Digital Media Engagement & Children's Health and Well-Being: A Divide by Family Structure?

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ABSTRACT

The aim of the present study is to examine the health impact of digital media engagement among children age 6 -17 in the U.S., and its interaction effect with children's family structure. Using data from 2011-2012 National Survey of Children's Health (NSCH), we estimated the impacts of different digital media activities on children's general health, behavior, anxiety, and depression. Ordinal regression models were processed for two groups stratified by family structure. Statistical analyses from this study indicated that health and well-being of children as well as the health impacts of different digital media activities vary by children's family structure. Digital media engagements are more likely to negatively impact the health and well-being of children and adolescents in other alternative families than their peers in two-parent families.

Compliance with Ethical Standards
Research involving human participants and/or animals
All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent
This study is based on a secondary analysis of a publicly available existing data of NSCH 2011-2012. For this type of study, formal consent is not required.

Keywords
Digital Media Engagement, Family Structure, Health & Well-Being, Children & Adolescents, American Society.

Introduction
Digital media is so pervasive in children's lives nowadays. It is reported that majority of children have accesses to bedroom television, computer, the Internet, video-game console, and phone for connecting with their friends with shared interests via social media sites [1,2]. Recent years have further witnessed how TV, Internet, computer and video games having been vying for children and adolescents' time and attentions [3]. The potential impact of digital technology and digital media on children's health and well-being has become one among the key controversial subjects of debate among the scholars [4].

Some benefits of children's engagement in digital media such as enhancing their social connections, communication skills, and technical skills have been discussed in existing studies [5]. With more and more e-learning programs integrating digital media with students' educational activities have been launched, some scholars [6] even argued that game-based e-learning was more effective than conventional instructional methods for children.

However, given the sedentary nature of most digital media-involved activities, considerable concerns of the negative impacts of media on children and adolescents' health and well-being have been expressed among public health advocates [7,8]. For example, a meta-analysis of 52 published health studies confirmed the significant association between TV viewing and obesity in children and youth [9]. Empirical study has also evidenced that screen time is adversely associated with the sleep outcomes, which is fundamental to children and adolescents' health and well-being [10]. A study from Canada further confirmed that access to electronic entertainment and communication devices and the night time use of such devices are associated with short sleep duration and obesity among Canadian children [11]. Some scholars

[12] even argued that the association between screen-based media activities and negative heath among children and adolescents can be essentially replicated in different countries, even there were cross-national differences in the strength of some relationship.

Aside from the negative health impact of the sedentary nature of digital media engagement, there is also new emerging research examining the association between childhood mental health problems and digital media engagement. Much debate and polarization, however, exists in the current literature [13]. Some research has reported mixed results of digital media engagement on adolescents' mental health [13], whereas some has evidenced negative effects [14]. A school-based research in Australia [15] has evidenced that the excessive video game playing was associated with poorer health, lower health-related quality of life (HRQoL), and depression/anxiety among adolescents. Existing research has also documented that excessive media engagement might result in attention problems, school difficulties, sleep and eating disorders, depression and cyber-bullying among children and adolescents [10]. There are also concerns that digital media might provide platforms for risky or even illicit behaviors for children and adolescents [16]. A recent study [17], however, has reported such health benefits of using digital media for children as increased self-esteem, perceived social support, increased social capital, and safe identity experimentation.

Some studies have examined the association between children and adolescents' digital media engagement and their social background [3,18-20]. Racial/ethnic disparities in excess of digital media among younger generations in the U.S. have been reported [3]. Studies have also revealed that children and adolescents from different racial/ethnic groups and gender groups have different patterns of digital media engagement [3,19,20]. For example, Hispanic children watch more television than white children but less than African American children [21]. Boys tend to spend more time with screen-based activities and intense videogames than girls [14,19]. Further, children's digital media engagement is associated with family characteristic, particularly family structure [22-25]. Children and adolescents from single parent families usually spend more time with radio and TV [18].

Prior research [19,23] also indicated that there existed racial and gender differences not only in children's digital media engagement but also in their impacts on children's academic performance. The interaction analysis of digital media engagement, obesity and gender [26] has revealed that the effect of digital media engagement on children's obesity will vary across children's gender and age. But how does digital media engagement interact with children's family structure in impacting their health and well-being? Is there a digital divide across different family structures? Up to now, there are still insufficient literature to answer such questions. The present study therefore aims to fill this gap in current literature by testing whether the health and well-being effects of digital media engagement would be different for children and adolescents living in different family structures.

