Saudi Parents’ Security and Privacy Concerns about their Children’s Smart Device Applications

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Abstract—In this paper, we investigate Saudi parents' security and privacy concerns regarding their children's smart device applications (apps). To this end, we conducted a survey and analysed 119 responses. Our results show that Saudi parents expressed a high level of concern regarding their children's security and privacy when using smart device apps. However, they expressed higher concerns about apps' content than privacy issues such as apps' requests to access sensitive data. Furthermore, parents' concerns are not in line with most of the children's installed apps, which contain apps inappropriate for their age, require parental guidance, and request access to sensitive data such as location. We also compare Saudi parents' practices and concerns with those reported by Western (mainly from the UK) and Chinese parents in previous reports. We find interesting patterns and establish new relationships. For example, Saudi and Chinese children have a higher level of autonomy in installing apps in their devices than Western children who mostly request apps installation from their parents. However, there are more Saudi and Chinese parents who end up uninstalling apps from their children's devices than Western parents. This suggests that parents' involvement in installing children's apps reduces the number of uninstallation incidents which are mostly negatively received by children. Furthermore, Saudi and Western parents show higher levels of privacy concerns than Chinese parents. The low level of privacy concerns expressed by Chinese parents even after being informed about possible privacy implications could be related cultural or political reasons. Finally, we tested 14 security and privacy practices and concerns against high vs. low socioeconomic classes (parents' education, technical background, and income) to find whether there are significant differences between high and low classes (we denote these differences by “digital divide”). Out of 42 tests (14 properties × 3 classes) we find significant differences between high and low classes in 7 tests only. While this is a positive trend overall, it is important to work on bridging these gaps. The results of this paper provide key findings to identify areas of improvements and recommendations, especially for Saudis, which can be used by parents, developers, researchers, regulators, and policy makers.

Index Terms—Internet, security, privacy, online, children, kids, parents, smart, devices, apps, digital divide.

I. INTRODUCTION

A. Motivation

Smart devices such as smartphones and tablets, along with their applications (apps), represent an integral part of almost everyone’s daily life. Children are increasingly spending more time using these devices and apps. In the UK, as of 2019, according to research by Ofcom [1], 45% of children between 5 and 15 years old own a smartphone, compared to 35% in 2015. In the US, as of 2019, according to the Common Sense census [2], 53% of children between 8 and 11 years old, and 91% of children between 8 and 18 years old own a smartphone, compared to 32% and 77% respectively in 2015. In Saudi Arabia, according to a report by “Norton” [3], Saudi Arabia’s children rank the highest in accessing tablet devices, where 74% of them do so. Moreover, Saudi children are the youngest to own their first connected mobile device, where on average, a 7 year old Saudi child has his/her first connected device [3]. Furthermore, the Internet penetration rate in Saudi Arabia is 93.31%, according to the 2019 yearbook of the General Authority of Statistics (GAS) in Saudi Arabia [4].

In recent years, two studies have looked at parents’ security and privacy concerns regarding their children’s smart device apps [5], [6]. The aforementioned two studies surveyed Western (mainly from the UK) [5] and Chinese parents [6].

In this study, we pay particular attention to Saudi parents’ security and privacy concerns about their children’s smart device apps. There are several reasons that make Saudi Arabia an interesting and unique target to study. First, Saudi Arabia is a developing country that was established in 1932 under the name of Kingdom of Saudi Arabia (KSA) [7], and is located in south-western Asia. Second, it has one of the youngest populations in the world. As of 2019, 31.42% (10,749,944) of Saudi population are below 20 years old, and 24.52% (8,389,963) are below 15 years old [8]. Third, it is a wealthy country, mainly from oil export revenues which represent 70% of its export earnings according to the Organization of the Petroleum Exporting Countries (OPEC) [9]. Saudi Arabia has around 17% of the world’s proven oil reserves and is the second largest member of the OPEC [9].

Saudi Arabia is developing rapidly. Obviously, the strong economy combined with its young population are the two main factors for such rapid development. This in turn resulted in high rates of technology adoption and Internet access. However, parents’ awareness about emerging technology issues such as security and privacy may not be in line with the

$^1$The report surveyed 6086 parents who have children between 5 to 16 years old in 10 different countries from around the globe.

$^2$Owning or borrowing.

$^3$The number of population of Saudi Arabia in mid 2019 according to GAS is 34,218,169 [4].
adoption pace. It is not surprising to hear comments such as the following comments by an orthodontic specialist and a mother of two children, 5 and 8 years old [10]:

I do not know how to use the smart TV anymore because it is more complicated, but the [smart] TV is very simple for my children to use. They know how to switch from YouTube to cable channels and to Netflix. Sometimes I need them to do that for me.

The need for supporting families in children’s online security and privacy issues has been realised by the Saudi government. Recently, in 2020, the Saudi Crown prince Muhammad Bin Salman launched an initiative to protect children in the cyber world at the Global Cyber Security Forum in Riyadh, Saudi Arabia [11]. Our research is a step in this direction.

The main goal of this study is to understand Saudi parents’ security and privacy concerns about their children’s smart device apps. The results of this study will help us better understand the status of Saudi families to identify areas of improvements, set recommendations, and develop the right tools towards a safer online world for children.

B. Research Questions

The main research questions in this study are as follows:

1) What security and privacy concerns do Saudi parents have about their children’s smart device apps?
2) What are they doing to mediate these concerns?
3) Where do Saudi parents stand in terms of security and privacy practices and concerns compared to Western and Chinese parents’ practices and concerns outlined in previous reports?
4) Are there different security and privacy practices and concerns between different cultures and political systems?
5) Are there significant differences in security and privacy practices and concerns between high vs. low Saudi socioeconomic classes (i.e. “digital divide”)?

C. Contributions

The main contributions of this paper are: first, we conducted a survey to understand Saudi parents’ security and privacy practices and concerns about their children’s smart device apps. We analysed 119 completed responses by Saudi parents of one or more children whose ages range between 6 to 12 years old. Second, we compared several aspects of Saudi parents’ security and privacy practices and concerns about their children’s smart device apps with those reported by Western and Chinese parents. We identified interesting patterns and established new relationships, which can be linked to political and cultural differences. Third, we tested whether there are significant differences between high vs. low Saudi socioeconomic classes (parents’ education, technical background, and income) in terms of security and privacy practices (digital divide). Out of 42 tests, we found significant differences between high and low classes in 7 tests only.

The term “digital divide” is a common term used to describe the gap between the societies that have access to technology and those that do not. While we use it to describe a different sort of gap, we find it a suitable term.

D. Organisation

This paper is organised as follows: in section II, we summarise related work. In section III, we describe our study methodology. In section IV, we discuss our results. In section V, we examine whether there is a digital divide (significant differences between high vs. low Saudi socioeconomic classes). In section VI, we make recommendations. Finally, in section VII, we conclude the paper.

II. Related Work

In this section, we describe related work which we classify into three categories: 1) Internet usage and the associated risks, 2) parents’ concerns about children’s online safety, and 3) means to ensure children’s online safety. Our study mainly fits in the second category: parents’ concerns about children’s online safety. However, we include the other categories for completeness, to provide the full picture of this realm.

A. Internet Usage and the Associated Risks

While Internet access provides unprecedented opportunities for communication, learning, and entertaining, it brings numerous risks with it. For example, access to global information brings with it the risk of viewing inappropriate or illegal content, access to social networks brings with it the risk of being exposed to bullying and sexual harassment, and the list goes on [12]. In [12], Hasebrink et al. provide a classification for online risks from two dimensions: the child’s role and the provider’s motive. Table I illustrates Hasebrink et al.’s classification.

B. Parents’ Concerns about Children’s Online Safety

The closest work to ours is Zhao et al.’s [5]. They surveyed 221 parents from Western countries (mainly the UK, where 78% of the respondents are from the UK) regarding what privacy concerns parents have about their children’s mobile apps. They identified patterns for practices and concerns. For example, they found that when choosing an app for their children, parents care about apps’ content more than the personal data that the apps might collect. Additionally, they found that some of the most widely used apps by children are inappropriate for their age. Subsequently, Wang et al. [6] conducted a related study that surveyed 593 parents from China. Wang et al. compared some of their findings with those reported by Zhao et al. [5] on Western parents. Interestingly, Wang et al. found some different trends between the two populations, possibly due to political and cultural reasons. For example, Chinese children show higher levels of autonomy in installing apps in their devices than Western children. Additionally, Western parents show higher levels of privacy concerns than their Chinese counterparts. We aim to extend this research line to study Middle Eastern parents by surveying Saudi families.

With respect to Saudi families, there are few studies that have investigated children’s online safety from various perspectives. In [13], A. M. Alqahtani surveyed 115 adolescents from the Gulf Cooperation Council (GCC) countries including,
TABLE I: Hasebrink et al.’s classification of online risks from two dimensions: the child’s role and provider’s motive [12].

| Child’s Role | Commercial | Aggressive | Provider’s Role | Values |
|--------------|------------|------------|----------------|--------|
| Content: child as recipient | Advertising, exploitation of personal information | Violent web content | Problematic sexual web content | Biased information, racism, blasphemy, health “advice” |
| Contact: child as participant | More sophisticated exploitation, children being tracked by advertising | Being harassed, stalked, bullied | Being groomed, arranging for offline contacts | Being supplied with misinformation |
| Conduct: child as actor | Illegal downloads, sending offensive messages to peers | Cyberbullying someone else, happy slapping | Publishing porn | Providing misinformation |

Saudi Arabia, who were studying in the UK, and their ages ranged between 13 and 18 years old. The survey consisted of several high-level questions about keeping safe online. The study found that online risks are not fully understood by adolescents or their parents. The results also suggest that GCC adolescents’ online behaviour differs from their UK counterparts in terms of Internet usage, which may be a route that GCC adolescents take in future. In [14], N. Alqahtani conducted a study on 30 Saudi parents and their children (30 children) to investigate associations and correlations between what children say about online risks and what their parents do to mediate those risks. They found disparity between parents’ perspectives and their children’s online behaviour, in addition to a lack of collaboration between parents and children to provide online safety. In [15], Almogbel et al. examined the relationship between parents’ educational and economical level against parental control over their children’s Internet usage. The study concluded that parents’ demographic variables seem to have no effect on the level of control for their children’s browsing behaviour.

