many workers globally engage in remote work at least part of the time are challenging to generate due to a lack of nationally representative surveys. However, existing surveys suggest that 26% to 28% of employees globally work remotely at least part of the time (Aksoy et al., 2023; Sherif, 2024), with estimates indicating that between 8% and 28% of workers work from home most of the time (Aksoy et al., 2023; Sherif, 2024). Furthermore, surveys indicate that the number of remote workers has nearly tripled since pre-pandemic levels and has increased fourfold since 2015 (Sherif, 2024). Figure 6 below, provided by Sherif (2024), illustrates this trend.

Figure 6: Estimated Percentage of Employees Who Work from Home All or Most of the Time from 2015 to 2023



Source of Figure 6: <https://www.statista.com/statistics/1450450/employees-remote-work-share/>

These trends toward increased telecommuting and remote work are evident across every world region (Aksoy et al., 2023; Sherif, 2024; UNDP, 2021), including the Middle East and North Africa in general (Bahsoun, 2022) and Qatar in particular (Hajhamad, 2022). However, as is the case worldwide, exact estimates of how many workers engage in remote work in the Middle East and North Africa are difficult to find, and no nationally representative surveys exist. Nonetheless, one convenience sample of more than 1,500 employees from across the Middle East reported that 72% worked remotely at least part-time, with 60% of employees in Qatar indicating that they work remotely at least some of the time (Bahsoun, 2022; Hajhamad, 2022). While it is challenging to assess how representative these samples are of Qatar or the Middle East as a whole, they nonetheless reflect the growing trend toward remote work in the region.

As families worldwide access more communication technology, experts anticipate a continued increase in remote work (UNDP, 2021; UN, 2020b). Access to remote work shapes family life in numerous ways (UNDP, 2021; UN, 2020b). Specifically, remote work opens opportunities for families to start their own businesses, economically prosper in new ways, potentially relocate to more affordable areas, and achieve better work-life balance (UNDP, 2021; UN, 2020b). However, many jobs in all nations cannot be performed remotely, and numerous employers are enacting “return to office” policies now that the COVID-19 pandemic is over (UNDP, 2021). Consequently, in some nations with more technologically connected and advanced economies, the percentage of workers who work remotely has stabilized or even slightly decreased since the pandemic (Aksoy et al., 2023). While the overall trend worldwide points toward increases in remote work for the foreseeable future, this trend has slowed or

could potentially slow in more technologically developed nations (Aksoy et al., 2023).

Drivers of Telecommuting and Remote Work

Existing research identifies two major drivers of telecommuting and remote work: 1) whether families reside in more technologically and economically developed nations and 2) whether family members possess the technological skills and economic means necessary for remote work. More technologically and economically developed nations provide more opportunities for telework and remote work because they have the technological capacity and financial resources to invest in infrastructure that facilitates telework (ITU, 2023). This infrastructure includes national broadband internet networks and affordable access to digital communication technologies like cell phones, videoconferencing software, and computers (ITU, 2023). Economies in these nations also grow increasingly dependent on knowledge-intensive sectors such as telecommunications, financial institutions, real estate, and education, as well as manufacturing and agriculture (UNDP, 2021). Given that remote and telework opportunities are most prevalent in these knowledge-generation fields (Aksoy et al., 2023; UNDP, 2021), families living in such nations are more likely to have access to telework and remote work opportunities.

Similarly, within any given nation, families with greater technological skills and economic means are more likely to have opportunities for telework (UNDP, 2021). Such families are more likely to possess the technological literacy necessary for family members to operate the technology required for telework (UNDP, 2021). They are also more likely to be on career paths that provide them with the economic means to obtain the technology necessary for remote work and to have career paths that offer opportunities for remote work (UNDP, 2021). Illustrating this point, highly skilled and younger employees typically engage in continuous education opportunities that promote digital literacy at rates double those of low-skilled and older employees (UNDP, 2021).

In summary, the rapid increase in telecommuting and remote work worldwide has radically shifted how families approach work (UN, 2020a; UN, 2020b; UNDP, 2021). This shift has been driven by the increasing integration of technology into societies, persistent economic development, and advancements in digital literacy and access to technology for families (UNDP, 2021). Although this changing nature of work opens new doors for family prosperity and work-life balance, it also presents potential pitfalls. Future chapters will discuss these outcomes and their potential policy implications. Ultimately, the rapid increase in telecommuting and remote work worldwide is one of the chief drivers of the technology mega-trend and its effects on families around the globe (UN, 2020a; UN, 2020b; UNDP, 2021).

Summary

This chapter examined four key predictors of how the technology megatrend impacts families globally and in the Middle East. These predictors include: the emergence and increasing popularity of assisted reproductive technology; the proliferation of communication technologies; the increased use of assistive technologies, digital interventions, and telehealth; and the rise of telecommuting and remote work. Each of these trends profoundly shapes how technology affects family dynamics.

- **Assistive reproductive technologies** are becoming increasingly important for helping families grow, as 1 in 6 people experience infertility at some stage in life. From 2015 to 2020, the number of children born through assistive reproductive technology grew from 157,000 to 9 million worldwide. However, inequalities in access to this technology and debates regarding its application in different cultural contexts persist.

- **The growth of communication technologies**, including online video games, internet-based devices, social media, and wearable technology, has been exponential over the past 20 years. Most people now own such technologies, and family members spend increasing amounts of their day on them, reshaping family communication and connection.
- **Access to assistive technologies and telehealth** has substantially increased in recent years, allowing more people to obtain needed healthcare and health technologies. Yet, even in the most developed nations, over 1 in 10 people who need assistive technologies cannot access them. Given that most family members will require such technologies at some point, and families often serve as primary sources of financial and social support, assistive technologies are becoming integral to how families work, play, and find fulfillment together.
- **Telecommuting and remote work** have increased at least fourfold since the onset of the COVID-19 pandemic. This shift opens new economic opportunities and provides families with more chances to balance work and family life. However, opportunities for remote work are more plentiful for families in technologically and economically advanced nations, as well as for those who possess greater technological skills and economic means.

All four of these drivers of technological change have increasingly integrated technology into families' lives. The outcomes of this technological megatrend for families will be explored in the next chapter.

OUTCOMES

The current chapter explores the outcomes of technological changes on families, detailing technology-related potential risks, benefits, and changes occurring at both individual and family levels. In Qatar and around the world, the introduction and proliferation of new medical and communication technologies have generated substantial changes in family formation, characteristics, and experiences related to health and well-being (Ortiz-Ospina & Roser, 2024; Roser et

al., 2024). The individual family's use of internet technologies and social media can be beneficial or harmful, depending on how technology is utilized (Cotten, 2022; Cotten et al., 2011; Valkenburg et al., 2022; Winther et al., 2022). Below, we provide an overview of the technology megatrend's impact on the health and well-being of families, including a discussion on how this megatrend has increased access to health services and affected families' physical and mental health.



Moreover, technology has always been inter-linked with education, but this connection has become stronger, particularly after the COVID-19 outbreak. New knowledge can emerge through technology, and technological changes are often driven by new ideas and knowledge. This strong connection necessitates continuous reflection on the best ways to effectively use technology for education, how it impacts learning and skills development, and the challenges associated with using technology in educational contexts. Additionally, technology has introduced significant changes in the information and materials available online, affecting how both adults and children engage with the internet and technology, which creates potential privacy risks that will be detailed later in the chapter.

Finally, work and job characteristics around the world have radically changed in the last decade due to technological shifts (UNDP, 2021). Now more than ever, many families have members who are telecommuting, working remotely, starting their own digital businesses, or participating in the gig economy (UNDP, 2021). As described by the UNDP Accelerator Labs (co-built by the Qatar Fund for Development), the nature of work is evolving (UNDP, 2021), making it essential to explore the impacts of these changes on work-family balance, family relationships, family health, and family economic prospects resulting from the technology megatrend's transformation of work.

6.1

FIRST OUTCOME: CHANGES IN FAMILY FORMATION, CHARACTERISTICS, AND RELATIONSHIPS WITHIN THE FAMILY

Several studies highlight the role of technology in family formation, structure, and parent-child relationships (Burhan et al., 2021; Kurt, 2023; Smedts, 2008). First, technology can influence how individuals enter parenthood and the overall concept of parenthood (i.e., the social status of being a parent and the psychological and emotional adjustments required to meet the needs of children; Guzzo & Hayford, 2020). Assisted reproductive technology (ART) has introduced new ways of becoming parents and created new forms of parenthood, leading to a disjunction between the genetic, gestational, and social aspects of parenthood (United Nations Educational & International Bioethics Committee, 2019). By separating sexuality from procreation and contraception, ART may contribute to increased acceptance of gender equality and non-traditional family structures, fostering inclusivity.

Second, technology can facilitate or hinder the construction of emotional bonds within the family, reinforcing or undermining the notion of family as a primary source of emotional belonging (Carvalho et al., 2015; Romero-Ruiz et al., 2017). Technology has benefits for families, such as providing parents with support in parenting practices and access to online resources for parenting skills (Haslam et al., 2017). However, it also has negative aspects, including its interference with parent-child relationships (Modecki et al., 2020). Technology can mediate communication within

the family. A recent review of 73 peer-reviewed studies categorized technology use within the family into four types: personal use of technology (i.e., each family member uses technology alone, with no interaction with other relatives), technoreference (i.e., using technology for personal purposes in the presence of family members), technology-mediated communication between family members, and co-use of technology with family members (Tammisalo & Rotkirch, 2022). The review concluded that personal use of technology and technoreference were related to negative relationship outcomes, such as low marital quality, relational aggression and distress, limited time spent together as a family, and low parental adjustment. Conversely, technology-mediated communication was associated with positive relationships between parents and children, siblings, and other relatives, increasing perceptions of satisfaction, intimacy, and support within the family (although no conclusions were drawn about whether technology-mediated communication generates relational closeness for romantic partners). Finally, co-use of technology was connected to positive relational outcomes (Tammisalo & Rotkirch, 2022).

Third, modern parents are tasked with protecting their children from the risks associated with digital media and technology while teaching them how to use technology properly (Kurt, 2023). Risks such as technology addiction, prolonged screen time,

social media pressure, excessive use, exposure to harmful and inappropriate content, unwanted privacy disclosure, and cyberbullying can negatively impact children's well-being, necessitating parental monitoring and control (Chen et al., 2023). Parents must mitigate technology-related risks and teach children how to use technology to maximize its benefits (Yadav & Chakraborty, 2022).

Fourth, technological advances in medicine have increased longevity, allowing younger and older family members to spend more time together. This is also connected to a prolonged transition to adulthood and independence from the nuclear family, resulting in stronger intergenerational ties and relationships (Fingerman et al., 2020).

Finally, technological changes, combined with globalization, demographic shifts, societal changes, and economic developments, have led (and continue to lead) to transformations in gender roles within families (Oláh et al., 2018; Oláh et al., 2020). Before delving into this topic, it is essential to emphasize that while changes in gender roles can be described as resulting from technological advancements (as part of a broader modernization process), this is a complex issue (Inglehart, 2020). Indeed, the transformation of gender roles is linked to various technological, demographic, historical, and economic factors, creating an intricate connection that makes it challenging to attribute changes in gender roles solely to technological advancements. Moreover, although transformations in gender roles are a global phenomenon, cultural differences exist in how these roles are defined and enacted. Different world regions, countries, and policy contexts have developed distinct patterns of family characteristics and gender roles, both in the past and present.

Major trends affecting gender roles in families are connected to increases in infertility rates and the age of marriage and childbearing. In turn, infertility and postponed family creation are related to changes in women's employment aspirations and emerging female work patterns (Bertrand, 2020). New educational systems and labor markets often require individuals to achieve higher educa-

tion and skills development levels. Consequently, many people delay starting a family to pursue further education and career advancement. In exploring changes in gender roles, theoretical frameworks (Goldscheider et al., 2015; Oláh et al., 2018) differentiate between two phases: the first phase is characterized by women achieving economic independence and responsibilities that were historically attributed only to men, while the second phase sees men becoming more active in child-rearing. Nevertheless, men's increasing contribution to domestic tasks and family care activities remains a growing phenomenon, often considered essential for achieving a complete gender revolution.

6.2

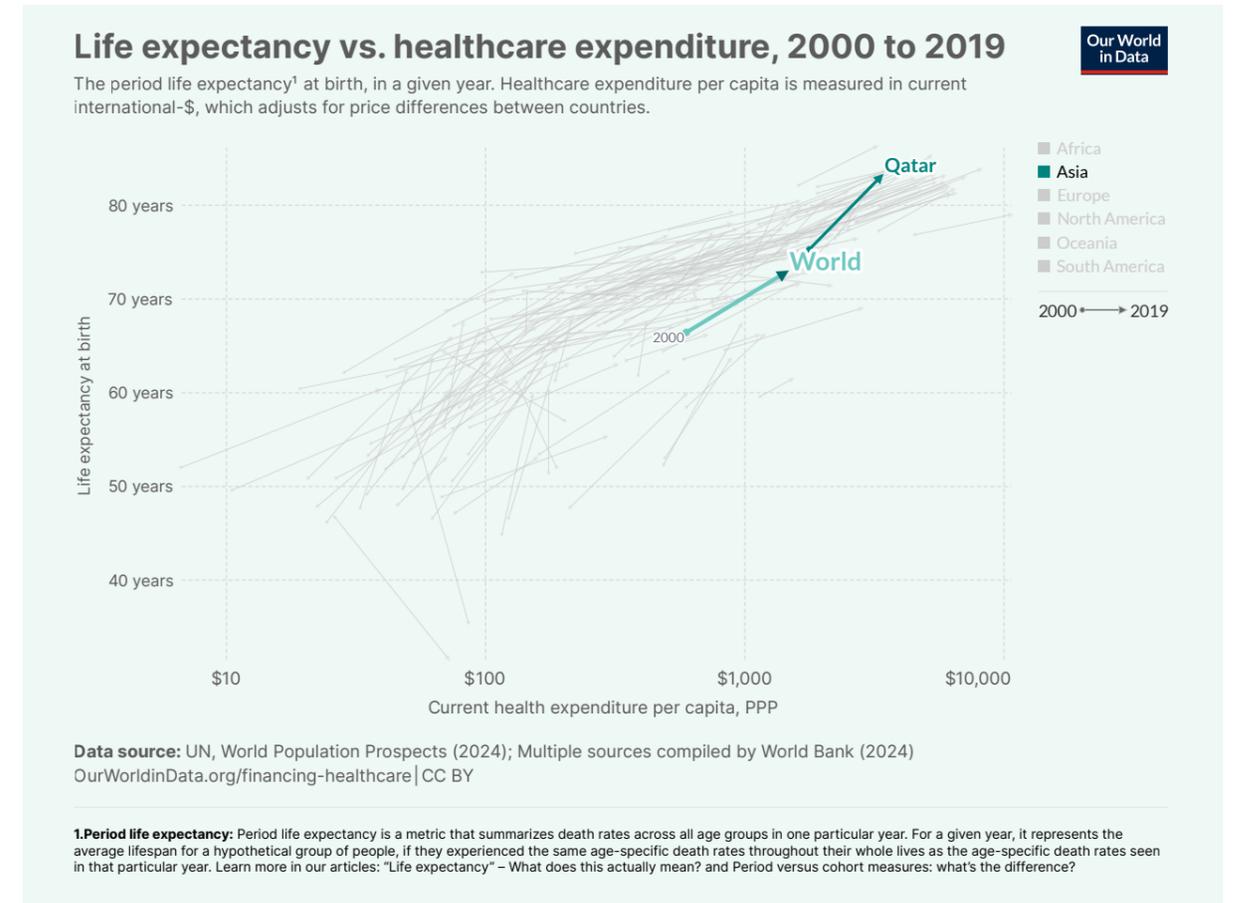
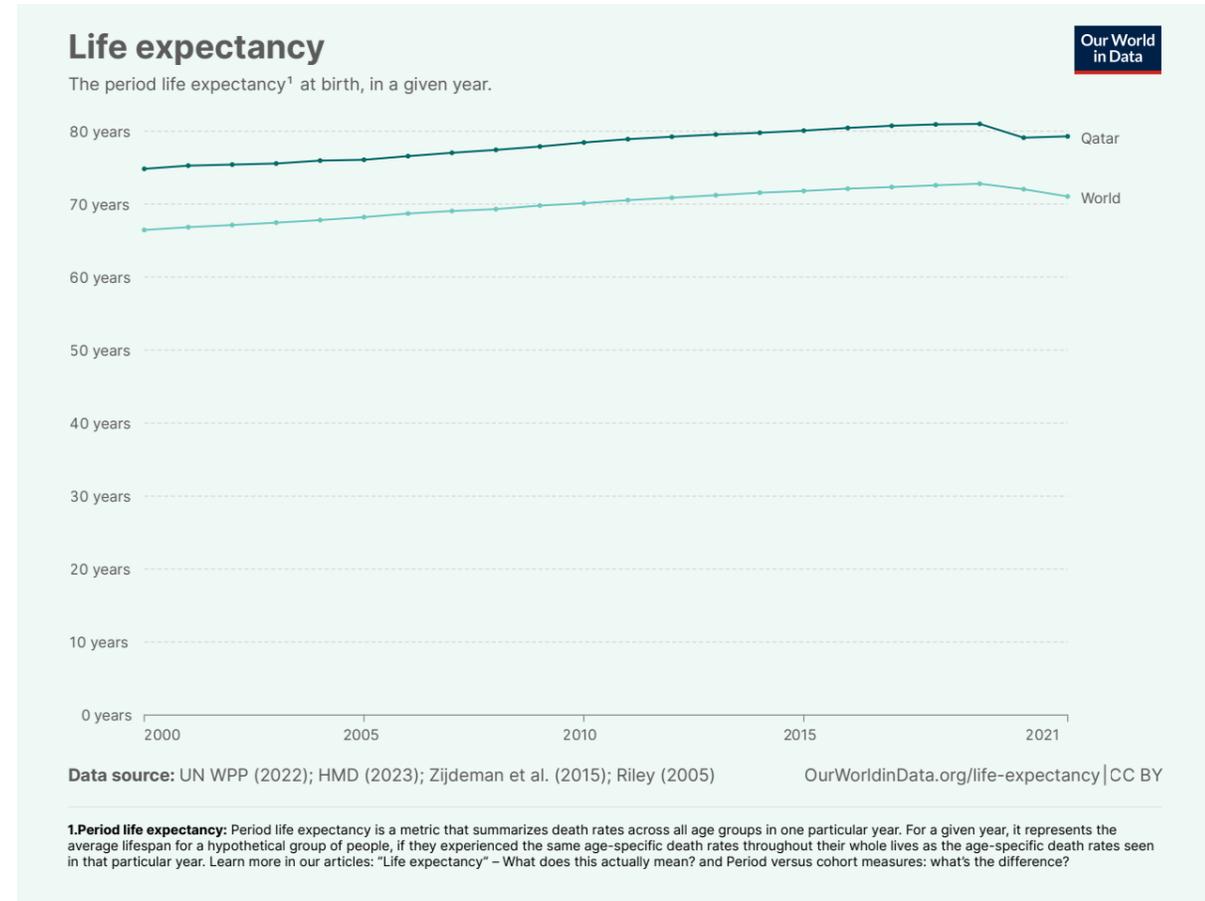
SECOND OUTCOME: CHANGES IN FAMILY MEMBERS' HEALTH AND WELL-BEING