Methods
Data for this study come from the 2011-2012 National Survey of Children's Health (NSCH), a comprehensive study to assess multiple aspects of physical, emotional, and behavioral health, and the relevant social factors of non-institutionalized American children aged 0 to 17 years [27]. The 2011-2012 NSCH includes a nationally representative sample of 95,677 children randomly selected from each of the 50 states and the District of Columbia with a complex multistage stratified sampling design. The respondent of 2011-2012 NSCH study was the parent or guardian in the selected child's household who was knowledgeable about the health and health care needs of the selected child. We only focused on children and adolescents age between 6 and 17 in this study, which include 65,033 children and adolescents.

Measures
Child's Family Structure
Child's family structure was measured with a binary category of 1 = two-parent family (biological or adopted), and 0 = other (including single-mother family, step-family, and other family types).

Child's Health & Well-being
Child's health and well-being was the dependent variable in this study, which was operationalized by children's general health, children's behavioral problems, children's anxiety, and children's depression. All these four indicators of health and well-being were measured by parent's answer to a self-rated single-item question, which has been used increasingly in health research to assess behavior issues, depression, and anxiety [28-30]. The general health of child was measured by parent/guardian's self-rated evaluation of the selected child's health with three categories of "excellent/very good," "good," and "fair/poor". Child's behavior problems, depression, and anxiety was assessed by the question asking whether child had behavioral problems, depression, or anxiety problems respectively. All these three variables were measured at the ordinal level with three categories of "does not have condition," "ever told, but does not currently have," and "currently has condition."

Child's Digital Media Engagement
Child's digital media engagement was assessed by the following four variables: child has digital device access in bedroom (1 = yes, 0 = no); child's average time spent on watching TV per weekday (in hours, ranging from 0 to 12); child's average time spent on using computer per weekday (in hours, ranging from 0 to 12); and child's weekly time spent on digital devices (1 = does not use device; 2 = uses devices 1 hour a day or less, 3 = uses devices more than 1 hour but less than 4 hours per day, 4 = uses devices more than 4 hours per average week day).

Covariates & Control Variables
Previous study on children's health and well-being [31-33] has confirmed the health impacts from children's household economic situation, maternal health, children's after-school program participation, and neighborhood context. We therefore controlled for the following variables in our analysis: child's family poverty

level (from 1 = "at or below 100% of poverty level" to 8 = "above 400% of poverty level"), dummy coded child's health insurance status (1 = insured at time of survey), dummy-coded child's after-school program participation (1 = participates in 1 or more extracurricular activities), dummy-coded maternal general health of the selected child (1 = excellent or good; 0 = fair or poor); and number of child's neighborhood amenities, including sidewalks, parks/playgrounds, recreation center, and library (from 0 = "no amenities" to 4 = "has 4 amenities from the list").

All analyses controlled for child's demographic background variables, including sex (0 = female; 1 = male), age (0 = 6-12 years; 1 = 13-17 years), race/ethnicity (dummy variables for "Hispanic"; "non-Hispanic black"; and "Multi-racial/Other" were created).

Statistical Analysis

All statistical analyses were estimated with SAS 9.2 procedures designed to analyze data derived from a complex sample survey to adjust for the potential sampling errors. We began our statistical analysis by examining the differences in prevalence of all variables across two different family structures by examining the descriptive statistics of the variables used in the analysis for children in two different family structures with SAS PROC SURVEYMEANS procedure, which computes estimates of variable means and the associated standard errors and was usually used for descriptive statistical analyses for data derived from a complex sample survey.

Multivariate statistical analyses were then tested for each group stratified by family structure. All the dependent outcomes in this study were measured at the ordinal level, so we used proportional odds models with logit link function with SAS PRO SURVEYLOGISTICS procedure to assess changes in the odds of being in the outcome category versus not being in the outcome category. For each stratified group, four ordinal models regressing children and adolescents' general health, behavior, anxiety, and depression on all explanatory variables were performed respectively. The reference category for "general health" was "excellent/very good". The reference category for "behavior", "anxiety", and "depression" was "does not have condition" respectively.