Unlike previous work in the Saudi Arabia context, our study is focused on mobile apps and privacy concerns, which none of the previous work investigated. Furthermore, while Almogbel et al. provided a high-level examination for the relationship between parents’ socioeconomic status and their children’s Internet usage in [15], our study provides a new perspective. We provide an in-depth examination of a different and wider set of parameters (14 properties about parents’ practices and concerns against 3 socioeconomic aspects) in a larger population, to identify whether there are significant differences between high vs. low Saudi socioeconomic classes in terms of security and privacy practices and concerns.

C. Means to Provide Children’s Online Safety

Hartikainen et al. [16] classified the means for ensuring children’s online safety as follows:
1) Industry mediation: such as age restriction, reporting mechanisms, and automatic filtering techniques.
2) Policies and educational efforts: such as digital literacy programs, teaching online safety in schools, and creating guidebooks for children and parents.
3) Social mediation: such as conversations with children about Internet usage, limiting, or monitoring it.
4) Technical mediation: such as installing malware detection tools, or parental control software.

5) Developmental process: such as viewing children’s online safety as a developmental process of youth growth.

However, most of the aforementioned mediation means have limitations. For example, industry mediation such as reporting tools have their technical issues including reliance on users or administrators, e.g. to report abuse. In addition, automated screening tools often suffer from false positive alerts. Policies, educational, and social mediation such as conversations are not trivial. For example, children can be more competent in emerging technologies than their parents and teachers. Therefore, parents and teachers may be unfamiliar and struggle with emerging technologies. Technical mediation has technical limitations that affect their efficiency. For example, some parental control software can be circumvented by children. In addition, some might highlight ethical concerns regarding children’s privacy when parents use parental control software to monitor them.

Designing the right tools for children’s online safety is non-trivial. Finding the right balance between technical efficiency, transparency, and children’s privacy is challenging. A study by Ghosh et al. [17], analysed reviews of parental control apps posted by children. They found that children’s reviews are significantly lower than those in parents’ reviews (76% of the children’s reviews are one star) [17]. Clearly, children are not viewing these tools positively. However, there might be profound reasons behind this phenomena that needs further research.

III. Methodology

In this section, we describe our methodology. We start by describing our targeted sample, followed by how we design and deploy our survey.

A. Targeted Sample

Our targeted sample is those who identify themselves as: 1) Saudi citizens and residents, and 2) have one or more child whose ages are between 6 to 12 years old and have regular access to smart device apps. We stated the aforementioned two conditions in the survey invitation letter. However, to ensure correctness, we included several questions in the survey that enable us to filter out unwanted responses (i.e. those that do not meet the aforementioned conditions). For example, the survey includes a question about whether the respondent is living in Saudi Arabia or elsewhere. This question enabled us to filter out responses coming from outside Saudi Arabia. Furthermore,
to check the respondent child’s age, we included a multiple choice question about the child’s age with choices ranging from 6 to 12 years. Therefore, a respondent who does not have a child within the specified age range will not find the correct answer, and ideally should not participate in the survey.

B. Survey Design

Our survey consists of 51 questions divided into the following sections: 1) introduction, 2) demographics and device usage, 3) parents’ privacy controls and concerns, and finally 4) reflection. The majority of questions are multiple choice questions, while several questions require short textual inputs. We used the “logic” feature in designing our survey. That is, some questions appear only if certain conditions in the previous question(s) are met. For example, a question appears only if the previous question answered with “yes”. Therefore, the actual number of questions that each participant received varied based on their answers. Our survey was delivered in the Arabic language, the native language of Saudi Arabia. We chose to use Arabic because we want to reach a wide range of the Saudi society, including non-English speakers. Our survey is based on Zhao et al’s survey in [5]. We modified Zhao et al’s survey in terms of both breadth (more questions added) and depth (several questions and answers adjusted and improved). However, many questions remain common with our survey which allows us to compare several aspects of both studies. We translated Zhao et al’s survey questions mainly using Google translate, followed by manual editing as needed. We designed the survey in an electronic format using the “alchemer”, an online survey platform that enables high level of customisation, and supports Arabic. It also provides several advanced features including reports and customised queries of the results. We used a professional license that provides advanced survey features such as the “logic” feature which we used in the survey questions.

The survey starts with a login page (not counted as a survey section), which asks participants to enter the survey password which is enclosed within the survey invitation. The password is meant to protect our survey since it is publicly available online. The first section of the survey is “Introduction”, which contains all the information that the participants need to know before starting the survey such as the purpose of the study and the “informed consent”. The second section is “Demographics and Device Usage”, which asks about the parent(s) and their child’s demographic data, in addition to the child’s device usage. The third section is “Parents Privacy Controls and Concerns”, which is the core of the survey. It consists of four subsections: 1) “Installing Apps for Your Child”, 2) “General Practice”, 3) “Privacy Concerns”, and 4) “Parental Controls”. Finally, the fourth section of the survey is “Reflection”, which contains one optional open question, to enable the participants to reflect on what they have learned from the survey, or to provide further comments, if any.

Participation in the survey was voluntary. We did not offer reimbursement of any kind to respondents to avoid multiple responses, or inaccurate responses, from irresponsible individuals who might participate only for the sake of reimbursement, without fulfilling the survey conditions.

C. Ethical Considerations

We followed the common ethical guidelines required for studies that involves human subjects. We obtained a formal ethical approval form our institution’s (KAU) research ethics committee for our study. Participants were provided with a written informed consent. In the consent form, we informed them about the research title and goals, how their data will be collected, processed, stored, secured, and for how long, in addition to all the information they need to know before taking part in the survey. Participants were informed that they agree to take part in the study by clicking the “Next” button in the informed consent page (we used an online survey). They are also informed that they can quit the survey at any point without any consequences, by closing the browser. Furthermore, we did not collect personally identifiable data (e.g. name, national ID, and work place). Participants were informed that the results of this study will be published in an aggregated format. Finally, participants were provided with our contact details, if they have any concerns. Our survey was distributed to all King Abdulaziz University’s (KAU) staff through the staff mailing list through KAU’s Deanship of Postgraduate Studies, in addition to our personal and professional networks as we will elaborate in section III-D.

D. Survey Deployment

We deployed the survey in two phases: a pilot survey, followed by the actual survey. In what follows, we describe each phase.

1) Pilot Survey: Before we deploy the survey, we distributed a pilot survey to three participants, all of whom are females. Two of those participants satisfy the survey conditions: Saudis, and have one or more children who are between 6 to 12 years old who use smart devices regularly. The third participant did not have children. Therefore, we asked her to answer the child-related questions based on an imaginary child that she built in her mind. Since the pilot survey responses will not be included in the results, the correctness of the pilot responses is not important. Our goal from the pilot survey is to gather overall feedback, test the online survey deployment from different device types and manufacturers, and measure the time needed to complete the survey. We asked the participants to write down their comments, if they have any. After they finished the survey, we had a short conversation with each participant. We identified several issues reported by them such as the survey length, the use of unfamiliar terms to our society, and typos. We modified the survey based on the pilot respondents’ comments, if the comment made sense to us too. For example, we received several comments regarding the survey length. Hence, we reduced the number of questions by removing several unnecessary questions. We also received a comment regarding the term “partner” which may not be

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5 We received it by email communication with the main author of Zhao et al. [5].
6 https://translate.google.com
7 https://alchemer.com, formerly known as https://surveygizmo.com
compatible with our conservative society. Hence, we replaced it with the term “spouse”. We then communicated the changes to the respondents and consider any further comments. We repeated this process until the participants had no further valid comments on the survey. This process took multiple rounds to be completed.

2) Actual Survey: Once we reached a satisfactory version of the survey after the pilot survey phase, we distributed the survey through an invitation letter which contains a link (URL)\(^8\) to our online survey. We sent the invitation either individually or through groups, to our personal and professional networks. The survey is distributed mainly using the WhatsApp\(^9\) messaging app, email, and LinkedIn\(^10\). We posted the LinkedIn invitation through the first author’s LinkedIn account, where the invitation was visible to her professional network connections only. In addition, we distributed the survey to KAU’s staff through a mailing list through the KAU’s Deanship of Postgraduate Studies. KAU is a large state university in the western region of Saudi Arabia. It has over 4000 academic \(^{18}\) and 4000 administrative staff \(^{19}\). In the invitations to our personal and professional networks, we added a statement to encourage the recipients to circulate them among their networks, especially among parents’ groups of their children schools. Parents’ WhatsApp groups are common among parents in our society. We avoided sharing the survey link over “public” social media accounts which may contain random followers whom we neither know directly or have a common connection with. This is to avoid incorrect or duplicate responses from irresponsible users of such public social networks, or possibly from automated software bots.