Increased Access to Health Services

Over the last 20 years, technological innovations in medicine have contributed to improvements in multiple health indicators that benefit families, including increased life expectancy, declines in child mortality, reductions in hunger, and long-term declines in global poverty (Roser et al., 2024). These technological advancements are often logistical innovations, as they ensure that more families can obtain vaccines, primary care

services, maternal care services, and life-saving medicines. Additionally, they facilitate greater access to health-promoting indoor plumbing, electricity, and clean cooking sources (Bradley & Rothenberg, 2022; Ortiz-Ospina & Roser, 2024). The charts below demonstrate this trend, highlighting that life expectancy has increased worldwide and in Qatar in particular, as investment in healthcare and public health systems (such as proper sanitation) has grown (Ortiz-Ospina & Roser, 2024; Roser et al., 2024).

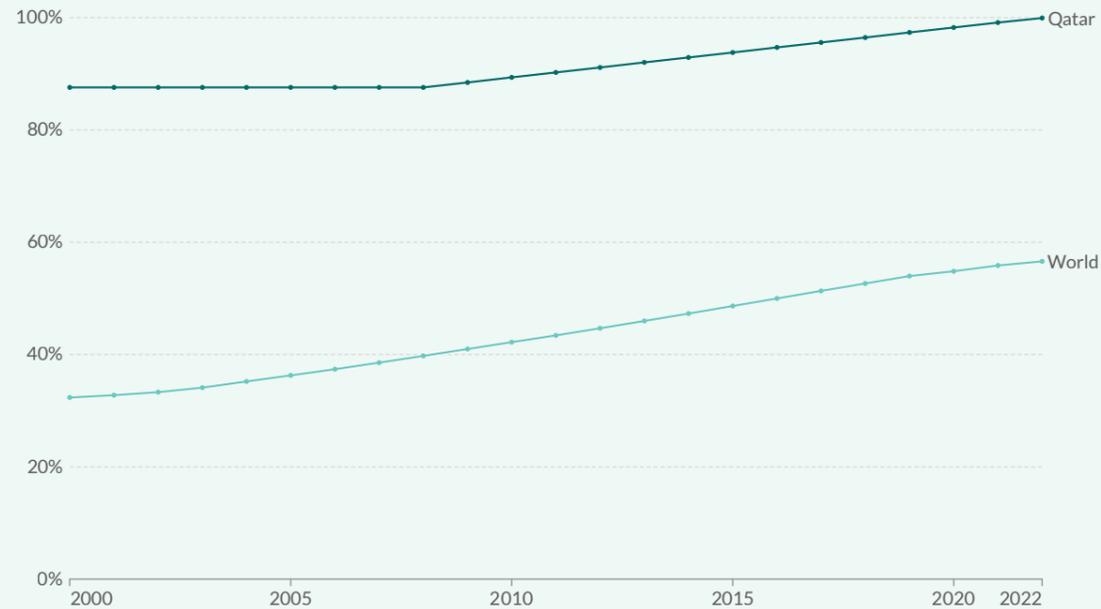
Figure 1: Series of 3 Charts Demonstrating Increases in Life Expectancy, Associations between Increased Healthcare Investment and Life Expectancy, and Increases in Clean Water and Sanitation in Qatar and Around the World.



Share of the population using safely managed sanitation facilities

Our World
in Data

Safely managed sanitation is improved facilities¹ which are not shared with other households and where excreta are safely disposed in situ or transported and treated off-site.



Data source: WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP) (2024)
OurWorldinData.org/sanitation | CC BY

1. Improved sanitation facilities: Improved sanitation facilities are those designed to hygienically separate excreta from human contact, and include: flush/pour flush toilets connected to piped sewer systems, septic tanks or pit latrines; pit latrines with slabs (including ventilated pit latrines), and composting toilets.

Source: Roser et al., 2024; Ortiz-Ospina & Roser, 2024

These charts demonstrate that one outcome of the technological megatrend benefiting family health has been increased investment in health technologies, leading to greater life expectancy in Qatar and globally (Ortiz-Ospina & Roser, 2024; Roser et al., 2024). When observers consider technology's impact on healthcare, they might envision complex robotic surgery systems or AI doctors. However, over the last 20 years, technological innovations that improve the transportation and storage of vaccines, expand the availability of primary care visits, educate healthcare professionals, enhance food security, and create safer family environments have played a much more crucial role in promoting family health (Bradley & Rothenberg, 2022; Ortiz-Ospina & Roser, 2024; Roser et al., 2024). Continued investment in these technologies is essential to close gaps in family access to medicines and healthcare (Ortiz-Ospina & Roser, 2024; Roser et al., 2024). Indeed, the poorest and least developed nations still lag significantly behind in training medical professionals per capita, access to medicines and vaccinations, and availability of medical services and hygienic family environments (Bradley & Rothenberg, 2022; Ortiz-Ospina & Roser, 2024; Roser et al., 2024).

In addition to logistical and public health technologies, other innovative solutions are also enhancing family access to healthcare at unprecedented rates by increasing access to telehealth, assistive technologies, and online health content. Furthermore, innovations in information technology have enabled the creation of data systems that link care for families across providers and health systems (Bhaskar et al., 2020; Jia et al., 2021; Rajput, 2023; Ravinetto et al., 2024; WHO & UNICEF, 2022).

Globally, telemedicine has expanded rapidly since the onset of COVID-19, providing new opportunities for families around the world to access health services (OECD, 2023; Omboni et al., 2022). However, over 85% of telehealth patients in the early months of the pandemic were from high-income countries, highlighting the need for further expansion of telemedicine services in low-income nations (Rajput, 2023). This expansion seems to

be welcomed by clinicians, as 66% of healthcare professionals worldwide expect most medical consultations to be conducted remotely in the next 10 years (Rajput, 2023). Policymakers and scientists have advocated for a shift in telemedicine investment toward low- and middle-income nations, believing that telemedicine can serve as a "safety net" to ensure that most people worldwide receive medical care during future public health emergencies (Bhaskar et al., 2024).

The situation is similar for assistive technologies. The expansion of assistive technologies in the last 20 years has provided more families with greater access to items such as spectacles, hearing aids, and rehabilitation equipment than ever before (WHO & UNICEF, 2022). However, significant gaps remain in access to these technologies, with families in high-income nations being almost nine times more likely to obtain them compared to those in low-income nations (WHO & UNICEF, 2022).

Another way the technology megatrend has increased healthcare access for families is through the much more widespread availability of medical information online (Jia et al., 2021). Experts generally agree that broad access to health information online has positively impacted families seeking knowledge about their health conditions, aided by the existence of online communities and forums that answer health questions, privacy features provided by browsing online, and archived health information (Jia et al., 2021). However, a lack of misinformation checks and low reliability of health information can also limit the extent to which online medical information can improve family health (Jia et al., 2021).

A final way the technology megatrend is reshaping healthcare access is through the widespread proliferation of information systems that link care and medical records from multiple providers (Rajput, 2023; Ravinetto et al., 2024). Electronic medical records allow healthcare providers to coordinate care, ensuring better outcomes for the families they serve, and enable national health systems to identify emerging public health crises and respond

rapidly (Rajput, 2023; Ravinetto et al., 2024). As artificial intelligence, machine learning, and other advanced data analytic technologies are adopted more widely, they have the potential to further improve health data and outcomes for families (Bizzego et al., 2022; Rajput, 2023; Ravinetto et al., 2024). However, this proliferation of health data raises serious privacy concerns regarding who has access to such data and how it will be used (Rajput et al., 2024; Ravinetto et al., 2024).

Technology's Impact on Mental and Physical Health

The discussion around technology's impact on mental and physical health has centered on two different types of conversations. The first examines how technological innovations in medical and public health interventions, along with the global dissemination of these interventions, have broadly improved family health over the last several decades (Bradley & Rothenberg, 2022; Ortiz-Ospina & Roser, 2024; Roser et al., 2024). The second, perhaps more contemporary discussion focuses on how families' use of the internet and social

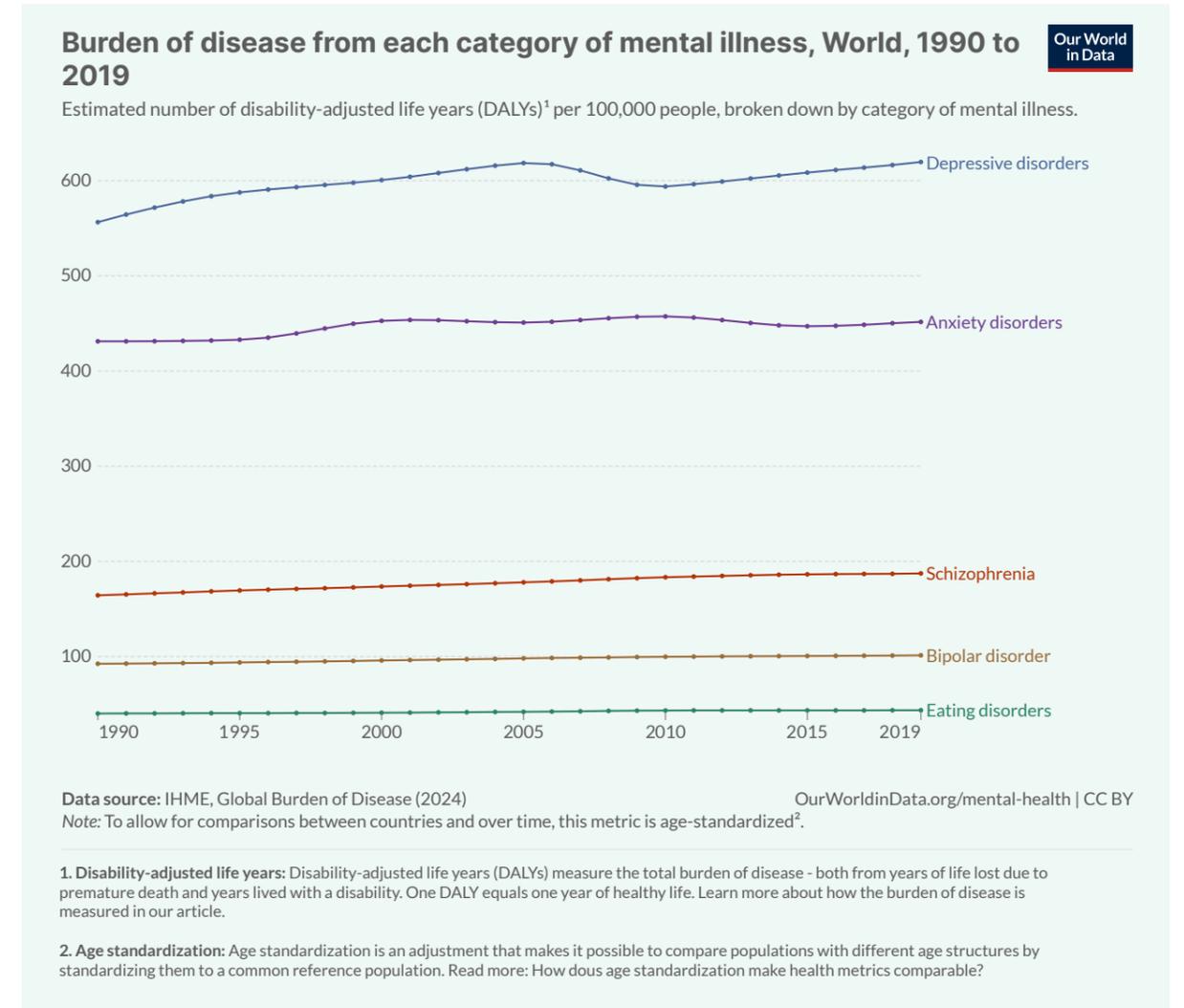
media technologies has impacted family health in recent decades (Cotten, 2022; Cotten et al., 2011; Valkenburg et al., 2022; Winther et al., 2022). We explore both questions when considering mental health and physical health in the sections below.

Mental Health

Have Technological Interventions Improved Family Mental Health in the Last Several Decades?

Unfortunately, despite the rollout of new mental health technologies in the form of evidence-based treatments (Weisz et al., 2017), it appears that mental health problems have not decreased dramatically in the last 30 years. Figure 2 below shows this trend; despite the rapid development of evidence-based mental health interventions, the burden of disease from mental illnesses worldwide per 100,000 people has not significantly decreased (and may have even increased due to COVID-19; GBD 2019 Mental Disorder Collaborators, 2022; Roser et al., 2024).

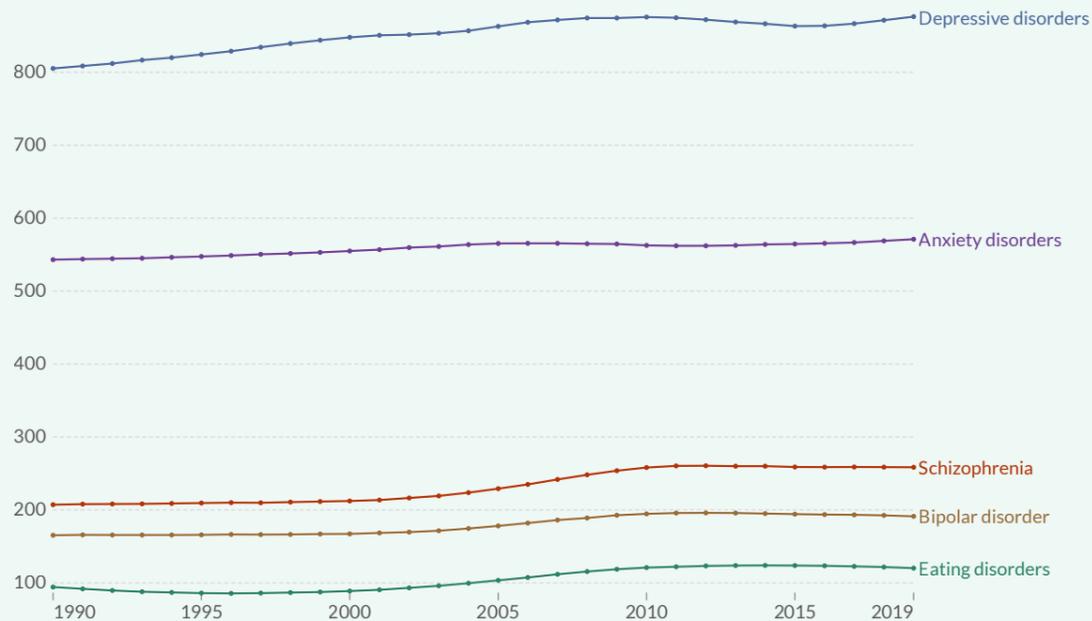
Figure 2: Burden of disease from mental illness around the world and in Qatar, from 1990 to 2019



Burden of disease from each category of mental illness, Qatar, 1990 to 2019

Our World in Data

Estimated number of disability-adjusted life years (DALYs)¹ per 100,000 people, broken down by category of mental illness.



Data source: IHME, Global Burden of Disease (2024)

OurWorldinData.org/mental-health | CC BY

Note: To allow for comparisons between countries and over time, this metric is age-standardized².

1. **Disability-adjusted life years:** Disability-adjusted life years (DALYs) measure the total burden of disease - both from years of life lost due to premature death and years lived with a disability. One DALY equals one year of healthy life. Learn more about how the burden of disease is measured in our article.