Results

Descriptive Results

Table 1 presents descriptive statistics for all variables for children in two-parent families and in other alternative families respectively, estimated with SAS 9.2 PROC SURVEYMEANS procedure. Descriptive statistics suggests that children and adolescents in two-parent families on average reported better health than their peers from the other alternative families for all four health indicators used in this study. White children were more likely to live in two-parent families (70%), whereas minority children and adolescents, particularly blacks, were more likely to live in other alternatively structured families. Notable differences were also apparent in

Variables		2-Parent (N = 45261)		Other (N= 20335)		Range/Categories
		Mean	SE	Mean	SE	
Dependent Variables	General Health	1.12	.38	1.22	.50	1 (excellent/very good), 2 (good), 3 (fair/poor)
	Behavioral Problem	1.03	.25	1.15	.50	1 (does not have condition), 2 (ever told, but does not currently have), 3 (currently has condition)
	Anxiety Problem	1.09	.40	1.17	.52	1 (does not have condition), 2 (ever told, but does not currently have), 3 (currently has condition)
	Depression	1.04	.27	1.14	.46	1 (does not have condition), 2 (ever told, but does not currently have), 3 (currently has condition)
Independent Variables	Child's Sex	.51	.49	.52	.50	0 = Female, 1 = Male
	Child's Age	.49	.50	.44	.49	0 = 12-17 years; 1 = 6-11 years
	Hispanic	.12	.33	.15	.35	0 = Other, 1 = Hispanic
	White	.70	.46	.50	.50	0 = Other, 1 = White
	Black	.05	.22	.49	.39	0 = Other, 1 = Black
	Multiracial/Other	.11	.31	.12	.32	0 = Other, 1 = Multiracial/Other
	Bedroom TV or Electronic Devices	.37	.48	.33	.47	0 = No; 1 = Yes
	TV Time	1.49	1.73	1.67	.76	0 - 3
	Computer Time	1.37	1.73	1.88	2.24	0 - 12
	Other Digital Devices Time	1.26	.78	1.44	.91	0 - 3
	Child's Activities Participation	.89	.31	.78	.41	0 = No Participation; 1 = Participates in one or more
	Health Insurance Coverage	.96	.19	.94	.23	0 = Not insured at time of survey; 1 = insured at time of survey
	Household Poverty	6.17	2.33	2.37	1.10	1 (At or below 100% of poverty) – 8 (Above 400% poverty level
	Maternal General Health	.72	.45	.43	.49	0 = Fair/poor or good; 1 = Excellent
	Neighborhood Amenities	3.20	1.08	3.12	1.14	0 = No Amenities; 1 = Has 1 amenities; 2 = Has 2 amenities; 3 = has 3 amenities; 4 = Has 4 amenities

Table 1: Table 1: Descriptive Statistics by Family Structure (N = 65, 596, Data from 2011-2012 National Survey of Children's Health). Note: SE = standard error.

household economic situation and maternal health, with children and adolescents in two-parent families reporting better household economic situation and better maternal health compared to their peers from other alternative families. Further, children in two-parent families on average spent less time on watching TV and using computers and playing digital games, even though more of them reported available TV or electronic devices in their bedrooms in comparison to their peers from other alternative families.

Ordinal Regression Results

Table 2 reports the estimates from the ordinal analyses regressing children and adolescents' general health, behavioral problems, anxiety, and depression on all explanatory variables for children in two different family structures respectively.

Statistic results in Table 2 suggest that having TV or electric device in bedroom was significantly related to childhood health and well-being, particularly for children and adolescents in other alternative families. For example, having TV or other electronic devices in bedroom was not significantly related to the general health for children and adolescents in two-parent families. But it was significantly associated with children's behavior and depression. However, having a TV or other electronic devices in bedroom was significantly related to the increase of the probability for them to report more behavior issues (OR = 1.44, p < .05), and depression (OR = 1.57, p < .05). For children and adolescents in other alternative families, having a TV set or other electronic device in bedroom was significantly related to the increase of the probability of reporting poorer health (OR = 1.24, p < .05), relatively higher level of behavior problems (OR = 1.53, p < .05), and more depression (OR = 1.71, p < .001). For children and adolescents in other alternative families, the probability of reporting more behavior problems, and more depression would significantly increase by 9% and 14% respectively, compared to children and adolescents in two-parent families.