E. Data Analysis

This section is meant to provide a high level overview of the data analysis method we used. More details are embedded in the rest of the paper as needed. After we closed the survey, we gathered the data for analysis. We employed both descriptive analysis to summarise results, and exploratory analysis to explore data and find new relationships \(^{20}\). In section V, to identify whether there is a digital divide between high vs. low Saudi socioeconomic classes, we used the Chi-Squared test or the Fisher-Irwin test (the latter used only if the expected frequency is less than 5) \(^{21}\).

IV. RESULTS

A. Responses

We received 136 completed responses. In this paper, we exclude a total of 17 responses for the following reasons. First, we exclude 3 responses for respondents who reported that they are living outside Saudi Arabia. Second, we also exclude 2 responses from participants who described their relationship with the child as an “aunt” and as a “grandmother” as we decided to count responses from those who have a formal guardianship with the child (either a “parent” or a “guardian”), to avoid inaccurate responses. Third, while we are initially interested in understanding both Saudi citizens and residents (non-Saudis living in Saudi Arabia), in this report, we decided to focus only on Saudi citizens. As a result, we exclude 12 responses from those who identified themselves as non-Saudis.

We end up with 119 completed responses from respondents who identified themselves as: 1) Saudi citizens, 2) living in Saudi Arabia, and 3) parents or guardians of at least one child whose age is between 6 to 12 years old who have regular access to smart device apps. In what follows, we report the survey results in detail.

B. Demographics and Device Usage

1) Parents’ Demographics: In terms of respondents’ demographics, as listed in Table II, our respondents are mainly from the western region of Saudi Arabia (73.95%), followed by the central region (16.81%), while the remaining minorities are from the Eastern, Northern, and Southern regions. The regional bias is very likely due to the fact that the first author (principle investigator) lives in the western region of Saudi Arabia (Jeddah city), and we distributed the survey through KAU, a large state university in Jeddah city. Although most of the respondents are from the Western region of Saudi Arabia (a.k.a. Makkah Region), it is a very large and diverse region, with a population of 9,033,491 in mid 2019 \(^{4}\), which makes it representative for the Saudi society. Most of the respondents are females (86.55%). The gender bias in such a study about parenting and children is not surprising. A similar bias towards female respondents has been observed in two related studies, one in the UK \(^{5}\), and the other in China \(^{6}\).

Most of our respondents are middle-aged, where 55.46% range from 35 to 44 years old, and 23.53% are from 25 to 34 years old. The average number of children (who are not older than 18 years old) in the respondents’ families is 2.73 children. The participants’ relationship with the child selected for the survey is mostly a parental relationship as 98.32% reported, while the remaining have a guardianship relationship. For brevity, in this paper, we use the term “parent(s)” to refer to both types of respondents: parents and guardians. See Table II for further details about parents’ demographics and Table IV for details about children’s demographics.

2) Parents’ Economical Status: Our respondents come from various economical statuses. We classify participants’ household monthly income into several classes. Our income classification is mainly based on the “sufficiency line” (i.e. the bare minimum line), a term coined by Aldamegh in \(^{22}\), who conducted a study that sets the minimum required monthly income for a 5 person family to have a decent standard of living in Saudi Arabia, which is meant to describe a slightly better line than the commonly used “poverty line”. The sufficiency line income varies between 6037.57 and 12,673 Saudi Arabian Riyal (SAR), according to Aldamegh in \(^{22}\). The exact income for a reasonable standard of living depends on the geographic region of Saudi Arabia since the sufficiency line model consists of ten variables that represent the basic needs for a good standard of living including accommodation, food, health care, transportation, and entertainment. However,

\(^{8}\)Using the secure HTTPS protocol.

\(^{9}\)https://www.whatsapp.com

\(^{10}\)Linkedin (https://linkedin.com) is a professional networking online platform.
on average, the sufficiency line income in Saudi Arabia is 8926.10 SAR, according to Aldamegh in [22]. Since Aldamegh’s study is based on data from 2013, we considered the inflation rate in Saudi Arabia from 2013 to 2020 according to data from [23] which we cross-checked with data from [24]. Accordingly, we updated the sufficiency line monthly income data from [23] which we cross-checked with data from [24].

The last block of Table II shows the economic status levels that we defined along with the responses we received, which are sufficiently diverse and can be representative for the Saudi society. Those in the middle income class (including “low-middle”, “middle”, “high-middle”) ranges represent a total of 46.22% of the respondents, while 18.49% are in the sufficiency line, 6.72% are in the “low income”, 21.85% are in the “above-middle income”, and 6.72% of the respondents prefer not to answer this question.

3) Parents’ Employment Status: As demonstrated in Table III, our participants have various employment statuses. The majority of the respondents (64.71%), and their spouses (74.79%), are full-time paid employees. We have a high percentage of respondents (18.49%) who identified themselves as “full-time housewife/househusband”\(^\text{11}\). However, all of them are females. The latter figure is not so surprising since financial independence for women in Saudi Arabia is non-obligatory. That is, men are obliged (by the Islamic “Shariaa” law) to finance their families, while women are obligated to remain at home.

4) Parents’ Educational, and Technical Backgrounds: Our respondents come from various educational and technical backgrounds. In terms of educational background, the majority have a university degree, where 40.34% have Bachelor, 26.05% have Masters, and 23.53% have Phd. degrees. In terms of technical background, we define this as having a degree or working in Computer Science (CS), Information Technology (IT), Information Systems (IS), or Computer Engineering (CE) fields. We communicated this definition to our participants within the concerned question in the survey. Table III shows the parents and their spouses who have a technical background. There are 16 (13.45%) of the responses where both parents have technical background. Table III shows the parents’ employment, educational, and technical backgrounds in more detail.

5) Children’s Demographics: The average age of the child selected for the survey is 9.14 years old. The children’s gender is almost equally distributed, where 50.42% are females, and

| Region          | Participants | N = 119 |
|-----------------|--------------|---------|
| Western         | 88 (73.93%)  |         |
| Eastern         | 6 (5.04%)    |         |
| Central         | 20 (16.81%)  |         |
| Northern        | 3 (2.52%)    |         |
| Southern        | 2 (1.68%)    |         |

| Age             | Participants |
|-----------------|--------------|
| 18 to 24        | 0 (0%)       |
| 25 to 34        | 28 (23.53%)  |
| 35 to 44        | 66 (55.46%)  |
| 45 to 54        | 22 (18.49%)  |
| 55 to 64        | 3 (2.52%)    |
| 65 or above     | 0 (0%)       |

| Gender          | Participants |
|-----------------|--------------|
| Female          | 103 (86.55%) |
| Male            | 16 (13.45%)  |

| Children not older than 18 years old | Participants |
|-------------------------------------|--------------|
| 1                                   | 8 (6.72%)    |
| 2                                   | 49 (41.18%)  |
| 3                                   | 37 (31.09%)  |
| 4                                   | 20 (16.81%)  |
| 5                                   | 3 (2.52%)    |
| 6                                   | 1 (0.84%)    |
| 7                                   | 1 (0.84%)    |
| 8                                   | 0 (0%)       |
| 9                                   | 0 (0%)       |
| 10                                  | 0 (0%)       |
| 11 or more                          | 0 (0%)       |

| Monthly family income in SAR         | Participants |
|-------------------------------------|--------------|
| Less than 6000                      | 8 (6.72%)    |
| From 6000 to 13,000                 | 22 (18.49%)  |
| More than 13,000 to 20,000           | 24 (20.17%)  |
| More than 20,000 to 27,000           | 19 (15.97%)  |
| More than 27,000 to 34,000           | 12 (10.08%)  |
| More than 34,000 to 41,000           | 7 (5.88%)    |
| More than 41,000 to 48,000           | 7 (5.88%)    |
| More than 48,000                     | 12 (10.08%)  |
| Prefer not to answer                 | 8 (6.72%)    |

\(^{11}\)One participant chose “Other” in the employment status question and specified her choice as “housewife”. Therefore, the actual number of full-time housewives is 23 (19.33%)
TABLE III: Parents and their spouses’ educational, employment, and technical backgrounds. Columns with “-“ value mean we do not have figures for them since participants are not offered “Don’t know”, “N.A.” answers for questions about themselves, but are offered them for questions about their spouses.

| Highest degree | Participants | Spouses |
|----------------|--------------|---------|
| Phd.           | 28 (23.53%)  | 13 (10.92%) |
| Masters        | 31 (26.05%)  | 22 (18.49%) |
| Bachelor       | 48 (40.34%)  | 55 (46.22%) |
| Diploma        | 1 (0.84%)    | 6 (5.04%)  |
| High School    | 8 (6.72%)    | 15 (12.61%) |
| Intermediate school | 2 (1.68%)   | 2 (1.68%)  |
| Primary school | 1 (0.84%)    | 1 (0.84%)  |
| Don’t know     | -            | 0 (0%)     |
| N.A.           | -            | 5 (4.20%)  |
| Other          | 0 (0%)       | 0 (0%)     |

| Employment status | Participants | Spouses |
|-------------------|--------------|---------|
| Full-time paid employee | 77 (64.71%)  | 89 (74.79%) |
| Part-time housewife/husband | 22 (18.49%)  | 10 (8.40%) |
| Self-employed or business owner | 1 (0.84%)    | 2 (1.68%)  |
| Unemployed, looking for work | 6 (5.04%)    | 2 (1.68%)  |
| Unemployed, not looking for work | 3 (2.52%)   | 0 (0%)     |
| Unable to work | 0 (0%)       | 0 (0%)     |
| Student          | 4 (3.36%)    | 1 (0.84%)  |
| Retired          | 1 (0.84%)    | 6 (5.04%)  |
| Don’t know       | -            | 0 (0%)     |
| N.A.             | -            | 2 (1.68%)  |
| Other            | 1 (0.84%)    | 0 (0%)     |

| Technical background | Participants | Spouses |
|----------------------|--------------|---------|
| Yes                  | 35 (29.41%)  | 21 (17.65%) |
| No                   | 84 (70.59%)  | 88 (73.95%) |
| Don’t know           | -            | 0 (0%)    |
| N.A.                 | -            | 10 (8.40%) |