2. **Age standardization:** Age standardization is an adjustment that makes it possible to compare populations with different age structures by standardizing them to a common reference population. Read more: How does age standardization make health metrics comparable?

Source: <https://ourworldindata.org/grapher/burden-disease-from-each-mental-illness?time=1990..2019&country=~QAT>

Mental health interventions developed and deployed over the last 30 years have proven effective worldwide, with improvements reported for over 60% of children and adults, comparable to gains seen with many traditional medical interventions (Cuijpers et al., 2020; Weisz et al., 2017). So why haven't these new intervention technologies decreased the global disease burden of mental illness in families? The issue appears to be accessibility (GBD 2019 Mental Health Collaborators, 2022). Most families in most regions of the world who need mental health services—including families in high-income nations—lack access to these services (GBD 2019 Mental Health Collaborators, 2022). To disseminate evidence-based mental health interventions and promote access, governments and the global health community need to collaborate on coordinating and distributing such interventions (GBD 2019 Mental Health Collaborators, 2022).

New technologies can help promote the dissemination and uptake of mental health services. For instance, new single-session mental health interventions that incorporate evidence-based principles are cheaper and quicker to deploy than longer protocols, can be accessed online, and remain highly effective for children and families (Schleider & Weisz, 2017). Additionally, family-wide evidence-based interventions for treating mental health problems have been adapted for online delivery, such as self-paced courses or workbooks (Nystrand et al., 2019). Although these interventions are not as effective as services provided by a mental health professional, they are still effective enough to be extremely cost-efficient and have great potential as first-line prevention programs that can be made available to entire populations of families (Jent et al., 2021; Nystrand et al., 2019). Furthermore, telehealth-based family therapy programs have been developed and shown to effectively treat child mental health difficulties (Comer et al., 2017), even for families who otherwise would not be able to access care (Davis et al., 2022; Garcia et al., 2021). Combinations of single-session interventions, online-delivered interventions, and telehealth options could allow for the wider dissemination of mental health treat-

ments to families worldwide and begin to reduce mental health burdens (GBD 2019 Mental Health Collaborators, 2022).

Have Families' Use of Internet and Social Media Technologies Impacted Mental Health?

A second, narrower, but more hotly debated topic concerning the technology megatrend and family mental health is whether the increasing use of the internet and social media technologies by families has helped or harmed mental health (Winther et al., 2022; Valkenburg et al., 2022). In addressing this question, it is crucial to avoid adopting technological determinism—the belief that technology itself directly causes positive or negative mental health outcomes (Cotten, 2022). The impacts of the internet and social media on family members' mental health largely depend on how these technologies are used, by whom, and for what purpose (Cotten, 2022).

When examining social well-being, systematic reviews and meta-analyses indicate that the use of internet and social media technologies generally promotes social well-being and connection in both children and adults (Winther et al., 2022; Valkenburg et al., 2022). Although these effects are small, they suggest that internet and social media users typically engage with these platforms to strengthen existing social relationships (Hancock et al., 2022; Winther et al., 2022; Valkenburg et al., 2022). These benefits also seem to apply to families in the Middle East, North Africa, and Qatar in particular (Winther et al., 2022). However, the research evidence examining these impacts in the Middle East and Qatar is limited, and new analyses with larger, more representative datasets are essential (Winther et al., 2022).

The question of whether social media use contributes to increases in mental illness, particularly anxiety and depression, remains incredibly controversial. Generally, experts agree that it is still too soon to determine whether social media use leads to greater depression and anxiety, and more data is needed from samples outside the United States and Europe to reach a clear conclusion (U.S. Sur-

geon General, 2023; Winther et al., 2022). That said, there is growing evidence suggesting that social media can be harmful to child and adolescent mental health (U.S. Surgeon General, 2023; Valkenburg et al., 2023), although the effects are very small and represent only one potential influence on mental health problems in these populations (U.S. Surgeon General, 2023; Valkenburg et al., 2023). An umbrella review of the evidence from seven meta-analyses and nine systematic reviews indicated that most associations between social media use and mental health in children were weak and inconsistent, but typically linked to slight increases in risks for anxiety and depression symptoms (Valkenburg et al., 2023). A similar meta-analysis that included adults found comparable small negative associations between social media use and depression and anxiety (Hancock et al., 2023). Other research suggests that this effect may only be evident at higher levels of social media use, such as three hours or more spent daily (Riehm et al., 2019). However, these potential harms are notable, as many adolescents around the world, including in the Gulf region, spend three or more hours a day on social media (U.S. Surgeon General, 2023; Winther et al., 2022).

In summary, existing evidence indicates that increased family use of social media has trade-offs; it slightly enhances social connection and support while also raising risks for anxiety and depression. How parents set limits around social media use, along with how they model and discuss social media engagement, likely plays a significant role in determining how these benefits and harms affect individual families (Winther et al., 2022). Additionally, governments and social media companies should collaborate to ensure that inappropriate

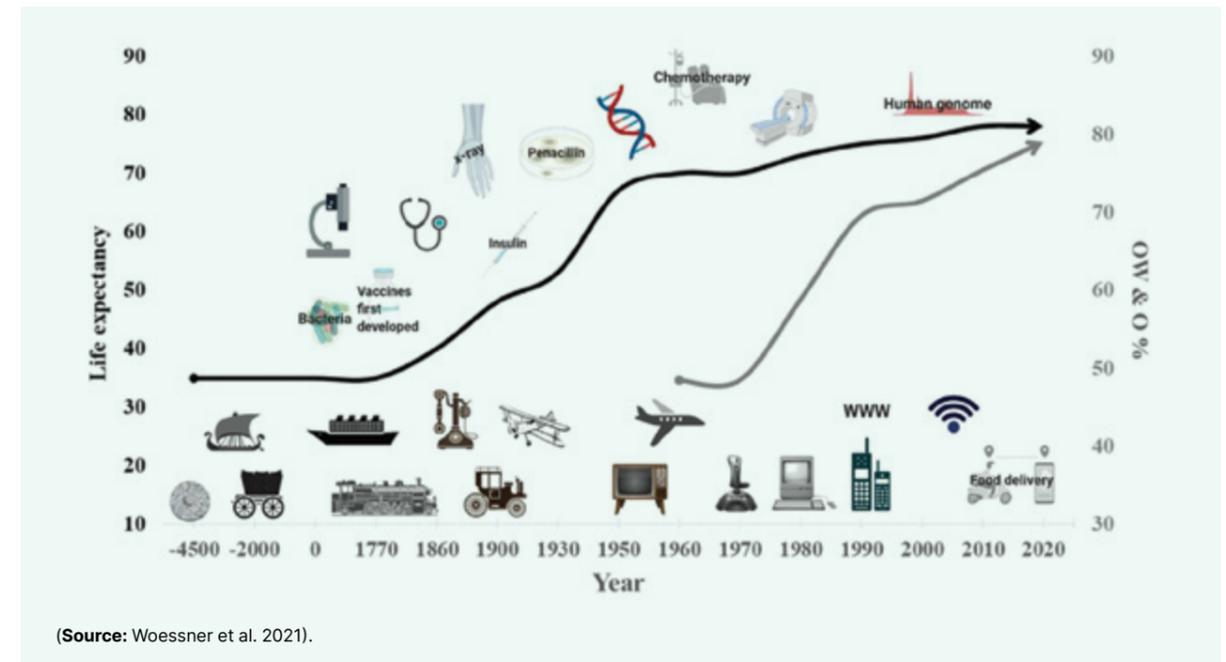
content—which can cause mental distress—is not easily accessible to minors (Winther et al., 2022). Ongoing debates about the best policies to prevent such inappropriate content from reaching children are essential and worthwhile to engage in globally (Winther et al., 2022).

Physical Health

Have Technological Interventions Improved Family Physical Health in the Last Several Decades?

It is clear that technological innovations in health-care have promoted family physical health over the last several decades. As discussed above, increased access to safe drinking water, improved housing and cooking environments, and the development of life-saving medicines, vaccines, and other health technologies have increased life expectancy and decreased the global burden of disease, both worldwide and in Qatar (Ortiz-Ospina & Roser, 2024; Roser et al., 2024). Moreover, advanced technology has replaced several physically demanding activities and jobs, allowing people to utilize machines for manual labor. Although technological innovations have enabled people to move away from physically demanding work—positively affecting their quality of life—and have facilitated medical treatments and innovations that enhance physical health globally, they have also contributed to more sedentary behaviors and negative habits, such as unhealthy sleep patterns (Nakshine et al., 2022; Woessner et al., 2021). As a result, the rate of obesity and its health-related consequences, including hypertension, diabetes, heart disease, strokes, and cancers, have increased (Silveira et al., 2022), as shown in Figure 3.

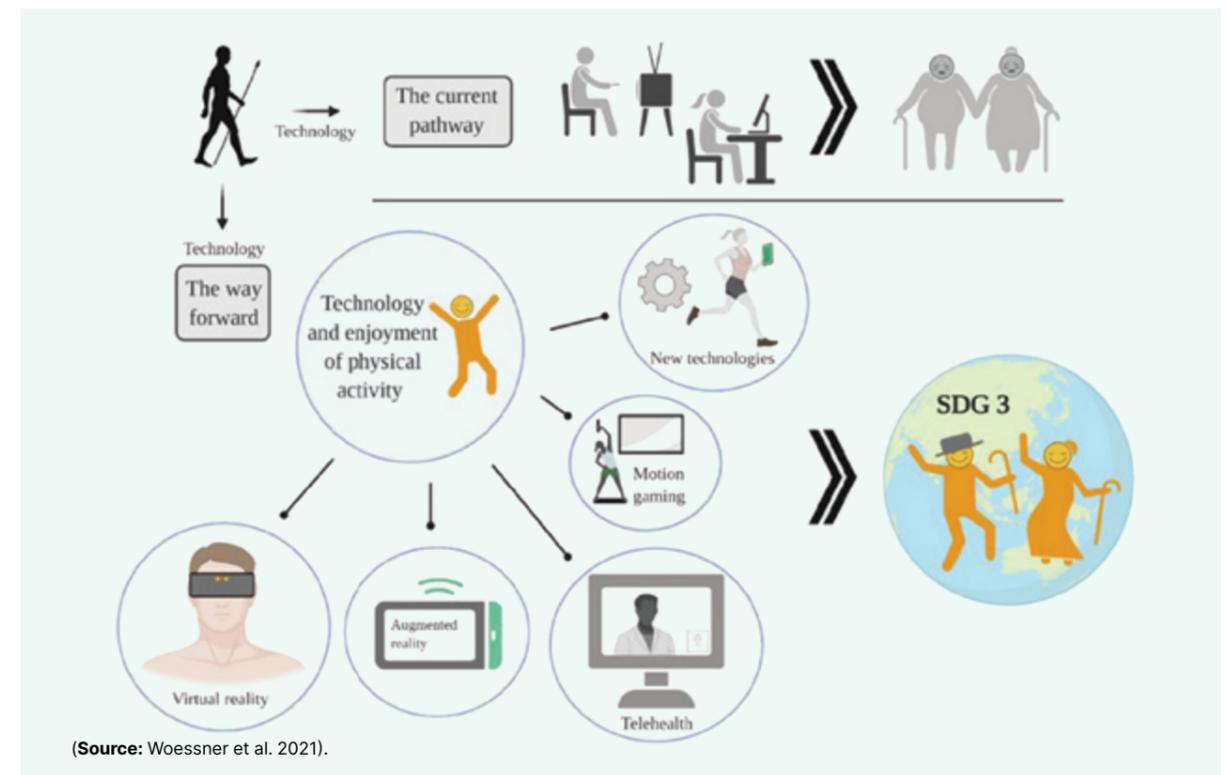
Figure 3: Trends in life expectancy and overweight and obesity trends (OW and O, grey line) with advances in technology and medical treatments



(Source: Woessner et al. 2021).

Nevertheless, technology can play an important role in promoting physical activity and supporting healthy lifestyles, as illustrated in Figure 4.

Figure 4: Possible pathways of the use of technology



(Source: Woessner et al. 2021).

The adoption of technology to promote physical activity, increase movement, and develop healthy eating habits can benefit various family members (i.e., children, parents, and grandparents). A substantial body of literature examines the effectiveness of technology in increasing physical activity in both non-pathological (e.g., decreasing sedentary habits in adults) and clinical conditions (e.g., for people with obesity, cardiometabolic diseases, or disabilities), as well as among young family members (i.e., children and adolescents), adults (i.e., women during pregnancy, parents), and elderly family members (i.e., grandparents). For instance, a recent review and meta-analysis highlighted that wearable devices positively impact physical activity for individuals suffering from chronic cardiometabolic diseases by motivating them to walk more and engage in physical exercise (Kirk et al., 2019). Another review focused on whether technology could facilitate “aging in place” (i.e., the ability to live independently, comfortably, and safely during old age) and showed that the use of accessible communication platforms, online video resources, and neurofeedback and biofeedback technologies can support healthy aging in older adults (Ollevier et al., 2020).

Several studies have recently emphasized the critical importance of examining the connection between technology and physical activity in the Middle East and North Africa, where diabetes and obesity rates are among the highest in the world, and sedentary habits are negatively affecting family members’ health (Chaabane et al., 2021; Nash et al., 2021; Tong et al., 2024). Common barriers to increasing physical activity in several Middle Eastern and North African countries include a lack of suitable sports facilities, time constraints, insufficient social support, and low motivation—factors that highlight the necessity for country-specific interventions (Chaabane et al., 2021). For example, an intervention in Qatar utilized the internet to collect valuable information related to health habits during pregnancy, resulting in positive dietary changes and increased physical activity (Al-Dahshan et al., 2023).

Have Families’ Use of Internet and Social Media Technologies Impacted Physical Health?

The effects of screen time and social media use on physical health are most often studied in children and adolescents. A recent WHO systematic review (2019) found primarily weak and null associations between screen time and being overweight or experiencing cognitive or motor difficulties in children under five years old (WHO, 2019; Winther et al., 2022). However, these guidelines still recommend that children spend less than one hour per day in front of screens (WHO, 2019; Winther et al., 2022). Studies of older children generally support these findings, indicating that the impacts of screen time on physical health appear to be relatively weak (Winther et al., 2022).

The potential effects of social media use on health risk behaviors are somewhat more alarming. Two recent meta-analyses, with a combined sample size of over one million adolescents, suggest that greater use of social media may be associated with higher rates of risky substance use and risky sexual behavior during adolescence (Purba et al., 2023; Vannucci et al., 2020). Both meta-analyses called for further research to explore the mechanisms that might explain the links between social media use and these risky behaviors. Some researchers speculate that when adolescents view their peers engaging in or discussing risky activities on social media, these behaviors may be perceived as more normative and, therefore, more appealing to those seeking social acceptance (Nesi et al., 2017).

AI Effects on Family Members’ Well-Being

As previously discussed, AI represents one of the most recent and influential technological changes, with several applications potentially affecting families worldwide. Among these, a special mention should be made of the current use of AI in digital interventions for mental and physical health and education.

AI and Digital Interventions

AI is being incorporated into digital interventions, particularly through web and smartphone apps, to personalize content, process clinical texts, and create chatbots for user interaction. Indeed, AI can collect contextual, behavioral, and linguistic information from users to predict psychological and statistical outcomes, deliver personalized interventions, and use chatbots as conversational search assistants to provide relevant health information (Boucher et al., 2021; D’Alfonso, 2020). AI chatbots have been adopted in several healthcare domains, such as medical consultations, instant communication during natural emergencies, and the promotion of medication adherence. Overall, AI chatbots have shown promise in improv-

ing physical activity levels, but it is still early to comprehensively assess AI’s effect on human lifestyles (Oh et al., 2021).

AI and Educational Outcomes

The increasing use of AI in education has led researchers and policymakers to adopt the term AIEd (i.e., AI in Education) and explore various aspects of AI implementation, including design, effectiveness, outcomes, and potential benefits. AI can positively affect students’ academic performance, particularly in correcting misconceptions, improving concentration, and increasing engagement in learning activities (Rong et al., 2022). Figures 5 and 6 illustrate applications of different types of AI in education.