Table 2 further indicates that no significant association can be found between TV watching time and children's behavior and anxiety problems. Other digital device time, however, was significantly related to behavior among children and adolescents in other alternative families (OR = .77, p < .001). Playing digital games and other devices was related to the decrease of anxiety for children and adolescents in other alternative families (OR = .99, p < .05). It was also important for children and adolescents' depression. But the effect for children and adolescents in two-parent families (OR = 1.23, p < .05) was different from that for children and adolescents in other alternative families (OR = .94, p < .05). Computer time was only significantly related to behavior problems for children and adolescents in other alternative families, and the impact was very weak (OR = 1.09, p < .05).

In addition, Table 2 indicate that family's economic situation significantly impacted children and adolescents' general health, with better household economic situation being associated with better general health for children and adolescents in both family structures. Health insurance was also significantly related to

children and adolescents' general health, though the effect would be different for children in two different family structures (OR was 1.71 & 0.91 respectively). Children in other alternative families with health insurance were more likely to report less behavior problems (OR = .36, p < .05), less anxiety (OR = .66, p < .05), and less depression (OR = .38, p < .001). In line with other studies, this research also indicates that maternal health was very important for children and adolescents [31,34]. Poorer maternal health was related to the increase in the probability of reporting poorer health, more behavior problems, more anxiety and depression symptoms. And more significant impacts were observed for children and adolescents in other alternative families than in two-parent families. For example, the odds ratios of reporting more behavior problems for these two different groups would be 2.66 and 1.75 respectively, with children from other alternative families almost two times more likely to report more behavior problems in comparison to their peers from two-parent families. Neighborhood amenities was also important for children's general health and the depression symptoms among children and adolescents in other alternative families (OR = .90, p < .05).

Discussion

This study examined children and adolescents' digital media involvement and its health impact as well as its variations across different family structures. It used four indicators to evaluate children and adolescents' health, including general health, behavior problems, experience of anxiety and depression. These four indicators provide a more systematic and complete evaluation of health and well-being and will help to specify the specific impact of different digital media engagement on different aspects of health and well-being. Focusing solely on one aspect of health and well-being, as is common in much literature on children's health [35], may neglect other aspects. And as indicated in this study, health and well-being is multifaceted and the digital media is influencing different health aspect differently.

Further, this study used four indicators to systematically examine children and adolescents' engagement in digital media and how each of these different digital media activities was impacting their health and well-being. The empirical analyses from our study indicate that different digital engagement activity might be playing different roles in impacting health and well-being among children and adolescents. The digital technology infrastructure at home is changing continuously and is presenting higher and higher penetration in the lives of children and adolescents. So how to systematically evaluate the functions of digital engagement activities to nurture children's health and development in media-rich environments is still a top public health challenge needing continuous attention from scholarly communities. This is especially important in the context of increasing media-rich environment and the proliferation of the digital media.

This study further contributes to the literature by incorporating differences in children and adolescents' family structures in our analysis. In line with the previous studies [36,37], our empirical study highlights the importance of a nurturing family environment.

Table 2: Ordinal Regression Results Predicting Odds of Child's Health & Well-Being.