TABLE IV: Children’s demographics.

| Age                | Participants |
|--------------------|--------------|
| 6                  | 17 (14.29%)  |
| 7                  | 19 (15.97%)  |
| 8                  | 11 (9.24%)   |
| 9                  | 16 (13.45%)  |
| 10                 | 18 (15.13%)  |
| 11                 | 15 (12.61%)  |
| 12                 | 23 (19.33%)  |

| Gender            | Participants |
|-------------------|--------------|
| Female            | 60 (50.42%)  |
| Male              | 59 (49.58%)  |

| Parental Relationship | Participants |
|-----------------------|--------------|
| Parent                | 117 (98.32%) |
| Guardian              | 2 (1.68%)    |

| Child’s school type                          | Participants |
|----------------------------------------------|--------------|
| Private (International)                      | 42 (35.29%)  |
| Private (non-International)                  | 37 (31.09%)  |
| Government                                   | 39 (32.77%)  |
| Other                                         | 1 (0.84%)    |

| Internet access (screen time) | Participants |
|-------------------------------|--------------|
| No access at all              | 3 (2.52%)    |
| Less than 2 hours             | 16 (13.45%)  |
| Between 2 to 4 hours          | 41 (34.45%)  |
| More than 4 hours             | 59 (49.58%)  |

| Device ownership               | Participants |
|--------------------------------|--------------|
| Has his/her separate device    | 82 (68.91%)  |
| Shares one device with his/her sibling(s) | 14 (11.76%) |
| Shares one device with one of his/her parents | 22 (18.49%) |
| Other                          | 1 (0.84%)    |

49.58% are males. This is nearly equivalent to the gender distribution of the the Saudi populations census for children between 5 to 14 years old (49.09% females, and 50.91% males), according to the 2019 GAS year book [4]. In terms of the child’s school type, 66.39% are in private schools (either International or non-International), and 33.61% are in government (state) schools12. Since private schools are with fees, and state schools are free, the school type can indicate the family’s economic status to some extent13. Table IV shows the children’s demographics in more detail.

6) Children’s Smart Device Usage: With respect to children’s used devices, Figure 1 shows the children’s most commonly used devices. Note that a child might have access to more than one device and we allowed parents to select all that apply. iPads are the most widely used devices by children (53.78%), followed by smartphones (34.45%), Parent’s Smartphone (31.93%), Android tablet (14.29%). The “Other” category is selected by 13.45% of the participants who listed devices such as Desktop, Laptop, Macbook, Nintendo, Smart TV, and Play Station.

The majority of children have their own devices (68.91%), while the rest share the device with their siblings (11.76%), or one of their parents (18.49%), and one (0.84%) chose “Other” and specified that the child is sharing the device with both parents and siblings. While sharing a parent device with his/her child might give the parent perceived control over the child’s usage of the device, it should be shared with caution. Parents’ smart devices may contain apps with inappropriate content such as confidential emails in the parents’ work email app.

In terms of the time children spend on the Internet (a.k.a. “screen time”), we classify the time children spend on the Internet into 3 categories: “very high” (more than 4 hours per day), “high” (between 2 to 4 hours per day), “low” (less than 2 hours per day), in addition to “no access at all”.

There are various hourly thresholds used to report screen time. However, we base our classification on a scale from [26], [27]. The American Academy of Child and Adolescent Psychiatry (ACAP) recommends limiting screen time for children whose ages range between 2 to 5 years old to around 1 hour per weekday, and up to 3 hours during weekend days. Moreover, ACAP recommends limiting (without specifying the limit) screen time for children starting from 6 years [28]. Limiting screen time for children is a controversial issue: some studies recommend no more than 2 hours per day and link high screen time to negative effects such as obesity [29], while others argue that there is little evidence that supports implementing screen time limits for children [30].

In our study, we find around half of the children (49.58%) spend “very high” screen time on smart devices, 34.45% spend “high” screen time, 13.45% spend “low” screen time, while 2.52% do not spent time on the Internet at all. Table IV
TABLE V: The top 10 most used apps by children, and their content rating according to Google Play [31] except in the App named “Games” we cannot specify content rating as “Games” is a category not an app name.

| App name | Content Rating | Request permissions to sensitive data |
|----------|----------------|--------------------------------------|
| YouTube  | Rated for 12+ Parental Guidance | Yes                                  |
| Games    | Depends on the game | N.A.                                  |
| Roblox   | Rated for 7+ Mild Violence Fear | Yes                                  |
| SnapChat | Rated for 12+ Parental Guidance | Yes                                  |
| TikTok   | Rated for 12+ Parental Guidance | Yes                                  |
| MS Teams | Rated for 3+ | Yes                                  |
| Among Us | Rated for 7+ Mild Violence | No                                   |
| Netflix  | Rated for 12+ Parental Guidance | Yes                                  |
| Instagram| Rated for 12+ Parental Guidance | Yes                                  |
| Classera | Rated for 3+ | Yes                                  |

C. Apps’ Security and Privacy Practices

1) The Most Commonly Installed Apps: We asked parents to write down the two most used apps by their children. Figure 2 shows the top 10 most used apps by children. Note that “Games” is a category and not a specific app name. However, we list it as reported by parents. Table V lists those apps along with the recommended minimum age for these apps, whether they require “parental guidance”, or contain violence, or request access to sensitive data, according to the apps’ “Content Rating” and “Permissions” in the apps’ “Additional Information” section in the Google Play Store [31].

To summarise the results, we rewrote the apps’ names to unify the language (to English)\(^\text{14}\), spelling, letter case (all names are converted to small letters), and removed extra spaces. We corrected some obvious misspellings such as

\(^{14}\text{If the app name is reported in Arabic letters.}\)

“Zome” which obviously refers to “Zoom”, “TikTalk” which obviously refers to “TikTok”. We removed some of the reported non-obvious apps which we could not find either in the Apple App store or the Google Play stores. It should be noted that some respondents listed app categories rather than app names such as “Games” and “Schools”. In these cases, we list the category as is. In addition, while we requested the respondents to name the two most used apps by their children, few respondents reported more than two apps. However, we include all the reported apps in our counting.

2) Apps’ Age Appropriateness and Permissions: To identify apps’ age appropriateness to children aged between 6 to 12 years, we manually checked the reported top 10 most used apps against the “Content Rating” section of the apps’ “Additional Information” section in Google Play [31] using a desktop web browser. We checked them on December 2020. We find 5 out of the top 10 most used apps in children’s devices require “parental guidance”, while 2 others contain “mild violence”, and 1 contains “fear”. The first most installed app is “YouTube”, which is reported by 57.98% of the parents. YouTube, and another four of the most used apps are appropriate only for 12+ year old children. Our results have only 23 (19.33%) children who are 12 years old. Out of those, only 6 children who are 12 years old (5.04%) reported YouTube as one of the most two used apps. This means that the rest of the YouTube users (52.94%) are under 12 years old. Clearly, a large percentage of children are using YouTube inappropriately. The second most installed app in children’s devices is “Games”, which is reported by 26.05% of the parents. The term “Games” is an app category and not a particular app. However, there are many games that may be inappropriate for children between 6 to 12 years old (our study sample), e.g. contain inappropriate content, or violence. The third most used app by children is a game called “Roblox”. While Roblox is listed in the Google Play store as suitable for children aged 7+ years old, the store states that it contains “mild violence” and “fear”, which suggests that it needs screen time control. Moreover, according to the Google Play store content ratings [32], the content ratings are “the responsibility of the app developers and the International Age Rating Coali-
Comparing how Saudi children’s favorite apps are installed with their Western and Chinese counterparts in [5], [6] respectively, we find interesting patterns. First, 32.77% of Saudi parents reported that their children’s apps are installed by the children themselves, compared to only 19% of Western parents, and 28.6% of Chinese parents who said so. At first glance, this reflects a higher level of autonomy and technical skills by both Saudi and Chinese children than their Western counterparts. However, such autonomy in apps installation at this age can be due to parents’ low technical background, or due to lower level of security and privacy concerns by Saudi and Chinese parents. The results suggest that Western parents are more concerned about security and privacy issues than Saudi and Chinese parents, which makes most Western parents install their children apps, possibly to ensure the apps’ safety for their children first. Second, Saudi parents appear to be more influenced by recommendations with respect to children’s apps selection (14.29%), compared to 8% of Western parents and 7.9% of Chinese parents. Third, Saudi parents are the least likely to select their children apps after some research (11.76%), compared to 15% of Western and 20.1% of Chinese parents.

4) Apps Installation Concerns: With respect to parents’ concerns when installing their children apps, we asked parents about the information they consider when installing a new app for their children. We allowed parents to select all that apply. As illustrated in Figure 4, the app’s content is the highest concern among Saudi parents, and is selected by 80.67%, followed by what the app does, which is selected by 64.71%. Parents’ concern about an app’s access to sensitive personal information appears as the third most selected concern, where it is selected by less than half of the parents (46.22%), followed by whether the app requires permissions (40.34%) and whether the app collects any information about their child (38.66%). These figures indicate that parents are more concerned about what their children receive (app’s content and function) than what their children provide to the app (app’s access to sensitive personal information, permissions, or the information the app collects about the child). However, security and privacy are two ways. Therefore, awareness for parents and their children about the importance of both aspects is needed. Finally, it is worth mentioning that our results show that the app’s cost comes as the last concern by Saudi parents, selected by only 19.33% parents.