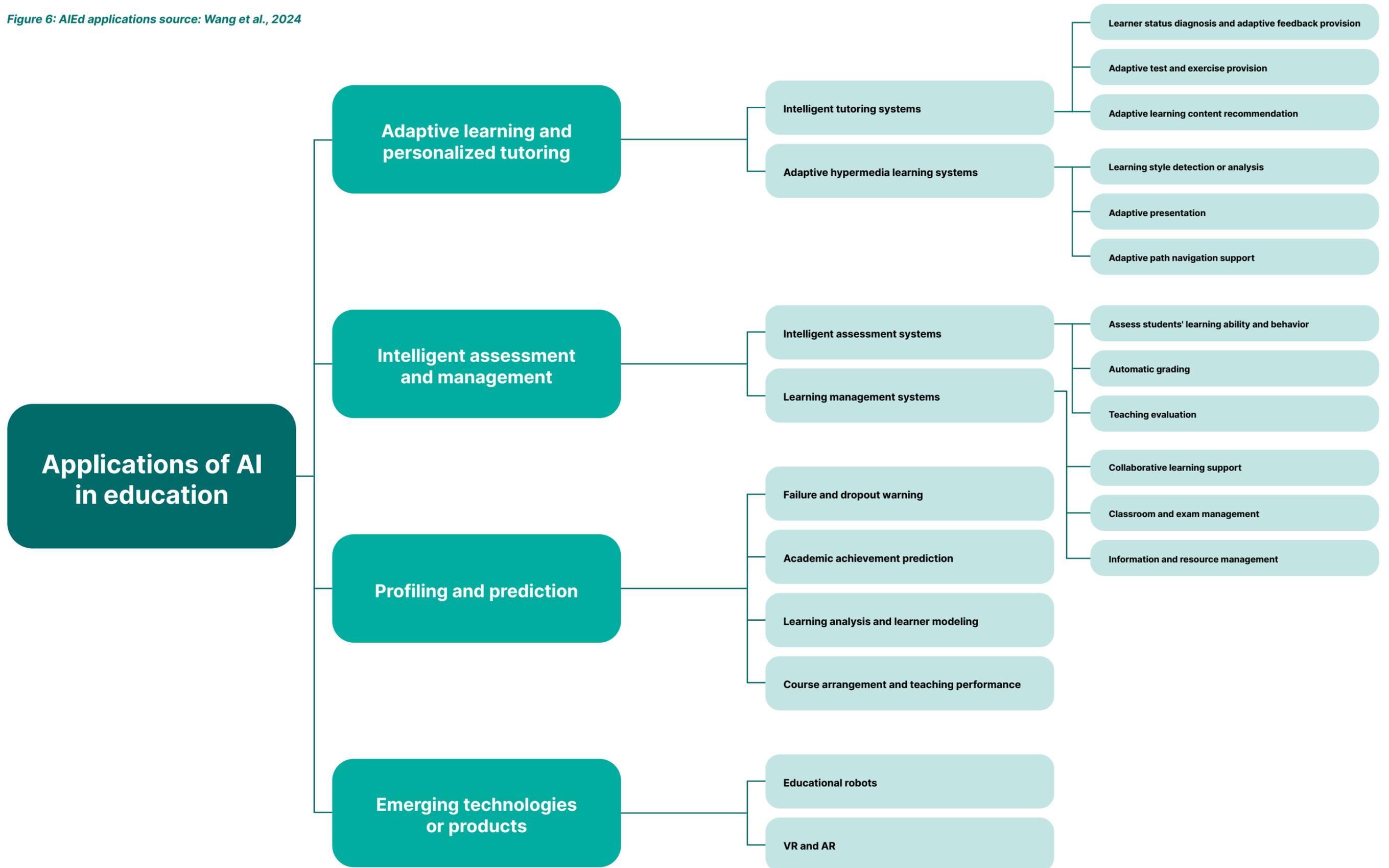
Figure 5: AI applications, benefits, and challenges for education (source: Zhang & Aslan, 2021)

AIEd Technologies	Proven and Potential Benefits for Teaching and Learning
Chatbots	<ul style="list-style-type: none"> Stimulating conversations Increasing learners’ interest and engagement
Expert systems	<ul style="list-style-type: none"> Pedagogical planning LMS uses Improving quality of interactions Leveraging the LMS
Intelligent tutors/ agents	<ul style="list-style-type: none"> Customized and timely materials, guidance, and feedback Customized learning experience based on needs, preferences, and prior knowledge
Machine learning	<ul style="list-style-type: none"> Analyzing large scale student data Predictive models Preventive and adaptive interventions
Personalized learning systems environments	<ul style="list-style-type: none"> Facilitating interactions Improving e-learning Customized learning materials and resources for tailored learning
Visualizations and virtual learning environments	<ul style="list-style-type: none"> Collaborative learning, engagement, and visual feedback Visualization of information Immersive learning environments

Challenges to be addressed:

- Costs & Scalability
- Ethics & Privacy
- Lack of AI expertise among educators
- Lack of actionable guidelines for educators

Figure 6: AIEd applications source: Wang et al., 2024



The State of AI in Education

The state of the literature regarding AI and education has been well summarized in a recent systematic review (Zhai et al., 2021), which reported on studies about AI and education produced from 2010 to 2020 (N = 100). According to Zhai and collaborators, previous research on AI and education has primarily focused on the development of AI education systems (e.g., intelligent tutoring systems), extraction (e.g., feedback, adaptive learning), and application (e.g., immersive learning). The review highlighted the most relevant challenges of AI in education, such as the fact that AI techniques can fail to support large-scale education, do not meet personalized learning needs, necessitate a reconceptualization of the role of educators, and rely on large amounts of personal and sensitive data.

Despite the significant and widespread use of AI in education, the latest UNESCO report on the use of technology in education (2023, p. 7) emphasizes that “technology has changed but not transformed education.” Although technology has led to changes in the development and distribution of educational content, learning management systems, language applications, augmented and virtual reality, personalized tutoring, and testing, there is no strong evidence of acceleration in knowledge gains and learning outcomes despite the proliferation of digital educational interventions. Indeed, the UNESCO report presents several key messages about the links between technology and education, highlighting both positive and negative effects:

1. **Good, impartial evidence on the impact of educational technology is in short supply:** While there is evidence of the positive influence of technology on education, it is often derived from studies conducted in wealthy countries or funded by companies aiming to sell technological products.
2. **Technology offers an educational lifeline for millions but excludes many more:** Although digital, accessible technology and universal design have opened opportunities for learners with disabilities or those living in hard-to-reach areas (e.g., due to the COVID-19 pandemic), access to technology is not yet equitable across different world regions or school settings.
3. **Some educational technology can improve some types of learning in certain contexts:** Although technology has increased access to teaching and learning resources, leading to medium-sized positive effects in some areas, the outcomes of technology adoption in education require more than just advanced technology for positive results. It is also essential to consider the detrimental impacts of inappropriate or excessive technology use.
4. **The fast pace of technological change is straining education systems to adapt:** While several countries have begun to implement technology in education, many students still lack access to technology in schools, and many teachers do not feel confident using technology in their work.
5. **Online content has grown without sufficient regulation of quality control or diversity:** Online content and digital technologies are primarily created and transformed by dominant groups, mainly from European and North American countries, thereby mostly benefiting learners from educated and affluent regions.
6. **Technology is often purchased to fill a gap, without consideration for long-term costs:** The long-term costs of technology for national budgets (e.g., the expense of transitioning educational settings to digital formats), children’s well-being (e.g., privacy risks), and the environment (e.g., CO2 emissions) must be taken into account.

6.3

THIRD OUTCOME: PRIVACY RISKS FOR FAMILIES

Families and Privacy

The rapid advancement and widespread adoption of technology have revolutionized how families interact, share, and communicate. However, this has also introduced significant privacy risks, as internet access has dramatically reshaped how and what information is available online. Despite various laws and regulations aimed at protecting privacy, families often face unintended consequences from the overexposure of their private lives on digital platforms.

Risks for Children

Cyberbullying: One primary area of concern for children utilizing technology is cyberbullying. Bullying is defined as “an aggressive, intentional act or behavior that is carried out by a group or an individual repeatedly over time against a victim who cannot easily defend him or herself” (Slonje et al., 2013). By extension, cyberbullying is bullying that occurs electronically, via information and communication technologies (ICTs). The worldwide prevalence of cyberbullying is difficult to identify, as definitions of bullying and the methodological procedures used to collect data vary by nation (Selkie et al., 2016). Moreover, the prevalence of cyberbullying is heavily influenced by the local cultural context (Barlett et al., 2014). For instance, a study of university students from Egypt, Iraq, Jordan, Saudi Arabia, and Qatar reported that 57.6% of students had not ex-

perienced cyberbullying, with 20% reporting that they experienced it only once; this can partially be attributed to the strong Islamic cultural values of respect and ethical behavior (Mahasneh et al., 2024). In contrast, a study of Pakistani university students found that only 10% of students had not experienced cyberbullying (Saleem et al., 2021). Given that cyberbullying does not occur in isolation but rather alongside physical, verbal, and social bullying, its prevalence and impact cannot be ignored (Thomas et al., 2014). Higher levels of cyberbullying victimization correlate with higher levels of depressive effects, with 93% of victims reporting feelings of sadness, hopelessness, and powerlessness (Nixon, 2014; Raskauskas & Stoltz, 2007). Moreover, a survey of adolescents across Europe noted that anger was the most common emotion in response to bullying, with younger female victims reporting the most significant emotional impact (Ortega et al., 2012).

“Sharenting”: Defined as the practice of parents, caregivers, or relatives sharing information about their underage children online, sharenting has grown in prevalence in recent years (Doğan-Keskin et al., 2023). These behaviors can manifest before birth, with parents sharing sonogram scans of their unborn children. In a study of children across ten nations, 81% of children under two had some form of digital footprint, including images online, with the average digital debut occurring around six months of age (AVG Technologies, 2010, from huffpost.com). Such a premature digital debut has

several detrimental impacts. Although many parents use social media to share positive moments from their lives, 67.3% of parents in a Polish study shared photos of their children that may be considered embarrassing and inappropriate. These embarrassing photos are classified as either funny, grimy, semi-nude, or nude, with most of the images being nude or semi-nude (Brosch, 2016). Such vulnerable photos increase the likelihood of children's identity theft and the appearance of their images on pornographic websites (Otero, 2017). According to the National Center for Missing and Exploited Children, half of the photos shared by child sexual abusers were first posted on social media by parents.

Sextortion: Once children reach an age where they can manage their own online presences, they become vulnerable to another form of child sexual exploitation known as sextortion. Sextortion involves threatening and blackmailing a child, most often with the threat that a nude or sexual image of them will be made public in exchange for additional sexual content, sexual activity, or money from the child (National Center for Missing & Exploited Children, 2017). This form of extortion has impacted a non-negligible proportion of youth (5%; Patchin & Hinduja, 2018). Victims of sextortion suffer a variety of detrimental effects, including losing relationships with friends or family, needing mental health support, moving schools or even communities, and even job loss and financial troubles (Wolak et al., 2018). Sextortion can also lead to more serious physical consequences, such as abduction. Of the 476 children reported missing to the National Center for Missing & Exploited Children (NCMEC) between 2020 and 2023, 92% had reported speaking to adults online prior to their disappearance. Global internet connectivity means that an offender does not need to be in the same country as their victim to sexually menace them, putting children worldwide at risk regardless of their geographic location (Wittes et al., 2016).

Risks for Adults

Intimate Partner Violence: Intimate partner vio-

lence (IPV) is a form of abuse that includes physical violence, sexual violence, stalking, and psychological tactics by a current or former intimate partner (Breiding et al., 2014). Although the majority of IPV occurs through in-person or physical means, newer forms of technology may provide new methods for aggressive individuals, offering more resources to monitor and harass their intimate partners. Cyber aggression refers to the use of newer ICTs, such as social networking websites and text messaging, to facilitate repeated harassing behavior by an individual or group intending to harm others (Marganski & Melander, 2015). In a 2010 survey of 16,000 adults by the United States Centers for Disease Control and Prevention, 10.7% of women and 2.1% of men reported stalking by intimate partners, with the most commonly utilized tactic being unwanted phone calls (Breiding et al., 2014). Other commonly employed tactics by aggressors include looking through one's phone without permission, purposefully ignoring one's communication through technological devices, and asking where one is going or what one is doing through texts and posts (Marganski & Melander, 2015). As a result of such tactics, victims of cyber IPV reported problematic drinking, marijuana and illicit drug use, and antisocial behavior (Melander & Marganski, 2020). Cyber IPV also co-occurs with in-person intimate partner violence, as 92.6% of those experiencing in-person sexual aggression also experience it virtually, compounding the harmful impacts of IPV (Marganski & Melander, 2015).

Revenge Porn: Nonconsensual pornography, also known as revenge porn, involves the sharing of nude or semi-nude images and videos of a person without their consent (Bates, 2017). Typically, these images are shared with malintent, aiming to harm and humiliate the victim for ending a romantic relationship. They can also be shared as a form of extortion, with abusers demanding a fee to remove the images. Revenge porn has several adverse effects on victims. In a survey of nearly 70 victims of revenge porn, 22% of respondents noted that their work performance had been affected, with 12% changing jobs and 5% being fired or demoted. Furthermore, 38% indicated that their

relationships with family and friends were damaged, and 40% felt distant and disconnected from people. Other common impacts included adverse changes in health, such as anxiety, self-harming behaviors and thoughts, and financial loss (Short et al., 2017).

Digital Infidelity: Digital infidelity refers to infidelity in a relationship facilitated through ICTs. Specifically, it is a form of infidelity in cyberspace where individuals engage in non-sexual relationships with others who are not their spouses, characterized by emotional closeness between the parties involved (Nagurney & Thornton, 2011). The internet has made infidelity significantly easier, giving people more opportunities to seek someone new (Wysocki & Childers, 2011). A survey of 5,187 users of the affair-seeking website AshleyMadison.com revealed that 63% of users cheated online while in an offline relationship, and nearly three-fourths cheated offline as well. Digital infidelity is also appealing because of how easily it can be concealed; more than 50% of users removed their digital traces after accessing such websites (Wysocki & Childers, 2011). However, those on the receiving end of internet infidelity report a loss of trust, feelings of betrayal, and the need to seek professional help to cope with the impacts (Vossler, 2016).

Overall, the expansion of technology presents both opportunities and challenges for families. It enhances connectivity and access to information but also introduces significant privacy risks for both children and adults. Therefore, leveraging technological benefits while safeguarding privacy and maintaining personal well-being remains a critical issue for policymakers.

6.4

FOURTH OUTCOME: IMPACTS OF WORK AND JOB CHANGES ON FAMILIES

Work-Family Balance

Several systematic reviews and comprehensive meta-analyses, including a recent comprehensive meta-analysis of 41,904 participants in 62 studies, have investigated how telecommuting and remote work impact work-family balance (Gajendran et al., 2024; Gajendran & Harrison, 2007). Surprisingly, working from home did not appear to significantly impact work-family balance in these meta-analyses (Gajendran et al., 2024; Gajendran & Harrison, 2007). This outcome seems to result from the fact that working from home increases autonomy but also contributes to isolation and family-work spillover (Gajendran et al., 2024; Gajendran & Harrison, 2007; Wu et al., 2022). In other words, although remote workers experience greater autonomy and spend more time with family members, they also feel compelled to take their work home more often and have less clear boundaries between work and family life (UNDP, 2021; Wu et al., 2022). These competing forces appear to balance each other out; consequently, there does not seem to be any substantial benefit or detriment of working from home on work-family balance overall. This lack of benefit or detriment regarding work-family balance also appears to be a trend in Gulf region nations, as some surveys of workers in the region indicate benefits of remote work on work-life balance, but that this balance depends on the conditions under which employees work remotely (e.g., Almubarak et al., 2023).

For instance, a survey conducted in Saudi Arabia during the COVID-19 pandemic found that men, bachelor's degree holders, non-married individuals, employees working in health and education, and those working flexible hours reported less positive experiences than other remote workers (Almubarak et al., 2023).

However, meta-analyses find that working remotely provides small but beneficial effects on job satisfaction, organizational commitment, perceived organizational support, and supervisor-rated performance (Gajendran et al., 2024). Similar findings have emerged among workers in Saudi Arabia (Aloulou et al., 2023), as well as in surveys of workers and employers across the Gulf region (Matsh, 2024). For example, 90% of workers surveyed in the UAE prefer working remotely, and 67.6% report productivity increases as a result of remote work (Matsh, 2024). Therefore, while telecommuting may not lead to work-life balance for families, it does seem to improve individual family members' perceptions of their work.

Family Relationships

Although technological changes do not appear to enhance work-life balance, limited existing evidence suggests that telecommuting and remote work may benefit family relationships. Remote workers can spend more time with family members, on childcare, and on housework (Stone &

Ozimek, 2023; Wu et al., 2022), which can subsequently improve relationships among family members (Wu et al., 2022). Similarly, in a longitudinal study of pre-pandemic remote work (Chen et al., 2023) and an older meta-analysis examining the effects of telecommuting (Gajendran & Harrison, 2007), working from home was associated with small reductions in family conflict arising from work. However, the benefits of working from home on family relationships may be diminished by increased caregiving responsibilities (Chen et al., 2023). Importantly, while many experts and policymakers speculate about how remote work impacts families, there is a dearth of literature that studies the effects of remote work on families, with virtually no research exploring these effects in longitudinal or nationally representative samples (UNDP, 2021). Such data are sorely needed (UNDP, 2021). In the absence of such data, existing evidence indicates that shifts to remote work allow for greater opportunities to spend time with family members and have small but positive effects on family relationships.

Family Members' Health

There is a larger, yet still limited, body of literature documenting the impacts of remote work, digital entrepreneurship, and gig work on individual family members' health and well-being. The comprehensive meta-analysis mentioned above indicated no overall effects of remote work on work-related stress or burnout (Gajendran et al., 2024). However, this null overall effect masked two competing, countervailing processes. Specifically, remote work was found to increase workers' sense of autonomy, which subsequently reduced work-related stress and burnout (Gajendran et al., 2024). Conversely, remote work also heightened feelings of isolation, which increased work-related stress and burnout (Gajendran et al., 2024).

Compared to working for others, entrepreneurship has been associated with greater overall positive well-being, more life satisfaction, and greater positive affect in a meta-analysis of 788,170 participants across 283 studies (though it had no impact on measures of negative well-being compared to

workers employed by firms; Stephen et al., 2023). In contrast, an examination of a nationally representative sample of gig workers in the United Kingdom revealed that the mental health and life satisfaction of gig workers were worse than those employed full-time or part-time, but better than those who are unemployed (Wang et al., 2022).