		General Health				Behavior				Anxiety				Depression			
		2-Parent (N = 45,261)		Other (N = 20,335)		2-Parent (N = 45,261)		Other (N = 20,335)		2-Parent (N =45,261)		Other (N = 20,335)		2-Parent (N = 45,261)		Other (N = 20,335)	
		OR	SE	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE	OR	SE
Explanatory Variables	Child's Sex	.87	.08	.89	.07	.41***	.17	.45***	.10	.96	.09	.67***	.09	.83	.15	.85	.11
	Child's Age	1.04	.09	.96	.09	.79	.16	.96	.11	1.44***	.10	1.32**	.10	2.51***	.19	2.65***	.13
	Hispanic	.58**	.43	.36**	.38	.17	.87	1.05	.41	.77	.47	.96	.43	.86	.60	.66	.46
	Black	1.41	.44	.56	.37	.18**	.87	.81	.38	.84	.51	1.22	.42	1.19	.61	.89	.45
	Multiracial or Other	1.01	.43	.71	.39	.17	.86	.82	.40	.69	.46	.59	.42	.91	.59	.48	.46
	Bedroom TV or Electric Device	1.13	.09	1.24**	.09	1.44**	.16	1.53**	.12	1.24	.07	.99**	.06	1.57**	.17	1.71***	.13
	TV Time	1.09	.06	1.08	.06	.99	.10	1.11	.07	1.12	.10	.92	.08	.98	.09	.98	.08
	Computer Time	1.01	.03	.99	.02	1.04	.04	1.09**	.03	1.38**	.14	.89*	.11	1.03*	.05	.99**	.03
	Other Digital Devices Time	1.14	.08	1.02	.08	1.06	.13	.77***	.09	.98	.04	1.02	.03	1.23**	.20	.94**	.10
	Child's Activities Participation	1.44***	.10	1.54***	.09	2.12***	.19	1.47***	.12	1.30**	.10	1.39**	.10	2.27***	.20	1.37**	.13
	Health Insurance Coverage	1.71***	.15	.91***	.59	.46**	.28	.36**	.25	.41**	.33	.66*	.23	.63	.39	.38***	.29
	Household Poverty	.86***	.02	.71***	.11	1.02**	.66	.79	.13	1.19	.20	1.17**	.15	1.09	.27	.96	.16
	Maternal General Health	3.58***	.09	2.45**	.09	2.66***	.16	1.75***	.12	1.94***	.10	1.36**	.10	2.41***	.15	1.77***	.13
	Neighborhood Amenities	1.94**	.04	1.90**	.03	1.06	.06	.96	.04	1.02	.04	1.01	.03	.99	.07	.90**	.04
Model Fit Statistics	Cox & Snell Pseduo-R^2	.13		.11		.02		.03		.02		.02		.02		.04	
	Nagelkerke Pseduo-R^2	.22		.16		.07		.06		.04		.05		.08		.08	
	McFadden Pseduo-R^2	.15		.17		.06		.05		.03		.04		.07		.06	

Table 2: Ordinal Regression Results Predicting Odds of Child's Health & Well-Being (N=65596, Data from 2011-2012 National Survey of Children's Health).

Note: OR = Odds Ratio, SE = Standard Error. *p < .05, **p < .01, ***p < .001.

Children and adolescents in the final sample were stratified into two sub-groups based on their family structures to identify the between-family structure differences in digital media influences on children's health and well-being. The statistical analyses from this study indicate that digital media engagement is less likely to negatively impact the health and well-being of children and adolescents in two-parent families. To promote health and wellness in children and adolescents, it is important to maintain a nurturing family environment. Such results provide support for hypothesis guided by social ecological theory and child development [38,39] that argue for the importance of a nurturing social environment and childhood family influence [40]. Additionally, this study supported the health disparities across different racial/ethnic groups as well as across different gender groups, which has been reported in other studies [34,41].

Findings from this study should be interpreted within the context of the study's strength and limitations. Several limitations of this study should also need to be noted. First, more and more schools are integrating computer-based educational activities at home [42]. The four indicators of digital media engagement used in this study, however, did not distinguish whether the digital media engagement was educationally oriented or non-educationally oriented. And these measures in this study have failed in specifying the purposes and time periods for children and adolescents' digital media engagement. Further, our study cannot specify what activities the children and adolescents were doing and whether the access to digital media and application of these digital devices are changing the daily routines or other health-related practices of children and adolescents. NSCH data collects data from interviewing parents or guardians who were knowledgeable of the selected child. The reliability and validity of information for children and adolescents collected from their parents has been argued as a clinical or research challenge and some scholars are concerned with the informant discrepancy between parents and children [43]. But the utility of parent's assessment of children's health-related studies in clinical and research settings has also been supported and some empirical parent-child dyads analysis [44] does not support the systematic variances and significant discrepancy.

Another limitation in this study is that our study is restricted to comparisons between children and adolescents in two subgroups, "two-parent family (biological or adopted)" versus "other alternative family". We just lumped alternative family structures other than two-parent family together as a sub-group, which includes families headed by single mother and other alternatively

structured. Family structures and forms have become extremely varied over the past 30 years with the proliferation of complex stepfamilies and families formed outside of marriage [45]. Differences in these sub-alternative family structures might be neglected. Examining the health and well-being of children and adolescents in different alternative family types, including single-mother family and parental cohabitation, might uncover astonishing results, as indicated in other previous studies [36,46].

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