Comparing Saudi parents’ apps installation concerns with those expressed by Western and Chinese parents in [5], [6], as illustrated in Figure 4, overall, Western parents show higher levels of concern than Saudi parents, in every aspect. Most notably, there are 50.67% more Western parents who are concerned about the app’s cost than Saudi parents. Similarly, 19.34% more Western parents care about whether the app collects any sensitive personal information about their child than Saudi parents, and 18.78% more Western parents care about whether the app collects any information about their child than Saudi parents.

It should be noted that our study and the one on Western parents [5] allowed participants to select all that apply, while the one on Chinese parents [6] appears to allow a single choice as the sum of all answers is exactly 100%.
Similarly, roughly speaking, Chinese parents show a similar trend to Saudi and Western parents\textsuperscript{17}. That is, privacy concerns (such as sharing and disclosing personal information) are not the highest concerns, and inappropriate content concern comes higher than privacy.

Having said that, despite the fact that Western parents in [5] selected more concerns than Saudi parents, both Western and Saudi parents share the highest two concerns: the app’s content, and what the app does. This suggests that parents’ one way thinking about security and privacy (i.e. what their children receive than what they provide or what the app collects) is a global issue.

5) **Password Protection:** We asked parents if they have a password to log in to the device or to install apps on their children’s devices, for example, to require their children to ask them before they can log in to the device or install apps. Our results show 84 (70.59\%) of the parents have a password on their children’s devices, while the remaining 35 (29.41\%) do not have any. The percentage of parents who do not have password protection in their children’s devices is worrisome: around a third of the parents do not use passwords in their children’s devices whether to log in to the device or to install apps. When we asked parents if they have any other mechanisms in place to protect their children’s privacy during their interaction with the device, only 40 (33.61\%) answered “yes”. Moreover, of the 35 parents who do not have a password, 28 (80\%) reported that they do not have any other mechanism.

Out of those who use passwords, we asked them how they use passwords in their children’s devices, and we allowed them to select all those that apply. 67.86\% of the parents use it to control who can log in to the device, and 52.38\% use it to control installation of free apps at all times, and 41.67\% use it to control installation of paid apps at all times. While 67.86\% of the parents who use passwords use it to control access (login) to their children’s devices, the percentage indicates a lack of using passwords to control access to children’s devices among more than third of the parents who use passwords. For those who do not use a password, without any alternative access control mechanism, the absence of login passwords represents a threat to the children’s privacy, especially in case of lost or stolen devices. It is worth noting that many Saudi families have household workers such as house keepers, cleaners, nannies, and drivers. According to the GAS in the labor force report for 2020 [33], there are 3,663,939 domestic workers in Saudi families. While ideally they are trusted by the hiring families, they are not family members to the children. Their relationship with the family is a form of business relationship. Therefore, children’s devices must be protected using passwords or alternative access control mechanisms, to control access to their devices which are very likely contain personal data about the children.

Compared to Western parents in [5], there is a considerably high percentage of Western children’s devices without passwords too (24\%). However, it should be noted that the aforementioned domestic workers issue regarding Saudi families is not an observed phenomenon in Western families. However, Western parents who use passwords have different priorities than Saudi parents. As illustrated in Figure 5, the first motivation for Western parents to have a password is to control installation of paid apps (58\%), followed by controlling login to the device (44\%), then controlling the installing of free apps at all times (38\%). This may suggest that Western parents’ main motivation is influenced by financial reasons (controlling paid apps). On the other hand, Saudi parents’ main motivation is for access control and controlling free apps, while control installation of paid apps comes as the third most selected reason.

6) **Refuse to Install or Uninstall an App:** When we asked parents if they have ever refused to install an app for their children because of privacy concerns about the app, 85.71\% of parents answered “yes”. Moreover, we asked parents if they have ever uninstalled an app for their children because of privacy concerns, 82.35\% of parents answered “yes”. Overall, 109 (91.60\%) of Saudi parents have either refused to install, or uninstalled an app from their children’s devices, due to privacy concerns about an app.

Comparing Saudi parents’ answers with their Western and Chinese counterparts in [5], [6] respectively, we find that this trend is similar to what is observed with Chinese parents, where 98\% of Chinese parents have either refused to install or uninstalled an app for their children due to privacy concerns. However, both Saudi and Chinese parents show a different trend from Western parents, where only 67\% of Western parents have refused to install an app and only 54\% have uninstalled an app for their children due to privacy concerns.

\textsuperscript{17}The comparison of Saudi parents’ installation concerns for their children’s apps with Chinese parents in [6] is a high-level comparison. This is because the answer choices provided to the respondents in [6] are not identical to ours. However, both have similarities that allow us find some high-level patterns.
| Concern                                                                 | Percentage of Parents |
|------------------------------------------------------------------------|-----------------------|
| Whether the app has appropriate content for my child                   | 96 (80.67%)          |
| What the app does                                                      | 77 (64.71%)          |
| Whether the app accesses any sensitive personal information           | 55 (46.22%)          |
| Whether the app requires permissions                                  | 48 (40.34%)          |
| Whether the app collects any information about my child                | 46 (38.66%)          |
| How much the app costs                                                | 23 (19.33%)          |
| Other                                                                  | 3 (2.52%)            |

Fig. 4: Information considered by the Saudi vs. Western vs. Chinese parents when installing apps for their children.

| Password usage                                                        | Percentage of Parents |
|-----------------------------------------------------------------------|-----------------------|
| Control log into the device                                          | 57 (67.86%)          |
| Control installation of free apps at all times                        | 44 (52.38%)          |
| Control installation of paid apps at all times                        | 35 (41.67%)          |
| Control installation of paid apps sometimes                          | 10 (11.90%)          |
| Control installation of free apps sometimes                          | 9 (10.71%)           |
| Other                                                                 | 2 (2.38%)            |

Fig. 5: Reasons for having a password on children’s devices by Saudi parents compared to Western parents. Note that the option “Control installation of paid apps sometimes” does not exist in the Western survey, hence the percentage present for the Western parents.
and Western parents’ practices as “authoritarian parenting style” which is often observed among Chinese parents. Such interpretation can be applicable to Saudi parents too as an Eastern society. However, looking at the previously mentioned figures in apps installation concerns in Table VI, we observe higher percentages of Saudi and Chinese children (32.77% and 28.6% respectively) who install their apps by themselves, compared to only 19% of Western children who do so. Moreover, we observe lower percentages of Saudi and Chinese parents (57.14% and 30.7% respectively) who install apps for their children after their children ask for them, compared to 71% of Western parents who do so. This may provide an explanation regarding why UK parents are less likely to uninstall their children’s apps.

7) Reasons for Refusing to Install or Uninstall an App: Of those who have either refused to install or uninstalled an app for their children, we asked them to select the concerns that led them to do so. We listed several concerns and asked them to select all that apply. We find that 91 (83.49%) parents selected “inappropriate content”, while only 49 (44.95%) selected “the app was asking for access to too many things such as camera, location, or microphone...”, and 39 (35.78%) selected “the app was accessing too much personal information about my child”.

Comparing Saudi parents’ reasons for refusing to install or uninstall an app for their children with their Western and Chinese counterparts in [5], [6] respectively, as Figure 6 illustrates, we find that they all show a similar trend. That is, in all the three societies, the primary concern for refusing to install or uninstall an app is “inappropriate content” (information the child receives), and they show less concern about privacy (information the child provides or that the app accesses). However, the figures show lower concern about inappropriate content by Western parents, where only 57% have concerns about it, compared to 83.49% of Saudi parents, and 71% of Chinese parents. This suggest that classifying content as “inappropriate” may vary between cultures. Such variations worth considering by parents, developers, and regulators with respect to children’s online safety tools and content rating schemes. In this regard, we recently become aware of an initiative in Saudi Arabia (called “qayyem”, an Arabic word which stands for rate) which is a step towards bridging the cultural gaps in the general rating schemes. This initiative provides a rating scheme for children’s online games. The games are rated by volunteer expert players who undergo training about the rating criteria for this specific scheme. The scheme considers Saudi cultural values and norms. For example, it provides “religious remarks” which lists concerns about the game with respect to Islamic values, and “financial remarks” which lists concerns with respect to finance and money integrity values. However, we do not have enough data to evaluate this initiative’s effectiveness.

8) Children’s Attitudes Towards Being Refused to Install an App, or Having an App Being Uninstalled by Parents: We asked parents about how their children felt about being refused to install an app or having their app uninstalled. To summarise the responses we manually labelled the answers with either: “positive”, “neutral”, or “negative”, based on the reported attitude. For example, answers such as “She was very understanding after I explained to her the risks” are labelled “positive”, answers that contain words such as “sad”, “mad”, and “upset” are labelled “negative”. Answers that contain negative then positive attitudes such as “she was upset at the beginning, and after explaining the reasons, she accepted the issue” are labelled negative too. Answers such as “lots of questions and demand to explain the reasons” are labelled “neutral”. This provides us a good estimation.

Out of the 109 parents who either refused to install or uninstalled an app for their children, we find that ~63 children’s reactions are negative (57.80%), while around ~31 (28.44%) are positive, and around ~15 (13.76%) are neutral. To reduce the conflicting situation of uninstalling apps for children, which is mostly negatively received by children, we suggest parents’ early involvement during the apps selection and installation to decide on the app appropriateness before the child has it.