In summary, while nationally representative datasets are sorely needed, it appears that remote work does not conclusively benefit or harm remote workers' health. This is because remote work promotes both autonomy and isolation, which have opposite effects on well-being. Entrepreneurship and gig work might provide small positive benefits to mental health and life satisfaction compared to not working at all (Stephen et al., 2023; Wang et al., 2022). However, gig workers' health suffers in comparison to those employed full or part-time (Wang et al., 2022).

Family Economic Prospects

Survey data, systematic reviews from the United Nations, and expert consensus from the United Nations support the notion that technological changes in the workforce could enhance family economic prospects (Aksoy et al., 2023; UNDP, 2021; UN, 2020a; UN, 2020b). For instance, 20,732 workers surveyed from 34 countries collectively identified that the top benefits of working from home were avoiding the commute (59.65%) and saving money on gas and lunch costs (43.84%), both of which contribute to family economic savings. Moreover, UN experts believe that the rise of the gig economy and digital entrepreneurship has allowed more families to access the labor market and generate income than ever before (UNDP, 2021; UN, 2020a; UN, 2020b).

MODERATORS

As discussed in previous chapters, technological changes are strongly related to how children, parents, and grandparents live every day, structure their relationships within the family, work, communicate, manage physical and psychological challenges, and respond to difficult situations (e.g., infertility, disability, aging, remote work). The current chapter describes some moderators that can influence the connection between technology and families. We apply the term “moderators” to factors that can alter the direction or

magnitude of the relationship between technology-related predictors and outcomes. Therefore, in this chapter, we examine factors that can impact the relationship between predictors (assisted reproductive technologies; communication technologies; assistive technology, digital interventions, telehealth; telecommuting, and remote work) and outcomes (family characteristics; family members’ health, well-being, and education; privacy risks for families; and family members’ work).

7.1

FIRST MODERATOR: ACCESS TO TECHNOLOGY

One moderator that determines the extent to which the technology megatrend impacts families is access to high-quality technology (ITU, 2023; UNDP, 2021). Indeed, access to high-quality technology influences the degree to which each of the predictors of the technology megatrend affects families and the extent to which families experience beneficial or detrimental outcomes from this trend.

Access to Technology as a Moderator of Drivers of the Technology Megatrend

Access to technology determines the extent to which families integrate new technologies like assisted reproductive technology, communication technology, assistive technology, telecommuting, and remote work into their daily lives.

Regarding assisted reproductive technology, infertility rates are similar across nations (WHO, 2023). However, in many low- and middle-income countries, families often lack access to assisted reproductive technology due to high costs and a shortage of adequate facilities and professionals (Chiware et al., 2021). Furthermore, in some nations, access to assisted reproductive technology is limited to certain types of families (e.g., heterosexual couples struggling with infertility) due to religious or ethical stances taken in those countries (Chiware et al., 2021). Assisted reproductive technology is only beneficial to families if they have access to it.

Similarly, communication technologies that can spur economic development and connect families—such as internet access, cell phones, internet-based devices, video games, social media platforms, and wearable technologies—only transform family environments if they are available to families (UN, 2020a; UN, 2020b). If nations are unable to develop the infrastructure to provide high-speed internet services or affordable devices to families, then those families cannot reap the benefits of cohesion, connectedness, and economic prosperity that these technologies offer (ITU, 2023).

The situation with assistive technology is similar (WHO & UNICEF, 2022). Assistive technology can have transformative impacts on families by enabling family members to lead high-quality lives where disabilities do not prevent them from achieving their goals (WHO & UNICEF, 2022). However, those benefits can only be realized if families have access to high-quality assistive technologies. Although there has been significant progress in providing access to assistive technologies, including telehealth technologies, worldwide (WHO & UNICEF, 2023) and in the Gulf region (Abd-alrazaq et al., 2023; Almubrak et al., 2023), barriers remain. Table 1 reports some of the most common barriers families face in accessing assistive technology. These obstacles hinder the ability of all families to take advantage of assistive technology, limiting its use primarily to families in high-income nations, who are nearly nine times more likely to access such products compared to those in low-income nations, where affordability is the main barrier to obtaining these technologies (WHO & UNICEF, 2022).

Table 1. Barriers hindering access to assistive technology

Barriers related to assistive technology products/services	
Inadequate product range, quantity, quality and suitability	Products can be unavailable, unsafe, ineffective, or even abandoned due to inadequate standards, and a lack of regulatory enforcement, coupled with insufficient knowledge about their safety and effectiveness, contributes to these issues.
High cost	Assistive products and professional services can frequently be overpriced.
Procurement and delivery challenges	Poorly designed, funded, and managed procurement and delivery processes delay and reduce access to assistive technologies, and these issues are often overlooked when identifying bottlenecks in the assistive technology system.
Barriers related to assistive technology users	
Lack of awareness	Individuals often lack knowledge about the availability, characteristics, types, and procedures for obtaining assistive products.
Limited physical and geographical access	Assistive products, services, and professionals may be out of reach for many individuals in some regions of the world.
Sociodemographic barriers	Stigma surrounding assistive technology in school settings, a lack of time and necessary support, and inaccessible physical environments are examples of sociodemographic barriers. Moreover, women and individuals with communication, cognitive, or self-care difficulties tend to access assistive technology less frequently than men and individuals with other impairments (e.g., mobility difficulties).
Barriers related to assistive technology professionals	
Capacity gaps exist in the assistive technology workforce	There is an unavailable workforce and a lack of professionals with adequate knowledge, expertise, and training in assistive technology.
Fragmentation of the assistive technology sector	As the size of the assistive technology market is not precisely known, there is a fragmentation in its provision. Assistive technologies are often categorized by subgroups of users rather than being viewed as part of a global market.
Barriers related to policies	
Low policy profile and lack of legislation	This is primarily due to a lack of awareness regarding the scope and scale of assistive technology needs, as well as the potential benefits of access to assistive technology for individuals, communities, and broader society.
Lack of funding and investment	

Telecommuting and remote work are essential for ensuring that parents spend more time with their children while remaining productive and accessing economic opportunities in the digital economy (UNDP, 2021). Furthermore, telecommuting and remote work technologies have become more accessible worldwide than ever before (UNDP, 2021). This trend is also evident in the Gulf region, where analyses indicate that up to 46% of workers already engage in at least partial remote work, and over \$29.7 billion has been invested in information and communication technology in 2024 (Matsh, 2024). However, access to telecommuting and remote work is still much higher in high-income nations with established digital and high-speed internet infrastructure, which is crucial for enabling remote work (ITU, 2023; UNDP, 2021). Without access to these infrastructures, families cannot benefit from remote and telecommuting opportunities (ITU, 2023; UNDP, 2021).

Access to Technology as a Moderator of Outcomes of the Technology Megatrend

Access to technology not only determines whether families experience the drivers of the technology megatrend but also influences the extent of the benefits they can derive from it. Access to telemedicine, medical professionals, and new vaccines and medical interventions varies widely across nations (Ortiz-Ospina & Roser, 2024; Roser et al., 2024). This access determines whether families can participate in the global trend of reduced disease burden and increased life expectancy over the past 30 years (Ortiz-Ospina & Roser, 2024; Roser et al., 2024). Encouragingly, even a small amount of access can yield significant benefits: the most substantial advantages from increased medical technology access for families occur within the first few hundred dollars of healthcare expenditures per capita (Ortiz-Ospina & Roser, 2024; Roser et al., 2024). With just a modest investment in healthcare technologies, many more lives can be saved and extended (Ortiz-Ospina & Roser, 2024; Roser et al., 2024).

Regarding mental health, there is no mission more crucial for helping families realize the benefits of new mental health intervention technologies than providing greater access to these resources (GBD 2019 Mental Health Collaborators, 2022).

The global per capita mental health burden has not significantly decreased, primarily because the vast majority of families needing mental health interventions cannot access them (GBD 2019 Mental Disorder Collaborators, 2022; Roser et al., 2023). Fortunately, access to integrated digital health systems and telemental health services is rapidly increasing both globally (Garcia et al., 2021; Jent et al., 2021) and in the Gulf region (Abd-alrazaq et al., 2023; Almubarak et al., 2023).

Increasing Families' Access to High-Quality Technologies

Clearly, few factors are more important in determining whether families benefit from the technology megatrend than access to technology. Increasing families' access requires a multisectoral, global effort among nations and businesses (ITU, 2023; UNDP, 2021). Nations can directly enhance access by investing in the infrastructure necessary for medical and communication technologies to reach families (ITU, 2023; UNDP, 2021). This primarily involves expanding internet access, high-speed internet, electricity, and the availability of communication and assistive devices to as many citizens as possible, thereby bridging digital divides between urban and rural, as well as high-income and low-income areas (Bradley & Rothenberg, 2022; ITU, 2023; UNDP, 2021).

Nations can also indirectly improve access to high-quality technologies by enhancing national development levels, as measured by educational opportunities, mortality rates, and per-capita income (UNICEF, 2019). In many countries, national development has been propelled by providing universal access to free healthcare for families and establishing strong social safety nets that ensure food security, financial support, and pensions for older adults (UN, 2019). Indeed, no single factor predicts early childhood development more powerfully than national levels of development (Bornstein et al., 2021). Promoting national development equips families with the educational knowledge and financial resources necessary to access new technologies and determine the most effective ways to apply them to help their children grow and thrive (Bornstein et al., 2021; Bornstein et al., 2022).

7.2

SECOND MODERATOR: LEARNING HOW TO USE TECHNOLOGIES

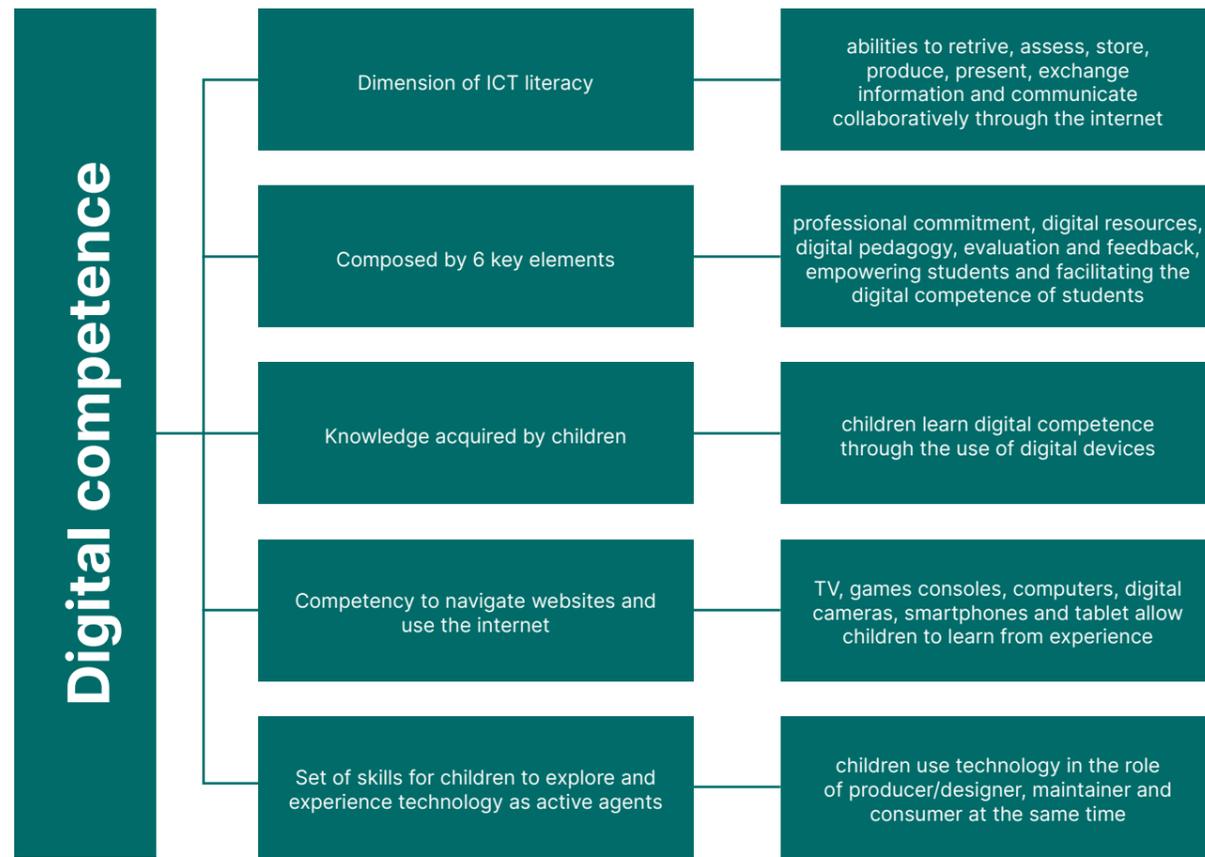
Another moderator that influences the extent to which the technology megatrend impacts families is related to individuals' knowledge about technology, its characteristics, and its potential uses. Overall knowledge of technology, its possibilities, and its risks is essential for individuals to utilize technology to its full potential, develop a sense of control over it (and consequently avoid the sensation of being controlled by technology), adopt ethical and responsible practices to prevent technology-related abuse or risks, and leverage technological tools for their own benefit (Huda et al., 2024). For instance, this overall knowledge and feeling of empowerment can moderate access to health systems, telemedicine, e-health, and digital tools (Pérez-Escolar & Canet, 2023; Wilson et al., 2021).

The overall concept of technology use has been defined as "digital competence," which refers to the "confident, critical, and responsible use of, and engagement with, digital technologies for learning, at work, and for participation in society" (European Commission, 2018). Digital competence encompasses a combination of knowledge,

abilities, and attitudes necessary for the effective and responsible use of digital tools and technologies. This includes "information and data literacy, communication and collaboration, media literacy, digital content creation (including programming), safety (including digital well-being and competencies related to cybersecurity), intellectual property issues, problem-solving, and critical thinking" (European Commission, 2018, p. 10).

Closely related to digital competence is another important aspect that influences the relationship between technology and families: digital literacy. This is defined as the ability to use digital media to find, evaluate, and communicate information using both technical and cognitive skills. Researchers have extensively explored the concept of digital competence in children, evaluating the role of teachers and parents in its development, as well as in elderly generations. A recent review applied the concept of digital competence to early childhood education and highlighted the most relevant definitions and characteristics used in research studies and policy documentation (Figure 1; Su & Yang, 2024).

Figure 1: Definitions and characteristics of digital competence



Digital competence is an essential set of abilities that enables family members to navigate technological changes and use technology as a helpful tool and potential source of well-being in various situations and contexts (Morte-Nadal & Esteban-Navarro, 2022; Ramsetty & Adams, 2020; Vallès-Peris & Domènech, 2024). For instance, digital competence is strongly linked to the digital inclusion of citizens (Pérez-Escolar & Canet, 2023).

Digital inclusion refers to equipping individuals who do not already possess knowledge and skills in information and communication technology,

thereby helping vulnerable or at-risk populations overcome digital inequalities and the digital divide. The concept of digital inclusion should not be viewed as merely providing universal access to the internet and digital technology across different regions and demographics. Instead, it should focus on ensuring that each individual has the adequate support, skills, and opportunities to use technology effectively for personal and professional success.

Digital inclusion encompasses the following five Cs: connectivity, capability, content, confidence, and continuity (Fisher & Bradbrook, 2004).

7.3

THIRD MODERATOR: PARENTING IN THE AGE OF TECHNOLOGIES

Parenting styles significantly influence children's use of technology by shaping their awareness and habits. A lack of protection, poor communication about internet-related risks, and insufficient guidance can leave children vulnerable to online dangers and unhealthy usage patterns. Conversely, proactive and communicative parenting can foster responsible and beneficial technology use.

As such, differing parenting styles can lead to different outcomes for children and their technology usage. Based on the Baumrind (1971; 1991) parenting model, the major parenting styles are authoritarian (i.e., characterized by high levels of demand and low levels of warmth and psychological autonomy), authoritative (i.e., characterized by high levels of demand but also warmth and psychological autonomy granted to the child), permissive (i.e., characterized by low levels of demand but high levels of warmth and autonomy), and neglectful (i.e., characterized by low demand, warmth, and autonomy; Eastin et al., 2006). These styles are based on the dimensions of control and warmth, which have a direct effect on children's use of technology. Indeed, the control dimension includes setting rules for internet usage, providing guidance for online activities, and taking measures to limit inappropriate exposure to the internet. Meanwhile, the warmth dimension involves advanced communication between parents and children during internet use, fostering closeness

to demonstrate care (Özgür, 2016).

Regarding the control dimension, the primary way parents can moderate their children's internet usage is by limiting the time they spend online. Of the four parenting types, children of authoritative parents are significantly more likely to have low screen exposure, defined as less than one hour a day. In contrast, children of authoritarian, permissive, and neglectful parents are significantly more likely to have excessive screen exposure, defined as more than four hours a day (Çaylan et al., 2021).

Parents can also guide their children on how to behave online. Parents who adopt an authoritarian parenting style dictate exactly what their children can watch and browse on the internet and impose strict rules on how long their children can spend online. Authoritative parents are more likely to provide guidelines on internet use and discuss online interactions, including the dangers associated with them. Permissive parents typically avoid criticizing or confronting their children about their internet usage and accept all of their children's choices, rarely imposing rules or limiting screen time. Neglectful parents tend to leave their children alone while using the internet and have little communication with them regarding their online activities (Ihmeideh & Shawareb, 2014). However, parental mediation does not benefit all age

groups, and the most popular parental mediation method is simply talking to their children (Harahsheh et al., 2023).