Comparing Saudi parents with their Western and Chinese counterparts in [5], [6] respectively, similar to Saudi children, a total of 55% of Western parents reported that their children reacted negatively (upset, sad, or confused) when parents refused to install or uninstalled an app for them, while still 40% of parents reported that their children were able to understand their parents’ decisions. In comparison to Chinese parents, Wang et al. [6] asked Chinese parents a different but somewhat relevant question. They asked parents about their children’s reactions to “parents safeguarding practices”. 58.3% of Chinese parents said their children “would understand parents’ decisions after explaining the risks to them”, 12.1% said that their children “would fully understand the decisions and accept without any argument”, 22.1% of parents said that their children “would be able to understand them but refused due to some other reasons”, while only 7.1% of parents said that their children “would be upset and refuse their parents’ help”. Obviously, Chinese children are more understanding of their parents decisions than Saudi and Western children. Wang et al. [6] linked this to the “authoritarian parenting style” that is often observed in Chinese parents.

D. Privacy Concerns

1) Thinking and Talking about Privacy with Children: We asked parents how often they think about their children’s online privacy in relation to their interaction with tablet or smartphone devices. Saudi parents seem very concerned about their children’s online privacy. 52.94% of parents reported that they think about it “at least once a day”, and 27.73% of parents think about it “at least once a week”. See Table VII for the rest of the answers.

We then asked parents how often they talk about online privacy issues with their children in relation to interactions with tablet or smartphone devices. We find encouraging but not perfect results overall, where 36.97% of parents talk about it “at least once a day”, 26.05% of parents talk about it “at least once a month”, and 14.29% of parents talk about it “at least once a year”. Having said that, there are 7.56% who “do not talk about privacy at all” with their children, which is a negative point. Table VII shows how often parents think and talk with their children about online privacy issues.
Comparing how Saudi parents think and talk about privacy with their children against their Western and Chinese counterparts in [5], [6], we find that Western parents expressed high level of concern about their children’s privacy too, where 45% of them said they think about it “very often”, and 47% “sometimes” or “occasionally” do so\textsuperscript{18}. Contrary to both Saudi and Western parents, Chinese parents did not express a high level of concern about their children’s privacy. As reported in Wang et al. [6]\textsuperscript{19}, only 10% of Chinese parents have “a lot of” concerns about their children online privacy, 47.5% have “some but acceptable”, 32.4% have “no” or “very little”, and 8.3% had never thought about this issue. The latter is a striking figure compared to only 4.20% of Saudi parents who do not think about their children’s privacy at all. The low level of privacy concerns that is observed in Chinese parents could be related to cultural or political reasons.

With respect to talking about privacy issues with children, 62% of Chinese parents “had never” or “very rarely” discussed privacy issues with their children. Again, this is a striking figure compared to Saudi parents, where the majority discuss privacy issues with their children on a regular basis as shown in Table VII (second column). We could not compare Saudi parents to Western parents in this aspect (talking about privacy with their children) as the report [5] on Western parents does not contain this data.

2) Parents’ Level of Privacy Concerns Before vs. After Being Informed About Possible Privacy Implications: We asked Saudi parents about their level of concern if an app used by their children asked for access to the camera, microphone, or location service on the device. Most Saudi parents expressed high levels of concerns about apps that request access permission to their children’s camera (77.31% are “very concerned”), or microphone (77.31% are “very concerned”), or location service (76.47% are “very concerned”). However, their levels of concerns significantly increased when they were informed about possible privacy implications of giving access permissions to their child’s camera (or photos), microphone, or location. This was revealed in scenario-based questions which ask about the same set of permissions differently. See Table VIII for the two questions we ask (before and after being informed about possible privacy implications). Figure 7 and Figure 8 illustrate the results.

\textsuperscript{18}Note that, Zhao et al. [5] and Wang et al. [6] used different scales than ours to measure frequency. However, our comparison is at a high level which does not require exact matching.

\textsuperscript{19}Wang et al. [6] asked about parents’ level of concern in general sense and not particularly about frequency of talking about privacy. However, this question is the closest to our comparison which is at a high level and does not require exact matching.
After being informed about possible privacy implications, we find 36.97% more parents became “very concerned” about their children’s privacy with respect to camera and microphone access permission, and 28.57% more parents became “very concerned” with respect to location services.

Comparing Saudi parents’ level of concern about their children’s privacy before and after being informed about possible privacy implications against their Western and Chinese counterparts in [5], [6], we find that Western parents show a similar trend. 51% of Western parents are “very concerned” about microphone and photo access, and this percentage increased by 24% after being informed about possible privacy implications. However, regarding concerns about location access, there is not much increase in the level of concern after being informed about possible privacy implications since the majority of Western parents (62%) are already “very concerned” about location, and this percentage increased by 7% after being informed about possible privacy implications. However, this is not the case with Chinese parents, where Wang et al. [6] reported much lower levels of concerns expressed by Chinese parents even after being informed about possible privacy implications. 23.3% are “very concerned” about microphone and photo access, and this percentage increased by 16.6% only to become 39.9%. Moreover, 40.2% who are “very concerned” about location access, and this percentage increased by 8.5% to become 48.7%. Clearly, the Chinese parents’ level of concern about their children’s privacy is lower than that expressed by Saudi and Western parents. The Chinese parents’ low level of concern even after being informed about possible privacy implications indicates some level of normalisation for sharing personal data with third parties. This could be related to cultural or political reasons as we stated earlier in section IV-D1.

E. Parental Controls

1) Parents’ Experience With Privacy Settings: We asked parents if they have heard about privacy permission settings for an app and if so, how often they check privacy permission settings for their children’s devices. Our results show that 87 (73.11%) of Saudi parents have heard about privacy permission settings for an app. Of those, a total of 45.98% check privacy permission settings for their children’s devices at least “once a month” (this figure includes those who check them “at least once a week”, or “at least once a day”). See Table IX for detailed results. Of those who check privacy settings, 90.79% either “strongly agree” or “somewhat agree” that tuning privacy permission settings reduces their privacy concerns about what their children use on the device. See Table X for detailed results. Interestingly, 100% of those who have not heard about privacy permissions for an app are interested to learn more about them.

Comparing Saudi parents’ awareness and frequency of checking privacy permission settings for their children’s apps with their Western and Chinese counterparts in [5], [6], we find that Western parents show similar results. 72% of Western parents have heard about privacy permission settings. Moreover, a total of 66% of Western parents check privacy permission settings for their children’s devices either “from time to time” or “very regularly”, and 24% of them check those settings “whenever a new app is installed”. However, there are 11% who “can’t remember” when was the last time they checked them, compared to only 8.05% of Saudi parents who said so. Similar to Saudi parents, the majority of Western parents who check privacy settings (78%) felt that this reduces their privacy concerns about what their children use on the device.

2) Parents’ Experience With “Kids” and “Family” Stores: We asked parents if they have heard about the “Kids” app category on Apple’s app store or the “Family” category on Google’s Play store, which provide a content rating for apps into different age categories, such as under 5, between 6 and 8, or between 9 and 11. We find that 77 (64.71%) Saudi parents have heard about the aforementioned “Kids” and “Family” categories in app stores. Out of those who have heard about at least one these store categories, a total of 87.01% have tried to use them at some level, where 29.87% use them “all the time”, 36.36% use them “sometimes”, and 10.39% use them “rarely”. See Table XI for detailed results. Out of those who have tried to use at least one of these stores at any level, a total of 80.60% either “strongly agree” or “somewhat agree” that using the “Kids” or “Family” categories in app stores reduce
TABLE VIII: The questions asked to parents about their level of parents’ concerns: before and after we state possible privacy implications in the question.

| Serial No. | Question without privacy implications (before) | Question with privacy implications (after) |
|------------|-----------------------------------------------|------------------------------------------|
| 1          | How concerned would you be if an app used by your child asked for access to the camera or microphone on the device? | Many apps have access to a device’s photos or microphone, which could enable strangers to ask your child to share their photos or talk with them. How concerned are you about this possibility? |
| 2          | How concerned would you be if an app used by your child asked for access to the location service on the device? | Some apps can have access to a device’s location information, which could enable other organisations/companies to infer which school your child goes to, when and where you go on holiday, etc. How concerned are you about this possibility? |

TABLE IX: Frequency for checking privacy settings.

| Frequency                  | Parents |
|----------------------------|---------|
| At least once a day         | 7 (8.05%) |
| At least once a week        | 19 (21.84%) |
| At least once a month       | 14 (16.09%) |
| At least once every couple of months | 20 (22.99%) |
| At least once a year        | 0 (0%) |
| Less than once a year       | 4 (4.60%) |
| Whenever a new app is installed | 12 (13.79%) |
| I don’t remember. Last time was a long time ago | 7 (8.05%) |
| I don’t check them at all   | 4 (4.60%) |

TABLE X: Parents’ level of agreement towards Q. 46 statement: “I feel that tuning the privacy permission settings reduces my privacy concerns about what my child uses on the device”.

| Level of agreement | Parents |
|--------------------|---------|
| Strongly agree     | 30 (39.47%) |
| Somewhat agree     | 39 (51.32%) |
| Neither agree nor disagree (neutral) | 5 (6.58%) |
| Somewhat disagree  | 2 (2.63%) |
| Strongly disagree  | 0 (0%) |

TABLE XI: Parents who used either the “Kids” or the “Family” app store categories, or use parental control apps for their children.