Apart from the parenting styles outlined by the Baumrind model, parents may also hold certain attitudes about online activity that impact their children's online behavior. Children's technology usage significantly mirrors their parents' digital habits (Wartella et al., 2014). In fact, family and school environments are significant negative predictors of adolescent internet addiction (Chemnad et al., 2023). Parents who have positive perceptions of digital devices promote their use in children, enabling them to develop the digital literacy crucial for successful internet usage (Dong et al., 2021). Conversely, parents who have negative views about early digital use—such as beliefs that digital media expose children to inappropriate content—tend to implement restrictive mediation and enforce greater supervision of their children's digital activities. On the other hand, parents with positive views, such as believing that digital media will enhance their children's academic performance, are more likely to engage in co-use and apply active mediation (Nikken & Schols, 2015). Lastly, parents who believe technology is too complex for their children supervise and co-use technology less, often opting to restrict media use altogether (Nikken & Schols, 2015).

Family characteristics and demographics also play a role in children's technology usage. Research has highlighted a significant relationship between parental education level and internet parenting style. More highly educated parents tend to recognize the importance of setting rules regarding the media their children are exposed to (Rek & Kovačič, 2019). Thus, parents with higher education levels are more likely to utilize restrictive mediation, particularly in terms of limiting online content and screen time (Rek & Kovačič, 2019). Moreover, parents from higher socioeconomic backgrounds exhibit higher levels of digital parenting than those from lower socioeconomic backgrounds (Yaşaroğlu & Sönmez, 2022). Families with higher incomes create a more advanced digital environment within their homes, incorpo-

rating newer forms of AI technology compared to lower-income families. Consequently, children from lower socioeconomic statuses have fewer opportunities to acquire essential digital literacy skills (Nikken & Schols, 2015). Within families, parents are also more effective at preventing their children from digital risks when they have only one child compared to parents with two or more children (Yaşaroğlu & Sönmez, 2022). Furthermore, mothers tend to score significantly higher than fathers in terms of digital parenting attitudes, engage more thoroughly in mediation practices, and apply more supervision overall (Tosun & Mihci, 2020; Nikken & Schols, 2015).

As a result of internet usage regulations imposed by parents, children develop different relationships with technology. Stricter, more involved parents who exercise more mediation result in children who face fewer internet risks, such as exposure to inappropriate content or privacy invasions (Leung et al., 2012). Students who experience parental control are less likely to reveal personal information online (Valcke et al., 2007). However, there is also a positive correlation between children who have more positive interactions with media through such safety techniques and internet addiction (Valcke et al., 2007; Chou et al., 2016).

Overall, the way parents control their children's access to the internet can deeply impact how that child experiences technology. Parental control can moderate the amount of time spent online and the activities engaged in. For parents to facilitate the development of healthy relationships with technology, great care must be exercised so that children can reap the benefits while minimizing harm.

POLICIES

IMPACTING TECHNOLOGY AND FAMILIES



8.1

ASSISTED REPRODUCTIVE TECHNOLOGIES POLICIES

Policies on ART can differ across countries and societies, but for a policy to be clear and comprehensive, it should cover five attributes:

- 1. Specific Policy Goals:** Clearly define the desired outcome of regulating ART (e.g., protecting patients' rights or making IVF clinics financially viable).
- 2. Policy Tools:** Outline specific actions (e.g., registration of IVF clinics and donor databases).
- 3. Target Groups:** Specify who must abide by these policies (e.g., private IVF clinics).
- 4. Target Beneficiaries:** Clearly state who the beneficiaries of these policies are (e.g., married couples only, or single women allowed to use IVF services with donor sperm).
- 5. Implementers:** Identify the regulating bodies (e.g., government) responsible for overseeing the execution of these policies (Varone, Rothmayr, & Montpetit, 2006).

Policies can be open or narrow in terms of the leeway provided to target groups and beneficiaries, and there is wide variation among such policies worldwide (Vuuren & Aldersey, 2020). The International Federation of Fertility Societies' Surveillance report for 2022 stated that of the 90 countries that provided information for the survey, 69% reported some type of regulation for ART (Inter-

national Federation of Fertility Societies, 2022). Within Europe, countries such as Germany, Switzerland, and Norway are considered restrictive, having many limitations on ART access and the use of specific techniques such as egg and embryo donation. In comparison, France, the United Kingdom, the Netherlands, and Spain are more permissive, allowing egg and embryo donations. France restricts ART treatment access to married couples, while the UK and the Netherlands allow single persons and same-sex couples on a case-by-case basis. Spain has no restrictions. On the other hand, there is little regulation at the federal level in countries like Italy, Canada, and the United States. In these countries, ART regulation mostly pertains to funding for research and restrictions against cloning (in some US states) or is left to the private sector (Varone, Rothmayr, & Montpetit, 2006).

European countries with stricter laws, such as Germany and Norway, have debated the merits of public financing for something that affects a small minority. Lawmakers, priests, and feminist scholars debated infertility, with some arguing it is not a disease and ART interferes with divine plans. Consequently, legislation was restricted to heterosexual married couples only, leading to fertility tourism within Europe, where people from restrictive countries traveled to countries with more permissive laws, such as Spain (Trappe, 2017).

ART has become prevalent in Muslim countries,

with several countries passing legislation to regulate the process (Kooli, 2019). The first fatwa (Islamic ruling) regarding ART was issued by Dar El Iftaa in Egypt in 1980. A review of ART laws and regulations shows notable similarities between the legislations passed by several of these countries (Kooli, 2019). Most countries, including Turkey, Tunisia, Malaysia, and Saudi Arabia, have prohibited the sale of donor eggs, spermatozoa, and surrogacy. Additionally, most Muslim countries have forbidden cloning, genetic engineering, and the trafficking of human embryos and fetuses, and allow ART only for legally married couples (Kooli, 2019). Some countries, such as Qatar, are still in the draft stage and have not passed specific ART legislation, although they impose varying restrictions on how research can be conducted. The availability of ART for married couples has fostered positive effects on marriages between infertile couples, and 'conjugal connectivity' has been demonstrated across the region. The emergence of intracytoplasmic sperm injection (ICSI), which improves chances of conceiving in the case of male infertility, has positively impacted men's mental well-being, challenging the notion that women are solely responsible for infertility. These positive effects on gender dynamics are more evident in countries that have actively supported couples accessing ART, such as Algeria, Egypt, Iran, UAE, and Turkey. Public support in these countries includes insurance reimbursement or government-sponsored IVF for those unable to afford it (Kooli, 2019).

In Africa, South Africa, Ghana, and Nigeria have passed legislation regulating reproductive technology and have more available IVF treatment than other African countries (Gerrits, 2016). Sub-Saharan Africa is a global hotspot for secondary infertility and has the lowest IVF prevalence in the world. The lack of IVF clinics has led to transnational users traveling to Ghana, South Africa, and Nigeria for treatment (Gerrits, 2016).

High unmet needs and high rates of secondary infertility are also prevalent in Central Asian states and South Asia, excluding India. Infertility treatment is not a priority or supported sector in Paki-

stan and Bangladesh; however, India boasts over 500 IVF clinics and has embraced commercial gestational surrogacy (Inhorn & Patrizio, 2015). In response to the regulatory vacuum in India, the Assisted Reproductive Technology (Regulation) Act and the Surrogacy (Regulation) Act were passed in 2021. These acts establish requirements for the registration of ART clinics and surrogacy clinics with state-level authorities and introduce provisions for gamete donations. There are concerns among medical professionals that increased regulation by the state could lead to rising costs of ART, making it less affordable for people and opening avenues for corruption and bureaucratic delays that would diminish the industry's efficiency (Tank, Kotiswaran, Tank, & Tank, 2023).

8.1.1 COMMUNICATION TECHNOLOGY POLICIES

Protecting Children in Digital Spaces

As explored in previous chapters, the number of children exposed to the internet and using mobile phones, tablets, and computers is rising worldwide, and many schools and learning institutions have adopted computer-based learning in their curricula. Therefore, it is important for policymakers to address the complex and multifaceted issues related to children's exposure to technology, aiming to protect them from harm and educate them on the functional and safe use of technology. Policymakers are also called upon to create rules and opportunities for parents to learn more about technology-related issues, considering the important role parents play in protecting their children. For instance, a study in the UAE reported that approximately 50% of parents believe that digital threats such as cyberbullying and exposure to inappropriate online content are significantly increasing (Hosani, Yousef, Shouq, Iqbal, & Mouheb).

Several countries have enacted legislation to protect children in digital spaces. The European Union passed the General Data Protection Regulation (GDPR) in 2016, which emphasizes that

protecting individuals regarding the processing of personal data is a fundamental right. As individuals have the right to the protection of personal data, the GDPR aims to contribute to freedom, security, justice, economic union and improvement, social progress, and the well-being of populations. The regulation requires EU member states to incorporate elements of the GDPR into their national laws, and most of them, including Denmark, Spain, Greece, Germany, Sweden, and the UK, have passed legislation that conforms to GDPR regulations.

Among all these regulations, the GDPR stipulates that consent from parents or guardians is necessary for companies to use the personal data of anyone under 16. Spain places an additional legal responsibility on parents and guardians, mandating that children use online spaces and digital access in a manner that “guarantees adequate development of a child’s personality and preserves their dignity and fundamental rights” (Congress, 2021, p. 2). The EU’s Audiovisual Media Services Directive (AVMSD) aims to protect children using video-sharing platforms and audiovisual content on social media sites. It directs such platforms to implement measures, such as age verification or parental control systems, to shield minors from advertisements that may negatively affect their mental and/or moral development (Congress, 2021).

Increased access for children and teenagers to the internet and personal communication devices has also led to an upsurge in Self-Produced Child Pornography (SPCG). One of the most common forms of non-sexting SPCG is camming, in which children perform sexually explicit acts in front of a webcam in exchange for money, goods, or attention. In response to this increase in SPCG, many countries have amended their existing child pornography laws. For instance, in 2014, Australia’s Parliament of Victoria and Canada’s parliament passed legislation to exempt juveniles from prosecution if they are involved in self-produced pornography (Westlake, 2018).

European countries are working to enhance their

surveillance tools to track and apprehend online predators and block harmful websites. The UK’s communications regulator has introduced the Online Safety Act, which sets guidelines for tech companies to ensure robust age checks for children accessing content (Ofcom, 2024). They have also established safer internet centers in most member countries to promote digital awareness among parents and the public, along with hotlines that allow children to report anonymously if they have been exposed to inappropriate content (Fourie, 2020). These safer internet centers run campaigns, develop informational materials for parents and teachers, and organize information sessions and events. They also provide a helpline and hotline offering general advice on cyberbullying, digital safety, and grooming (European Commission, 2024).

Countries outside Europe have also initiated similar efforts. Qatar’s Ministry of Communication and Information Technology launched a website in 2010 called SafeSpace to promote online safety. It provides resources for parents, teachers, and children on how to navigate the internet safely (Ministry of Communications and Information Technology, 2024). The African Union has issued a Child Online Safety and Empowerment Policy focusing on institutional capacity, legal and regulatory frameworks, training, education, awareness, and international cooperation (African Union, 2024). Some African countries, such as Rwanda, have already enacted policies on child safety online. Rwanda’s Child Online Protection Policy, passed in 2019, covers child online protection in schools and across all sectors of society, including victim support, content removal frameworks, constitutional capacity building, and strengthening the criminal investigation process (Davidson, Kidron, & Phillips, 2019).

8.1.2 AI POLICIES

Several countries, tech companies, and organizations have recently developed and agreed on common guidelines for responsible AI use to ensure that AI technologies are developed and used according to ethical standards. Despite this mutu-

al agreement, each country has adopted specific and singular approaches and policies to address AI. For instance, the European Union has issued the AI Act, a policy measure to support trustworthy AI development, which defines four levels of AI-related risk, ranging from “minimal risk” (e.g., spam filters) to “unacceptable risk” (e.g., remote biometric identification), with corresponding regulations that vary from less to more restrictive (European Commission, 2021). The United States has created a more diverse and flexible approach to AI regulation, combining soft laws, federal initiatives, self-regulation, and responsible use (more information available at [CISA](#)). Finally, Qatar has developed a strategy to leverage AI to secure its economic and strategic future, preparing society for the effective adoption of AI technology aligned with local needs and traditions. Indeed, Qatar’s Ministry of Communications and Information Technology has recently launched Qatar’s National AI Strategy, focused on the six pillars of education, data access, employment, business, research, and ethics (Qatar Computing Research Institute, 2019).

8.1.3 WEARABLE TECHNOLOGY AND LOCATION-TRACKING DEVICES

Wearable technology helps reduce sedentary lifestyles by reminding people to get up and move (Leblanc et al., 2017). These devices can also be used by parents to track their children. In fact, many popular devices like AirTags, originally marketed for locating lost objects, are now being used to track children or pets. Research shows that marketers of location trackers often present the world as an unsafe place, portraying it as the mark of a responsible parent to keep track of their child (Mavoa, Nansen, & Coghlan, 2023).

An ethical question regarding the use of wearable technology as location-tracking devices is whether it is acceptable for parents to track their children and, in the future, for spouses to track each other or for governments to monitor citizens. Another aspect to consider is that the sale of user

data, including spatial location data, provides a revenue stream for technology companies. Children being tracked could have their data shared before they are aware of it or have consented to share their information.

Although location-tracking technology is marketed as a safety enhancement, it can also be misused by individuals intending to stalk or harm others. Approximately 13.5 million people are stalked in the U.S. each year, and nearly 1 in 3 women have experienced stalking at some point in their lives (SPARC, 2019). People have been victims of stalking and abuse long before such technology became readily available; however, the accessibility of location-tracking devices, wearable technology, and tracking apps has made it easier for stalkers. Reports have surfaced of stalkers placing location-tracking devices in women’s coat pockets, bags, and cars, or covertly installing tracking apps or software on their phones (Rumpf-Whitten, 2023).

Many states in the U.S. have amended their stalking laws to reflect the use of GPS-based location-tracking devices. Some states, like Arizona, have included the use of “any electronic, digital, or global positioning system device to surveil a specific person or a specific person’s internet or wireless activity continuously for twelve hours or more, or on two or more occasions over a short period, without authorization.” Other states, like California, have only prohibited electronic tracking devices attached or placed in motor vehicles within their stalking definitions (NCSL, 2022). In the UAE, using electronic tracking devices to monitor someone could lead to six months of prison time, a fine, or both (Haza, 2018).

8.2

ASSISTIVE TECHNOLOGY, DIGITAL INTERVENTIONS, AND TELEHEALTH POLICIES

8.2.1 Assistive/Supportive Technology for people with disabilities

According to UNICEF and WHO reports (World Health Organization & UNICEF, 2022), the following principles of assistive technology (AT) access should be considered when designing policies or programs for providing assistive technology to people with disabilities:

- a. **Accessibility:** Policies for providing assistive technology to people with disabilities should be accessible. This includes answering questions like, “Are the services, facilities, and information on AT accessible? Is access to them equitable?”
- b. **Affordability:** Alongside availability and quality, this principle seeks to address whether people can afford the assistive technology products they need. Questions to consider include, “Do these products comply with safety standards? Are they available in sufficient quantities?”
- c. **Adaptability:** AT services available to people with disabilities should be adaptable to their changing needs throughout their lives and in response to changing circumstances and environments.

- d. **Availability:** Products must be made available where the end users are, which often includes remote, rural, or difficult-to-access areas—factors that can increase transportation costs.
- e. **Acceptability:** This principle refers to the functionality and efficacy of the products themselves, asking whether they are designed with the needs of end users in mind.
- f. **Quality:** This principle refers to the overall standard of the products—whether they are well-designed, safe, and durable.

The WHO has established the Global Cooperation on Assistive Technology (GATE) initiative to ensure the provision of assistive technology to all who need it worldwide. Under this initiative, a list of fifty priority assistive technology products (APL) has been prepared, aiming to make these products available to all citizens in all countries who need them. Resolution 71.8 of the World Health Assembly (WHA 71.8) calls on nations to “develop a national list of priority assistive products that are affordable and cost-effective and meet minimum quality and safety standards, drawing on WHO’s priority APL.” However, many low- and middle-income countries do not have sufficient resources to provide all or even most of the products on the APL. In African countries, mobility aids are the most commonly provided products, and

many items on the APL list are not available at all (Smith, 2023). Moreover, the availability of assistive technology for certain disabilities and not others—specifically mobility-related disabilities—is also a characteristic in high-income countries. For instance, in Canada, where the costs of assistive technology are the most cited barrier, the government acts as the payer of last resort after private insurance and often does not cover repairs and maintenance of assistive technology products. As a result, mobility devices are the most frequently provided AT products (Berardi, 2021). Notably, Qatar’s e-Accessibility policy, launched in 2011, is one of the first policies on accessibility in the region. These policies ensure that people with disabilities in Qatar can fully take advantage of ICTs and increase the overall usability of ICT products for everyone (The Supreme Council of Information & Communication Technology, 2011).