| Frequency | Use “Kids” | Use “Family” | Use Parental Control |
|-----------|------------|--------------|----------------------|
| All the time | 23 (29.81%) | 16 (15.53%) |                     |
| Sometimes  | 28 (36.36%) | 29 (28.16%) |                     |
| Rarely     | 8 (10.39%)  | 8 (7.77%)    |                     |
| Tried, but found them unhelpful | 5 (6.49%) | 9 (8.74%) |                     |
| Used to, but no longer find them helpful | 3 (3.90%) | 4 (3.88%) |                     |
| Never used them | 10 (12.99%) | 37 (35.92%) |                     |

TABLE XII: Parents’ level of agreement towards Q. 43 statement: “I feel that Apple’s “Kids” or Google’s “Family” categories reduce my privacy concerns about what my child uses on the device”.

| Level of agreement | Parents |
|--------------------|---------|
| Strongly agree     | 12 (17.91%) |
| Somewhat agree     | 42 (62.69%) |
| Neither agree nor disagree (neutral) | 12 (17.91%) |
| Somewhat disagree  | 1 (1.49%) |
| Strongly disagree  | 0 (0%) |

TABLE XIII: The most commonly used parental control apps.

| App name         | Parents |
|------------------|---------|
| screen time      | 6       |
| ourpact          | 4       |
| family link      | 4       |
| qustodio         | 2       |
| familytime       | 1       |
| safekids         | 1       |
| net nanny        | 1       |
| netflix parental control | 1 |

We find that most Western parents (61%) have not heard about the “Kids” or “Family” app store categories. However, similar to Saudi parents, of those Western parents who have heard about them, 79% used them either “all the time” or “sometimes”. Of those Western parents who used them, 66.5% “strongly agree” or “somewhat agree” that they reduce their privacy concerns about what their child uses on the device.

3) Parents’ Experience With Parental Control Apps: We asked parents if they have heard about “parental control” apps, which allow parents to control their children’s tablet or smartphone devices, such as controlling the number of hours their children can spend on the device, creating a list of disallowed apps, and a list of disallowed websites. We find that 103 (86.55%) of Saudi parents have heard about these apps. Out of those who have heard about them, a total of 64.08% have tried them at some level, and a total of 12.62% have tried them or have been using them “but find them unhelpful”, while 35.92% “never used them”. It is surprising to see that over 35% of the parents who have heard about parental control apps state that they never used them. They might have some profound reasons such as a lack of technical skills by parents to use them, or a negative reputation about these apps (e.g. difficult to use). See Table XI for the full results. Finally, Table XIII lists the most used parental control apps that are reported by those who use them.

We could not compare this section’s result against the results of Western and Chinese parents as it does not exist in the relevant studies in [5], [6].

V. DIGITAL DIVIDE

In this section, we examine whether there are statistically significant differences between high vs. low Saudi socioeconomic classes in Saudi society in terms of practices and concerns about their children’s security and privacy online. We denote these differences by the term “digital divide”.

their privacy concerns about what their children use on the device. See Table XII for the full results.

Comparing Saudi parents’ awareness and use of “Kids” or “Family” categories in app stores with their Western and Chinese counterparts in [5], [6], contrary to Saudi parents, we
A. Analysis Methodology

We consider Saudi society from three socioeconomic perspectives: parents’ education, technical background, and income. For each perspective, we divide the responses into two classes: high and low. We define the high and low classes of each socioeconomic perspective in Table XIV. It should be noted that the total number of responses in each class of these perspectives is a partial set of the overall responses. For example, for the high education class, we consider responses where both parents have either a PhD or a MSc as their highest degree, and for the low education class, we consider responses where both parents have at most a BSc as their highest degree. We do not count responses where only one of the parents satisfies the high or low property. We also do not count the responses where the answer is not firm, such as “Not applicable”, “I do not know”, and “Other”. We also exclude them from the total count if we exclude them from any of the classes. The reasons for these exclusions are to have firm definitions and exclude noise, hence gaining more confidence in the results.

After we define the classes and extract the responses that meet the definition of each class, we then examine the responses of each class (e.g. high education responses vs. low education responses) against certain properties. These properties represent parents’ security and privacy practices and concerns, and are extracted from the survey questions. That is, from the respondent’s answer, we can identify if it meets the property or not. Table XV shows the properties we examine the socioeconomic classes against, and the conditions under which the properties are satisfied (i.e. met), along with the survey questions they are extracted from.

After counting the number of low and high responses that satisfy the properties defined in Table XV, we conduct the significant differences test using the Chi-Squared test or the Fisher–Irwin test (the latter is used only if the expected value is less than 5) [21], with level of significance alpha = 0.05.

B. Is there a digital divide?

After computing the significance tests, out of 42 tests, we find statistical differences between high versus low classes in 7 tests only. This is a positive trend overall. However, attention is required in the areas where we find a digital divide. In what follows, we summarise those areas of concerns, which are summarised in Table XVI, Table XVII, and Table XVIII. The results show that:

1) There are more high education parents who are aware about “Kids” and “Family” app store categories than low education parents. That is, 85.19% high education parents are aware about “Kids” and “Family” app store categories, compared to 58.82% low education parents who do so. This difference is significant ($\chi^2(1) = 5.63$, $p = 0.02(< 0.05)$). Obviously, higher education gives them the advantage to look for tools to protect their children online.

2) Out of those who are aware about privacy settings, there are more low education, low technical background, and low income parents who check privacy settings in their children’s devices frequently than high education, high technical background, and high income parents. That is, out of those who are aware about privacy settings, 61.76% low education parents, 62.00% low technical background parents, and 54.10% low income parents, check privacy settings frequently, compared to 21.74% high education parents, 15.38% high technical background parents, and 20.00% high income parents. These differences are significant. For education: ($\chi^2(1) = 8.86$, $p = 0.00(< 0.05)$), for technical background: ($\chi^2(1) = 8.99$, $p = 0.00(< 0.05)$), and for income: ($\chi^2(1) = 7.06$, $p = 0.01(< 0.05)$). These results suggest that parents from low socioeconomic classes show higher levels of concern about their children’s privacy in this aspect and are more responsive than parents from high socioeconomic classes. That is, once they become aware about privacy settings, there are more parents from low socioeconomic classes who check their children’s privacy settings frequently than parents from high socioeconomic classes. They are also not over checking (i.e. check them “at least once a day”) the privacy settings of their children’s devices, and checking them in a reasonable manner. Our results show that only a minority of them check privacy settings “at least once a day”. That is, out of the 21 low education parents who check privacy settings frequently, 5 (23.81%) check them “at least once a day”, out of the 31 low technical background parents who check privacy settings frequently, 5 (16.13%) check them “at least once a day”, and out of the 33 low income parents who check privacy settings frequently, 6 (18.18%) check them “at least once a day”.

3) There are more high technical background parents who use passwords in their children’s devices than low technical background parents. That is, 93.75% high technical background parents use passwords compared to 62.32% low technical background parents. This difference is significant ($\chi^2(1) = 5.92$, $p = 0.01(< 0.05)$). Obviously, their technical background gives them the advantage of knowing the importance of passwords, and how to set and use one.

4) There are more low income parents who think about their children’s privacy frequently than high income parents. That is, 96.34% low income parents think about their children’s privacy frequently (i.e. “at least once a month”) compared to 80.77% high income parents. This difference is significant ($\chi^2(1) = 8.02$, $p = 0.02(< 0.05)$). This suggests that low income parents are more concerned about their children’s security and privacy in this aspect than high income parents. Moreover, they might be over thinking it. Out of the 79 low income parents who think about their children’s privacy frequently, 50 (63.29%) think about it “at least once a day”. While thinking about children’s privacy is a positive sign of awareness overall, thinking about it on a daily basis can be classified as over

\[^{20}\text{There is no } \chi^2 \text{ value as we used the Fisher–Irwin test.}\]
TABLE XIV: Definitions of high and low (education, technical background, and income) which we use to examine the digital divide.

| Perspective       | High class definition                                                                 | Low class definition                                                                 | Q. |
|-------------------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|----|
| Education         | Both parents have either a MSc. or a Phd. as their highest degree                     | Both parents have at most a BSc. degree as their highest degree                       | 8 & 10|
| Technical background | Both parents work or have a degree in CS, IS, IT or CE                             | Both parents do not work nor have a degree in CS, IS, IT or CE                      | 9 & 12|
| Income            | The household monthly income is more than 34,000 SAR                                 | The household monthly income is at most 34,000 SAR                                   | 13 |

TABLE XV: Definitions of high and low (education, technical background, and income) which we use to examine the digital divide.

| Property                        | Satisfied (i.e. met) if:                                                                 | Q. |
|---------------------------------|------------------------------------------------------------------------------------------|----|
| Use password                    | Parents have a password to log in to the device or to install apps for their children's devices | 24 |
| Used paid app instead of free for privacy reasons | Parents have chosen a paid app of an otherwise free app with the aim to reduce privacy risks | 27 |
| Think about privacy frequently  | Parents think about privacy "at least once a month" (including "at least once a week", and "at least once a day") | 32 |
| Talk about privacy frequently   | Parents talk about privacy "at least once a month" (including "at least once a week", and "at least once a day") | 34 |
| High level of concern about cam. & mic. (before) | Parents are “very concerned” or “somewhat concerned” regarding apps requesting cam. and mic. access in their children’s devices before they are informed about possible privacy implications | 35 |
| High level of concern about location (before) | Parents are “very concerned” or “somewhat concerned” regarding apps requesting location access in their children’s devices before they are informed about possible privacy implications | 36 |
| High level of concern about cam. & mic. (after) | Parents are “very concerned” or “somewhat concerned” regarding apps requesting cam. and mic. access in their children’s devices after they are informed about possible privacy implications | 37 |
| High level of concern about location (after) | Parents are “very concerned” or “somewhat concerned” regarding apps requesting location access in their children’s devices after they are informed about possible privacy implications | 38 |
| Aware about “Kids/Family” apps | Parents have heard about the “Kids” or “Family” app store categories | 41 |
| Use “Kids/Family” apps at least “sometimes” | Parents use the “Kids” or “Family” app store categories at least “sometimes” (including “all the time”) | 42 |
| Aware about privacy settings    | Parents have heard about privacy permission settings of an app | 44 |
| Check privacy settings frequently | Parents check privacy permission settings for their children devices "at least once a month" (including “at least once a week” or “at least once a day”) | 45 |
| Aware about parental control apps | Parents have heard about parental control apps | 48 |
| Use parental control apps at least "sometimes" | Parents use parental control apps at least "sometimes" (including "all the time") | 49 |

thinking.