In low- and middle-income countries, affordability and availability are significant factors in policy-making for assistive technology provision for people with disabilities, as government or NGO-sponsored funding for assistive technology programs is simply insufficient to meet the needs of the population. Research from Bangladesh, Nepal, and India shows that the number of people with disabilities is significantly underreported due to social stigma (Karki, Rushton, Bhattarai, & Witte, 2023). Underreported statistics and the lack of detailed categorization in the data collected by low- and middle-income countries can lead to poor policymaking and decisions. Indeed, underreporting results in less budget allocation for assistive technology provision, which is especially critical for vulnerable segments of the population, such as females, the elderly, and those living in rural and underdeveloped areas.

Lack of awareness in these countries may be attributed to a top-down model, where information on programs and campaigns is disseminated from the government to service providers and, presumably, end users (Karki, Rushton, Bhattarai, & Witte, 2023). Information gaps about available assistive technology and support programs may lead people with disabilities to spend money on

privately procuring products and equipment that could have been obtained through subsidies or programs. A lack of awareness or access to specialists may also lead them to purchase products and equipment unsuitable for their needs. Such expenditure can often be very taxing on household budgets and may result in cutbacks in necessities like food.

Information gaps and top-down policies concerning people with disabilities have also been identified as issues in other regions of the world. For instance, in Cyprus, which has centralized policy-making due to its small size, many professionals and students remain unaware of available funding for assistive technology and mechanisms for referral and support within the education sector. In such situations, teachers cannot advise parents on the need for assistive technology for children with disabilities or how to access it (Mavrou, 2011). A similar problem of low awareness has been observed in the United Arab Emirates, where awareness of the availability of existing technologies is lacking (Maisikeli, 2023).

Governments in low- and middle-income countries have implemented various mechanisms to support communities in acquiring these products and equipment, from direct provision in India to lower import duties on assistive technology in Nepal. Research from India, Nepal, and Bangladesh has also indicated that awareness of assistive technology facilities and prevalent government assistance policies is limited among the target population, often leaving people unaware of their eligibility for assistive technology (Karki, Rushton, Bhattarai, & Witte, 2023).

8.3

TELECOMMUTING AND REMOTE WORK POLICIES

Because remote work and telecommuting opportunities have increased exponentially since the beginning of the pandemic, relatively few existing policies that regulate or promote telecommuting and/or remote work exist at regional or national levels. However, effective policies that do exist can be categorized into two types: (a) policies and legislation that protect workers' rights in telecommuting and remote work environments and (b) policies that bridge digital divides and aim to provide families access to the digital economy (Lockton Global Compliance, 2024; Stephan et al., 2023; UN Economic and Social Commission for Asia and the Pacific, 2018).

Policies and Legislation to Protect Workers' Rights

More than 30 nations have enacted new remote working legislation since the onset of the COVID-19 pandemic, which sparked significant growth in remote work (Lockton Global Compliance, 2024; UNDP, 2021). Generally, these pieces of legislation aim to protect families from the burdens associated with remote work by: 1) establishing written contracts between employers and employees outlining remote work expectations; 2) ensuring that remote workers enjoy the same rights as on-site employees, including adherence to regular working hours; and 3) mandating that employers provide employees with the necessary equipment to work remotely (Lockton Global Compliance, 2024). Enshrining these pro-

tections into law helps prevent the negative effects of telecommuting or remote work, such as unclear work hours, work-life spillover, work-life imbalance, and the economic costs of telework for families (UNDP, 2021; UN, 2020a; UN, 2020b). While the extent to which this legislation is enforced remains unclear, it represents a significant step toward enhancing a family's ability to thrive in a changing digital economy (UN Economic and Social Commission for Asia and the Pacific, 2018).

Some recent pieces of legislation go even further in protecting families. For instance, legislation introduced in Angola mandates that employers cannot reject telework requests from employees who are (1) pregnant and have health complications or (2) caring for a child under the age of 5. In Argentina, employees with children under 13 years of age or those caring for disabled or retired adults are entitled to flexible work schedules. Similar protections for pregnant mothers or those caring for disabled family members have been enacted in six other nations (Lockton Global Compliance, 2024).

Although it is uncertain whether these pieces of legislation will be phased out as the COVID-19 pandemic recedes, each serves as an excellent example of current best practices in protecting workers' rights in a digital economy to benefit families (UN Economic and Social Commission for Asia and the Pacific, 2018; UNDP, 2021).

Policies that Bridge Digital Divides

While remote work and the integration of technology into the workplace have the potential to accelerate economic growth and promote prosperity for families (UNDP, 2021; UN, 2020a; UN, 2020b), families also experience digital divides—inequalities in access to and outcomes from technology (UN Economic and Social Commission for Asia and the Pacific, 2018; UNDP, 2021). Inequalities in access to and outcomes of technology can leave millions of families unable to benefit from the economic opportunities provided by remote work and the digital economy, or worse, see their jobs replaced by machines (UN Economic and Social Commission for Asia and the Pacific, 2018; UNDP, 2021).

Numerous nations worldwide have invested in developing broadband internet networks and access to communication technologies to ensure that families can utilize digital technologies. These efforts have been remarkably successful; worldwide, 67% of all people (and 69% of people in the Middle East) are connected to the internet today, compared to just 16% in 2005 (ITU, 2023). Additionally, hundreds of billions are being invested annually in internet communication technologies, including an estimated \$25.3 billion in the Gulf region. However, continued investment in these infrastructures is necessary, as significant gaps in internet access remain, particularly in Africa (where only 37% of families have access) compared to Arab and Asian states (with 69% and 66% access, respectively) and the Americas and Europe (where access is 87% and 91%, respectively).

Although less common, national initiatives to promote online e-commerce platforms, increase digital literacy through adult skill education programs, and install technology-based financial inclusion systems have shown some success (UN Economic and Social Commission for Asia and the Pacific, 2018; UNDP, 2021). For example, connecting small producers with online e-commerce platforms has allowed families in over 1,300 "Taobao villages" in rural China to sell more than \$1.5 billion in prod-

ucts annually (UN Economic and Social Commission for Asia and the Pacific, 2018). Massive open online courses hosted by universities worldwide have provided millions with new opportunities to learn and implement digital skills (UN Economic and Social Commission for Asia and the Pacific, 2018). The Aadhaar platform in India is the world's largest digital identification program linked to a mobile phone number and a low-cost Jan Dhan bank account (UN Economic and Social Commission for Asia and the Pacific, 2018). This allows India's banking institutions to offer access to capital for various families and facilitates the direct transfer of government benefits to those in need (UN Economic and Social Commission for Asia and the Pacific, 2018). This platform exemplifies how countries can leverage national efforts to include everyone in the digital financial environment where remote work and access to technology increasingly reside (UN Economic and Social Commission for Asia and the Pacific, 2018).

The UN Economic and Social Commission for Asia and the Pacific succinctly categorizes these and other strategies for bridging the digital divide into four types of policy approaches: mission-oriented policies, grand challenge competitions, social-problem research programs, and promotion of grassroots initiatives (UN Economic and Social Commission for Asia and the Pacific, 2018). Each of these approaches is depicted in Table 1 below, reproduced from this commission's report:

Table 1: Policy Approaches to Bridge the Digital Divide and Promote Technologies Addressing the Needs of Low-Income Groups.

Mission-oriented policies	Examples	Characteristics
Set of complementary policies and measures aiming to address complex society challenges	<ul style="list-style-type: none"> Supporting financial inclusion in India Transforming fuel-based energy systems towards renewable energy in China 	<ul style="list-style-type: none"> Aim to change the direction of technological systems Focus on diffusion of technologies Seek the development of radical and incremental innovations Require leadership from the top, long-term investments and comprehensive policies
Grand challenge competition	Examples	Characteristics
Seek answers to intractable, complex and priority global health and development problems through crowdsourcing solutions.	<ul style="list-style-type: none"> Water abundance XPRIZE³⁴ 	<ul style="list-style-type: none"> Incentivizes researchers, engineers or development agents to come up with concrete solutions High upfront costs Addressing the challenges may require regulatory changes beyond the sphere of influence of competition organizers
Social-problem research programmes	Examples	Characteristics
Research programmes that specifically search solutions to development problems	<ul style="list-style-type: none"> Republic of Korea's social-problem research programme³⁵ 	<ul style="list-style-type: none"> Multi-departmental research projects driven by demand instead of supply Require joint planning and implementation across different research departments Require sound participation of civil society and citizens
Promotion of grass-roots innovations	Examples	Characteristics
Grassroots innovations are driven by groups typically excluded from the innovation process, through projects designed by local communities and/or inventions designed to meet specific local needs	<ul style="list-style-type: none"> India's National Innovation Foundation³⁶ 	<ul style="list-style-type: none"> These innovations are driven by grass-roots organizations, but governments can also encourage them

Source: UN Economic and Social Commission for Asia and the Pacific, 2018

POLICY RECOMMENDATIONS



9.1

ASSISTED REPRODUCTIVE TECHNOLOGIES

To Recommendation 1: Develop Structured and Common Rules and Regulations for ART

Countries that currently lack laws regulating ART should prioritize establishing rules and regulations to govern it, ensuring safety standards and the protection of beneficiaries' rights. Enacting legislation and framing rules would make information more accessible for those looking to explore options for dealing with infertility. Without governments taking the initial step of acknowledging the prevalence and importance of ART in today's world through regulation, they cannot progress to providing the necessary support in the form of psychological counseling, public assistance, subsidies for fertility treatments, or maintaining data banks. In the case of Muslim countries, legislation can serve as a resource for Muslims who do not reside in predominantly Muslim countries where the legislation may not conform to Islamic principles.

In Sub-Saharan African countries, governments and donor agencies are more likely to focus on providing aid and support for population control rather than fertility treatments, which can provide economic dividends to these nations. However, due to intense social pressure for parenthood, there exists an unmet need for ART. Just as there should be no disparities in securing nutrition or opportunities, the same principle applies to parenthood between the affluent and less affluent. Supporting couples and individuals who wish to

access ART treatments is crucial, especially given that infertility can lead to domestic violence and the breakdown of marriages. In societies where it is permissible, this may even result in men engaging in polygyny (Inhorn & Patrizio, 2015). Therefore, assistance for population control should be separated from assistance for addressing infertility, and donor agencies and governments should allocate funding to narrow the reproductive justice gap.

Recommendation 2: Promote Global and Financially Accessible ART Access and Support for Everyone Involved

Governments and donor agencies should invest in reducing the costs of IVF by implementing lower-cost IVF (LCIVF). Many non-profits are researching and successfully implementing LCIVF practices; further investment and funding could enhance safety and reduce risks associated with the method (Inhorn & Patrizio, 2015). Promoting safe and effective LCIVF may help infertile couples in low- and middle-income countries as well as less affluent couples in high-income countries overcome barriers to parenthood.

The inability to have offspring can lead couples to experience social pressure and stress. Therefore, while providing affordable and accessible ART should be prioritized, it is equally important to invest in infertility prevention. Rising rates of infertility have been linked to common environ-

mental toxins and unhealthy lifestyles (Pizzorno, 2018). Simple campaigns aimed at preventing, screening, and treating STIs may reduce infertility among both men and women. Similarly, campaigns promoting healthier living could raise awareness about the effects of smoking or processed foods on fertility. Such initiatives would be preferable to expenditures on expensive and invasive ART treatments later in life.

State Preparedness to Implement Assisted Reproductive Technology Policies

To effectively implement the recommendations related to assisted reproductive technology, nations must promote multidisciplinary research studies, debates, and discussions on various aspects of ART, from the protection of human rights to evaluating the risks and benefits of ART for all involved. States willing to engage in these discussions and develop new guidelines, rules, and regulations will advance toward a more accessible, structured, and secure use of ART techniques, thereby minimizing risks for couples, individuals, and children involved (recommendation 1). Concurrently, states must establish regulations for ART, supervise clinical practices, and take action to prevent legal uncertainties and the unethical commercial adoption of ART techniques. Moreover, states promoting public debates, policies, and programs will strive to ensure safe and controlled access to ART (recommendation 2).

9.2

COMMUNICATION TECHNOLOGY

Recommendation 1: Protect Children in Digital Spaces

Children's use of technology has grown exponentially, creating challenges for adults. It is essential that children are guided and protected in their online activities, which must be a collaborative effort involving policymakers, technology companies, and parents. In a recent report, the U.S. Surgeon General outlined several required actions, particularly regarding children's use of social media (United States Surgeon General, 2023):

Policymakers should:

- Strengthen protections to ensure greater safety for children by developing age-appropriate health and safety standards for technology platforms (e.g., designing technology that is safe for children's developmental stages, limiting features that increase screen time and engagement, and developing warnings for excessive use).
- Ensure technology companies share data relevant to the health impacts of their products and platforms (e.g., allowing independent researchers to access data).
- Support the development, implementation, and evaluation of digital and media literacy curricula in schools and academic standards.

- Increase funding for future research focused on the benefits and risks of children's use of social media and technology.
- Collaborate with international partners to protect children.
- Limit companies' use of children's data from their platforms and products.

Technology companies should:

- Conduct and facilitate transparent and independent assessments of their products and platforms regarding their characteristics and effects on children and adolescents (e.g., share findings and establish scientific advisory committees to inform users, caregivers, and policymakers).
- Prioritize user health and safety in the design and development of technological devices, websites, and platforms (e.g., enforce age minimums).
- Design, develop, and evaluate products aimed at fostering safe and healthy environments for youth.
- Create effective and timely systems and processes to address requests and complaints from users, families, educators, and others.

Parents and caregivers should:

- Create a family media plan (e.g., agree upon technology usage time and establish tech-free zones).
- Model responsible social media and tech behavior (e.g., demonstrate appropriate online actions).
- Teach children about technology and empower them to be responsible online participants at an appropriate age.
- Report any online risky behavior or harmful content.
- Collaborate with other parents to establish shared norms and practices.

Despite these detailed recommendations from the U.S. government, they should be viewed as goals worldwide. Regarding the recommendations for parents and caregivers, many find it overwhelming to monitor their children's digital activities and protect them from manipulation, abuse, or exploitation. Therefore, specific training programs should be made available to parents to equip them with the necessary digital skills to safeguard their children, such as ensuring maximum privacy settings on their children's accounts and restricting interactions to trusted family and friends (Fourie, 2020).

Moreover, all governments should review their laws and regulations to protect children's data and privacy, ensuring that age verification controls are implemented to minimize children's exposure to inappropriate content. Children should also be involved in discussions about tech-related issues (e.g., cyberbullying, online behaviors, actions to seek help, and attention to published content). Actively involving children is effective in many cases; for example, creating communities that protect each other against cyberbullying is the most effective way to counter such behavior. This should be complemented by creating safe spaces for children to share their experiences and

concerns (Fourie, 2020).

Recommendation 2: Develop Community Strategies for Online Literacy and Digital Safety

Online literacy, particularly regarding digital safety, should always be included in school curricula, and children should be educated about the dangers of cyberbullying, cyberstalking, and pedophilia. They should learn not to share pictures online or disclose personal information, such as addresses, on online forms (Fourie, 2020).

Many parents are aware that their underage children have social media accounts, which shifts some responsibility to the state and tech companies to ensure that children are not exposed to inappropriate content. Social media and tech companies should engage in efforts to protect minors and contribute meaningfully to this endeavor, rather than merely inquiring if a child meets a specific age requirement when creating a profile. Moreover, hotlines and awareness centers could be established for children and their caregivers, following the models adopted by the EU and Canada, providing support and solutions for individuals facing difficulties related to technology.

Finally, as children spend substantial time in front of screens, and research suggests that excessive social media use, multitasking, video games, and lack of face-to-face communication adversely affect children's physiological and psychological development, public campaigns should be initiated to spread information about the effects of excessive screen time on children and adolescents. Health services should be engaged in developing recommendations for parents on age-appropriate screen time limits, assisting them in fostering positive tech habits and suggesting that they co-view children's programs, as co-viewing has been shown to improve children's learning and development (Domingues-Montanari, 2017).

Recommendation 3: Increase Multistakeholder Collaboration for AI

Governments, local communities, and services need to establish comprehensive ethical frameworks for AI, agree on common regulations, standardize norms, balance technological advancements with ethical considerations, and promote responsible AI use. Global collaboration is necessary to help communities, families, and individuals use AI effectively, efficiently, transparently, and securely (World Bank, 2024). Key aspects requiring global cooperation include national security, ethical dilemmas, regulatory and innovation challenges, disparities in regulatory frameworks, adequacy of existing regulations, inclusive governance, and safe, inclusive AI adoption (World Bank, 2024).

Recommendation 4: Develop Laws and Regulations to Prevent Location-Tracking for Wearable Technology

In response to the increasing prevalence of location-tracking technology, policymakers should consider updating laws and regulations regarding stalking and the unauthorized placement of tracking devices on or near another person or their belongings. Laws should also address scenarios where these devices are used by spouses against each other or surreptitiously planted in joint property, such as a car. Policymakers might also engage with various manufacturers of location-tracking devices to ensure that their products emit alerts if they are attached to individuals who are not their registered owners.

State Preparedness to Implement Communication Technology Policies

To effectively implement the aforementioned recommendations for ensuring that individuals and families can safely use communication technologies, governments should take several actions. The recent report published by the U.S. Surgeon General (2023) highlights key steps, such as designing technology and applications that are appropriate and safe for children's developmental

stages, limiting features that increase platform usage and engagement, and enforcing strict age limits for the use of communication technology. States that develop strategies to mitigate risks associated with communication technology (e.g., cyberbullying, identity theft) will be moving towards safer access to technology for everyone, particularly for the youngest members of the population (Recommendation 1). Additionally, governments that create and implement prevention and awareness programs for children and their caregivers (i.e., parents and teachers) to develop digital literacy and skills will promote safe and effective use of communication technologies (Recommendation 2). Finally, to establish laws and regulations for the ethical use of AI and wearable technology (Recommendations 3 and 4), governments will need to conduct research on their risks and benefits, understand users' needs and usage patterns, and engage in ethical discussions with technology companies.