5) Out of those who are aware about “Family” and “Kids” app store categories, there are more high income parents who use them at least “sometimes” than low income parents. That is, 88.24% high income parents use “Family” and “Kids” app store categories at least “sometimes”, compared to 57.41% of low income parents. This difference is significant ($\chi^2(1) = 5.39$, $p = 0.02 (< 0.05)$). Seemingly, useful “Family” and “Kids” app store categories are not for free, which gives high income parents the advantage of using these apps more than low income parents.

VI. RECOMMENDATIONS

Having discussed the results, we now list the recommendations for parents, professionals, regulators, and policy makers.

A. For Parents

We provide the following recommendations for parents, guardians, teachers, or whoever is in a position of care for children’s safety online:

1) Check the apps’ appropriateness for children. Most app stores (e.g. Google Play and Apple’s App store) provide additional information about the apps to check an app’s age appropriateness for children, and what permission the app asks for. For example, Google Play store has the “content rating” and “permissions” sections under the “additional information” section for each app. Similarly, the Apple store has the “age”, “data used to track you”, and “data linked to you” sections. Our results show that half of the top 10 most used apps by Saudi children who are aged between 6 to 12 years old are rated for 12+ years and require parental guidance. While these rating systems do not seem perfect and parents need to make their own judgment (e.g. “MS Teams” is listed as suitable for children aged 3+ year old children in the Google Play store), they can be used as an initial assessment tool.

2) Get involved with children during the apps’ installation stage before the app is installed by the child. Our results suggest that parents’ involvement in installing their children’s apps reduces uninstallation incidents which are mostly negatively received by children.

3) When selecting apps for children, it is not enough to pay attention to the apps’ content only. The apps’ requested permission and data collection are equally
TABLE XVI: The statistical difference between high and low education against the listed properties. “No.” denotes the number of (low | high) education parents who satisfy the property listed in the column labeled “Property”, “Total” denotes the total number of (low | high) education parents, \( p \) denotes the p-value, \( \varphi \) denotes the effect size, \( n \) denotes the total sample, \( \chi^2(1) \) denotes chi-square test statistic with one degree of freedom. Note that the total numbers (“Total”) of (low | high) education parents in the properties number 10, 12, and 14 are derived from the numbers (“No.”) of the previous properties (9, 11, and 13) respectively. This is because the related questions for the properties 10, 12, and 14 are only shown to participants who answered “yes” for the awareness related questions which are related to properties 9, 11, and 13 respectively.

| Serial No. | Property                  | High Ed. No./Total | Low Ed. No./Total | \( \chi^2(1) \) | Fisher |
|------------|---------------------------|--------------------|-------------------|-----------------|--------|
| 9          | Aware about “Kids/Family” apps | 23/27 (85.19%)     | 30/51 (58.82%)    | \( \chi^2(1) = 5.63 \) | \( p = 0.02 \) \( \varphi = 0.27 \) \( n = 78 \) |
| 12         | Check privacy settings frequently | 5/23 (21.74%)     | 21/34 (61.76%)    | \( \chi^2(1) = 8.86 \) | \( p = 0.00 \) \( \varphi = 0.39 \) \( n = 57 \) |

TABLE XVII: The statistical difference between high and low technical background level against the listed properties. “No.” denotes the number of (low | high) technical background parents who satisfy the property listed in the column labeled “Property”, “Total” denotes the total number of (low | high) technical background parents, \( p \) denotes the p-value, \( \varphi \) denotes the effect size, \( n \) denotes the total sample, \( \chi^2(1) \) denotes chi-square test statistic with one degree of freedom. Note that the total numbers (“Total”) of (low | high) technical background parents in the properties number 10, 12, and 14 are derived from the numbers (“No.”) of the previous properties (9, 11, and 13) respectively. This is because the related questions for the properties 10, 12, and 14 are only shown to participants who answered “yes” for the awareness related questions which are related to properties 9, 11, and 13 respectively.

| Serial No. | Property                  | High Tech. No./Total | Low Tech. No./Total | \( \chi^2(1) \) | Fisher |
|------------|---------------------------|----------------------|---------------------|-----------------|--------|
| 1          | Use password              | 15/16 (93.75%)       | 43/69 (62.32%)      | \( \chi^2(1) = 5.92 \) | \( p = 0.01 \) \( \varphi = 0.26 \) \( n = 85 \) |
| 12         | Check privacy settings frequently | 2/13 (15.38%)     | 31/50 (62.00%)     | \( \chi^2(1) = 8.99 \) | \( p = 0.00 \) \( \varphi = 0.38 \) \( n = 63 \) |

important. Security and privacy are two ways: what the children receive (content) and what the children provides or the app accesses (privacy). Our results show that, when installing an app for their children, parents are more concerned about the app’s content and what the app does than the app’s access to sensitive personal information or the app’s requested permissions.

4) **Set passwords (or an alternative access control mechanism) to control both login to the device and installation of free and paid apps.** Our results show that around a third of the parents do not set passwords to control login to the device or to control apps installation on their children devices.

5) **Make use of the “Kids” and “Family” app store categories.** While they are not a panacea, they reduce parents’ privacy concerns as reported.

**B. For Professionals**

We provide the following recommendations for professionals such as researchers and developers:

1) **Raise awareness about the aforementioned issues.** All the aforementioned recommendations to parents require some level of technical background which may not be available to everyone. Professionals need to invest in security education for everyone, and particularly for parents towards their children’s security and privacy online. Our results show that parents seem very eager to learn about security and privacy, where 100% of those who have not heard about privacy permissions for an app reported that they are interested to learn more about them.

2) **Use “effective” awareness.** Awareness alone is not enough. Awareness needs to be effectively designed using a language that is comprehended by everyone. Our results show that stating privacy implications (what can go wrong) in a scenario-based format has significantly
TABLE XVIII: The statistical difference between high and low income against the listed properties. “No.” denotes the number of (low | high) income parents who satisfy the property listed in the column labeled “Property”, “Total” denotes the total number of (low | high) income parents, \( p \) denotes the p-value, \( \varphi \) denotes the effect size, \( n \) denotes the total sample, \( \chi^2(1) \) denotes chi-square test statistic with one degree of freedom. Note that the total numbers (“Total”) numbers of (low | high) income parents in the properties number 10, 12, and 14 are derived from the numbers (“No.”) of the previous properties (9, 11, and 13) respectively. This is because the related questions for the properties 10, 12, and 14 are only shown to participants who answered “yes” for the awareness related questions which are related to properties 9, 11, and 13 respectively.

| Serial No. | Property                                      | High Income No./Total | %  | Low Income No./Total | %  | \( \chi^2(1) \) | Fisher |
|-----------|-----------------------------------------------|-----------------------|----|----------------------|----|----------------|--------|
| 3         | Think about privacy frequently                | 21/26 (80.77%)        |    | 79/82 (96.34%)       |    | -              |        |
| 10        | Use “Kids/Family” apps at least “sometimes”   | 15/17 (88.24%)        |    | 31/54 (57.41%)       |    | \( \chi^2(1) = 108 \) |        |
| 12        | Check privacy settings frequently             | 4/20 (20.00%)         |    | 33/61 (54.10%)       |    | -              |        |

increased parents’ concern about privacy. This is a useful tip that our results provide for awareness content delivery.

C. For Regulators and Policy Makers

We provide the following recommendations for regulators and policy makers:

1) **Set guidelines and regulations that define transparent and fair data collection.** For example, in Europe there is the General Data Protection Regulation [34], and in the US, there is the Children’s Online Privacy Protection Act (COPPA) [35]. The latter sets certain requirements for online services directed to children. With the rapid uptake of digital technologies and lack of data collection regulations, non-regulated data collection by third parties can be harmful in the long run. It may normalise sharing personal data with third parties. Having said that, regulations such as GDPR and COPPA have their own technical and non-technical issues, such as the challenges in monitoring compliance, which may need non-conventional tools. For example, Reyes et al. [36] found many apps available in the US are violating COPPA. Nevertheless, we can learn from them and work towards improving their issues.

VII. CONCLUSION

In this paper, we conducted a survey to investigate Saudi parents’ concerns about their children’s security and privacy when using smart device apps. We analysed 119 responses and identified parents’ practices and concerns. We also compared Saudi parents’ security and privacy practices and concerns with those outlined by Western and Chinese parents in previous reports. This comparison revealed interesting patterns and allowed us to draw new relationships. We then tested whether there are significant differences between high vs. low socioeconomic classes in terms of security and privacy practices and concerns. We looked at the society from three perspectives: parents’ education, technical background, and income. Out of 42 tests, we find significant differences in 7 tests only. Finally, we made recommendations to improve children’s security and privacy online, which require efforts from multiple parties. The results of this study help us better understand our situation to identify areas of improvements, set recommendations, and develop the right tools towards creating a safer online world for our children.

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