9.3

ASSISTIVE TECHNOLOGY, DIGITAL INTERVENTIONS, AND TELEHEALTH

Recommendation 1: Create Functional Strategies for Improving Assistive Technology Access

Governments and support organizations should conduct surveys to ensure that disability-specific programs are implemented and that assistive technology products are procured and provided according to the needs of the target population. Additionally, governments and support organizations must ensure that assistive technology products are safe, effective, modern, affordable, and user-friendly for both individuals and their caregivers. Coordination among local support groups, international aid organizations, and government entities is essential to avoid gaps in service provision and ensure that certain types of disabilities or regions are not underserved or excluded. This coordination can also help reduce procurement costs through combined and coordinated orders.

Recommendation 2: Develop Awareness Programs and Reduce Socio-Cultural Barriers

Awareness programs can assist families in accessing information about free or subsidized assistive technology. These programs should target communities that are likely to need more assistance and face challenges in accessing available support. Awareness centers could focus on young children through teachers and schools to promote early intervention. Existing government health centers can also serve as a resource for reaching people in rural areas.

Stigma and socio-cultural barriers surrounding disabilities are pervasive in many countries (Vuuren & Aldersey, 2020). Governments should

undertake awareness campaigns and training initiatives to advocate for and promote the acceptance of assistive technology adoption among people with disabilities, empowering them to lead full and productive lives.

State Preparedness to Implement Assistive Technology, Digital Interventions, and Telehealth Policies

To effectively implement the recommendations that enable individuals and families to access assistive technology, digital interventions, and telehealth, nations must invest in research and clinical initiatives, technology infrastructure, and enabling environments, as well as preventive and awareness programs (WHO & UNICEF, 2022). States that invest in data collection through research projects aimed at identifying the main needs of users and conducting evidence-based studies to create operational tools for individuals using assistive technology, digital interventions, and telehealth will be better equipped to develop accessible and adequate products and interventions, thereby improving the quality of both physical and virtual environments (Recommendation 1).

Moreover, states that invest in programs, activities, and campaigns aimed at reducing negative attitudes and stigma toward assistive technology users (for example, using actors and influencers to promote positive views of people with disabilities and those utilizing telehealth, digital interventions, platforms, or applications) will be contributing to a more inclusive environment for individuals needing assistive technology, digital interventions, or telehealth (Recommendation 2).

9.4

TELECOMMUTING AND REMOTE WORK POLICIES

As work becomes increasingly digital and telecommuting, remote work, and digital entrepreneurship gain prominence worldwide, the United Nations has established the United Nations System Strategy on the Future of Work. This initiative aims to provide policymakers with a strategy and toolkit for crafting policies that protect families amidst these changes (UN, 2019). The strategy outlines five policy recommendations for safeguarding workers and families in this evolving work landscape:

Recommendation 1: Mitigate Labor Market Disruption

It remains uncertain whether technological changes and remote work will reduce or increase the overall volume of jobs. However, this transition could be disruptive to families. Workers face risks related to job polarization, where middle-class jobs shrink, and labor market exclusion, as technology may automate jobs while technical skills become more crucial for employment (UN, 2019; UNDP, 2021). The UN recommends that each nation establish effective transition policies to help workers and families build digital literacy and acquire new technology-based skills, thereby protecting them against market disruptions (UN, 2019).

Recommendation 2: Improve Skills Throughout the Life Course

Rapid shifts in telecommuting and technology-based occupations necessitate that workers continuously transform and adapt their skill sets throughout their careers. As complex problem-solving abilities become more essential than physical strength, the focus is shifting from job-specific skills to flexible, rapidly changing competencies. Consequently, it is vital to transform educational institutions to support flexible lifelong learning. Technology companies must also recognize the diversity of their customer bases, developing products and services that are inclusive and centered on human needs. Each nation should establish national training programs and emphasize community initiatives that enable workers to acquire new technical skills throughout their lives, ensuring that the burden of these expenses does not fall solely on workers (UN, 2019).

Recommendation 3: Bridge the Technological Divide

Despite remarkable growth in access to the internet, smartphones, and communication technologies over the past 15 years, a significant technological divide persists between nations (e.g., 37% of families in Africa have internet access compared to 91% in Europe; ITU, 2023). Telecommuting and new technologies can potentially accelerate economic growth and development in low- and middle-income nations, but investment in infrastructure is critical (UN, 2019). Such investment is especially urgent as the world reached

“peak child” (the moment with the most children on earth) in 2017 (Ritchie et al., 2023), with the majority living in low- and middle-income nations. To capitalize on this demographic dividend over the next 20 years, technology infrastructure investments must be made in these regions (Ritchie et al., 2023; UN, 2019). Policymakers should prioritize enhancing technology infrastructure, including internet and communication technologies, in low- and middle-income nations to maximize the potential benefits of this demographic shift (UN, 2019).

Recommendation 4: Protect All Forms of Employment by Governing with Legislation

Telecommuting and remote work have made it easier to work from home and spend time with family and friends (UNDP, 2021). However, these new employment forms also blur work-life boundaries, create less clear work hours, and sometimes lead to an increase in gig work, which can be less stable and more exploitative than traditional jobs (UN, 2019). Nations must prioritize the protection of all employment forms. As detailed in Chapter 6, over 30 nations have begun enshrining protections for remote workers in legislation that requires contracts between employees and employers, mandates that remote workers enjoy the same hours as in-office employees, ensures companies provide remote or flexible work options for those caring for young children or older adults, and shifts the cost of acquiring remote work technology from employees to employers (Lockton Global Compliance, 2024). Other nations should follow this example and establish legislation that sets clear boundaries around remote work while protecting the rights of workers and their families.

Recommendation 5: Strengthening Social Protection Systems

The global transition to remote and technology-based work will inevitably leave some families at a disadvantage (UN, 2019). To ensure that no one is left behind, social protection systems must be established to reduce the living conditions gap between those who acquire the skills to engage

in technology-based jobs and those who cannot (UN, 2019; UNICEF, 2019). To strengthen these social protection systems globally, UNICEF recommends four family-friendly policies to ensure that the future workplace accommodates families (UNICEF, 2019):

- 1. Providing Paid Parental Leave for the Care of Young Children:** Enshrine parental leave policies in law. Providing paid parental leave allows parents to invest in the development of future workers (their children) and is beneficial for business. Nations that have provided paid parental leave for decades have seen increases in subsequent parent workforce participation, boosting GDP per capita by 10-20% (UNICEF, 2019).
- 2. Support Breastfeeding:** Implement laws that provide breastfeeding breaks and ensure workplaces offer safe, clean, hygienic, and culturally appropriate spaces for breastfeeding. Breastfeeding is vital for ensuring adequate nutrition for children, particularly in low-income settings (UNICEF, 2019).
- 3. Provide Affordable, Accessible, and Quality Childcare:** Establish national business-government collaborations to ensure universal access to quality, affordable childcare from the end of parental leave until children enter grade school. The benefits of improved early childhood development fostered by quality childcare are significant (UNICEF, 2019).
- 4. Support Child Benefits:** Regular cash transfers to caregivers ensure families have the economic means to purchase essentials for raising children (UNICEF, 2019). This involves collaborating with businesses and the government to set livable minimum wage levels and establish systems that provide cash benefits for children, beginning with the youngest and aiming for universal coverage. Such benefits promote economic resilience and food security, especially for families in vulnerable settings (UNICEF, 2019).

These policies contribute to what the UN describes as a social protection floor (UN, 2019). The UN recommends that nations establish social protection floors that, at a minimum, include non-contributory payments for maternity and child health, access to essential medical services, and old-age pensions. Doing so ensures families are not left behind as workers and economies adjust to the rapidly changing technological landscape (UN, 2019).

State Preparedness to Implement Telecommuting and Remote Work Policies

To prepare for the implementation of the aforementioned recommendations to protect workers and families in the evolving telecommuting and remote work landscape, nations must invest in workforce development initiatives, technology infrastructure, robust legislative protections for workers, and strong social safety nets (UN, 2019; UNDP, 2021). States that invest in workforce development initiatives to enhance family digital literacy and technological skills will mitigate labor market disruptions stemming from remote work (Recommendation 1) and improve citizens' technological skills throughout their lives (Recommendation 2). By incorporating investments in technological infrastructure, including high-speed internet access and digital communications technology, into their national budgets, states will be better positioned to reap the benefits of their population's potential and ensure maximum technological access (ITU, 2023; Ritchie et al., 2023). This strategic investment will help bridge the technological divide (Recommendation 3).

Finally, states that engage in legislative efforts to establish firm work-life boundaries and provide clearer remote work hours will be more prepared to protect all forms of employment (Recommendation 4). Over 30 nations have already initiated such legislative efforts and should serve as models for other states aiming to enhance protections for workers and families in this emerging technological era (Lockton Global Compliance, 2024). Additionally, states invested in building strong social safety nets—including parental leave, breast-

feeding support, and quality childcare—will be better prepared to strengthen the support networks necessary for families facing challenges as the nature of work evolves (Recommendation 5; UN, 2019; UNICEF, 2019). Creating these robust social safety nets will require close coordination among policymakers, interventionists, legislators, health systems, and funding mechanisms (UN, 2019; UNICEF, 2019).

CONCLUSIONS

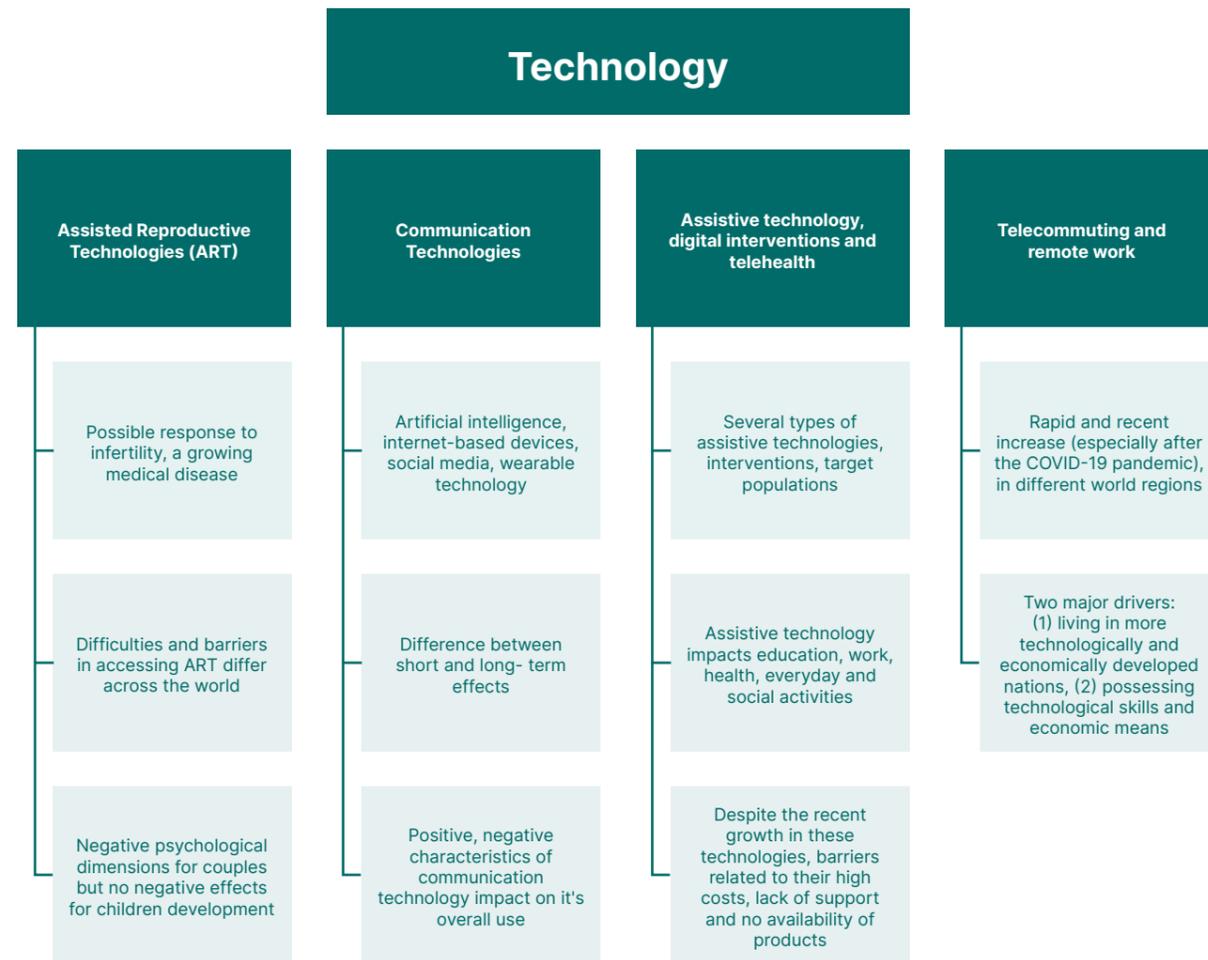
In September 2020, a report titled “Shaping the Trends of Our Time” was published for the UN’s 75th Anniversary, identifying four megatrends: climate change, demographic shifts and trends, urbanization and migration, and changes in digital technologies. These megatrends serve as transformative forces that shape and influence the lives of individuals worldwide, affecting how people develop, live, and work throughout their lives.

This report focuses specifically on the technology megatrend and details the available knowledge regarding its characteristics, the most relevant themes associated with technology, its effects, and the moderators involved. In particular, it explores the following areas: 1) assisted reproductive technologies (ART), 2) communication technologies, 3) assistive technology, digital interventions, and telehealth, and 4) telecommuting and remote work. The report emphasizes their effects on individuals’ lives globally and examines aspects that can moderate the connection between technology and individuals.

Adopting a family-oriented perspective, the report posits that families are both the foundation of society and a source of belonging, development, and identity for individuals. Therefore, for countries and economies aspiring to thrive, it is

essential to implement a family-oriented vision when exploring the megatrend of technological changes and to invest in family-oriented and family-friendly policies.

Figure 1: Technology predictors



The introduction and proliferation of medical, communication, assistive, and telecommuting technologies worldwide have significantly transformed families' formation, characteristics, and experiences related to health and well-being.

These changes can be either beneficial or harmful, depending on how technology is utilized. The most important changes resulting from technological advancements, as explained in the previous chapters, are summarized in Table 1.

Table 1: Most relevant technology outcomes

Outcomes	Principal predictor
Changes in family formation, characteristics and relationships within the family	
The introduction of new ways of becoming parents, has resulted in new forms of parenthood and contributed to increased longevity.	Assisted reproductive technology
Technology-mediated communication has created new forms of interaction, support, and monitoring within families.	Communication technology
Changes in family members' health and well-being	
Increased access to health services—through public health technologies, telemedicine, and the creation of data systems linking care across providers—has improved family health care coordination.	Assistive technology, digital interventions, telehealth
Despite advancements in mental health digital interventions, there has been no significant global decline in mental health issues, primarily due to limited accessibility in many regions.	Assistive technology, digital interventions, telehealth
Technology's impact on mental health varies, with both positive effects (e.g., fostering social connections) and negative outcomes (e.g., increased anxiety).	Communication technology, Assistive technology, digital interventions, telehealth
Technology affects physical health in both positive (e.g., aiding medical treatments) and negative ways (e.g., promoting sedentary lifestyles and poor sleep habits).	Communication technology
Although technology has influenced education, it has not yet transformed educational outcomes, as there is no strong evidence of accelerated knowledge gains or learning improvements.	Communication technology
Privacy risks for families	
Technology introduces risks such as cyberbullying, identity theft, sextortion, intimate partner violence, revenge porn, and digital infidelity.	Communication technology
Work and job changes	
Remote work has provided small but beneficial effects on job satisfaction, organizational commitment, perceived support, and supervisor-rated performance. Remote work has also allowed for more family time, leading to small but positive impacts on family relationships.	Telecommuting and remote work

Finally, technology's effects on family members' lives can be moderated by factors that alter the direction or magnitude of the relationship between tech-related predictors and outcomes. The most relevant moderators highlighted in the literature include access to technology, individuals' overall knowledge of using technology, and the actions parents can take to help their children navigate the internet and use technology effectively.

These aspects provide a comprehensive overview of the relationships linking technology and technological changes to critical factors such as physical and mental health, relationships, and work in individuals' lives. However, an important disclaimer must be made regarding a limitation of the current report: cultural sensitivities significantly shape the dynamics between technology and families. Each cultural framework, characterized by distinct values, traditions, knowledge, and morals, uniquely influences family responses to

technological advancements. Variations in cultural norms, values, practices, religious beliefs, social expectations, and historical backgrounds can lead to different technology-related outcomes and interpretations. Therefore, it is essential to consider these factors when evaluating the effects of technology on families in various regions.

For all these reasons, readers should keep cultural differences in mind while interpreting the current report's results and conclusions, which may not be universally applicable. Nevertheless, we hope this report will assist policymakers in creating a better world for families, where technology can be harnessed for individual development and personal achievements while minimizing its negative effects and risks.

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