Having Children Is Associated with a Higher Prevalence of COVID-19 among Young Adults in Kuwait

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Highlights of the Study

- Young adults (21–29 years) with children were more likely to report having had coronavirus disease 2019 (COVID-19) than young adults with no children.
- Among adults aged ≥30 years, having children was not associated with increased prevalence of COVID-19.
- Results of this report highlight the potential role of children in the transmission of COVID-19.

Keywords

Coronavirus disease 2019 · Severe acute respiratory syndrome coronavirus 2 · Children

Abstract

Objectives: The role of children in the transmission of coronavirus disease 2019 (COVID-19) remains unclear. We investigated whether having children is associated with self-reported COVID-19 among adults. **Subjects and Methods:** A web-based cross-sectional study enrolled adults living in Kuwait ($n = 2,355$; aged ≥21 years). Prior COVID-19 diagnosis and having children were self-reported. Associations were assessed using Poisson regression, and adjusted prevalence ratios (aPRs) and 95% confidence intervals (CIs) were esti-

ated. **Results:** Of the 2,355 participants (1,595 female subjects), 744 (31.6%) and 605 (25.7%) were of age 21–29 and 30–39 years, respectively. Overall, 4.8% (114/2,355) of the participants reported having had COVID-19, with 4.8% of females and 5.1% of males reporting prior COVID-19 diagnosis. In the total study sample, having children showed a trend for association with having had COVID-19 (aPR: 1.46, 95% CI: 0.99–2.14, $p = 0.056$). Among participants aged 21–29 years, having children was associated with an increased prevalence of COVID-19 (aPR: 2.50, 95% CI: 1.21–5.20, $p = 0.014$). Such an association was not detected in adults aged ≥30 years. **Conclusions:** Our epidemiological findings highlight the possible role of children in spreading COVID-19. Hence, preventive measures should consider the role of children.

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Introduction

In the early stages of the coronavirus disease 2019 (COVID-19) pandemic, caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), children were detected to be less susceptible to SARS-CoV-2 infection than adults, as COVID-19 disproportionately affects more adults than children [1]. However, this view has been modified as emerging investigations have shown that children are at a similar risk of infection as adults, but the clinical presentation of COVID-19 among children is different from that among adults, with the majority of children demonstrating mild or no symptoms [2].

Thus far, the role of children in spreading SARS-CoV-2 infection is unclear. A systematic review concluded that although limited studies have investigated the transmissibility of SARS-CoV-2 by children, some evidence of onward transmission from children exist [3]. Given the high viral load and prolonged viral shedding in pediatric COVID-19 patients and that most infected children may go unrecognized [2, 4], children can play a significant role in spreading the infection to their family and community. In this report, we used a population-based sample to investigate whether having children <18 years of age is associated with self-reported COVID-19 among adults and if this association differs according to the age of the adults. Such an epidemiological investigation may further our understanding of the role of children in SARS-CoV-2 transmission and guide public health policies.

Subjects and Methods

Adults were enrolled ($n = 2,368$; ≥ 21 years) in a cross-sectional study by completing an online questionnaire that was disseminated to residents of Kuwait between August 26 and September 1, 2020. The web-based questionnaire was disseminated using social media platforms, including Twitter, Instagram, and WhatsApp, as described in details by Alqudeimat et al. [5]. The snowball sampling technique, a nonprobability sampling method which yields a convenience sample, was used to recruit participants. The study was approved by the Health Sciences Center Ethics Committee for Student Research at Kuwait University (No. 754/2020). Completing the questionnaire was an indication of consent.

Participants reported demographic characteristics and self-reported if they have had received a COVID-19 diagnosis by a healthcare provider and whether their diagnosis was confirmed by real-time reverse transcription-polymerase chain reaction. Moreover, participants reported whether they have children, and those who reported having children further indicated whether any of their children are <18 years of age. In this analysis, subjects with no children and those with all of their children aged ≥ 18 years were grouped together. Hence, we analyzed a dichotomous variable: have children <18 years of age (yes/no). The current analysis in-

cluded subjects with complete information for all study variables ($n = 2,355$).

Analyses were conducted using SAS 9.4 (SAS Institute, Cary, NC, USA). Frequencies and proportions of categorical variables were calculated in the total study sample and after stratification by self-reported COVID-19 diagnosis status, and differences in proportions were evaluated using χ^2 tests. Associations between having children <18 years of age (exposure) and self-reported COVID-19 diagnosis (outcome) were assessed in the total study sample and stratified by age-groups of the participants. Associations were adjusted for age, sex, nationality, educational attainment, and employment status. A modified Poisson regression with robust variance estimation was applied to estimate and infer adjusted prevalence ratios (aPRs) and 95% confidence intervals (CIs). Additional analysis assessed the associations between having children <18 years of age and self-reported COVID-19 diagnosis while stratifying by both age and sex of the participants.

Results

Of the 2,355 participants (1,595 female subjects), 114 (4.8%) self-reported having had COVID-19 and 1,113 (47.3%) reported having children <18 years of age (Table 1). Of the 114 adults who self-reported having had COVID-19, 104 (91.2%) reported that the diagnosis was confirmed by real-time reverse transcription-polymerase chain reaction. The prevalence of self-reported COVID-19 diagnosis did not differ according to the sex (males: 5.1% vs. females: 4.8%, $p = 0.705$) and age of the participants (Table 1). However, the prevalence of self-reported COVID-19 diagnosis was higher among non-Kuwaiti than among Kuwaiti subjects (7.8% vs. 4.6%, $p = 0.034$), employed compared to unemployed participants (6.0% vs. 2.9%, $p < 0.001$), and was highest among subjects who reported an educational attainment of high school or less and least among those with a bachelor's degree (9.0% vs. 3.8%, $p = 0.011$; Table 1).

In the total study sample, participants with "children aged <18 years" were more likely to have had COVID-19 than those with "no children or with children aged ≥ 18 years" (5.5% vs. 4.3%; aPR: 1.46, 95% CI: 0.99–2.14; Table 2), though this association did not gain statistical significance. Among participants aged 21–29 years, "having children aged <18 years" compared to "having no children or all children aged ≥ 18 years" was associated with an increased likelihood of having had COVID-19 (12.0% vs. 4.1%; aPR: 2.50, 95% CI: 1.21–5.20). However, such an association was not evident in participants aged ≥ 30 years (Table 2). In additional analysis shown in Table 3, the association between having children aged <18 years and self-reported COVID-19 diagnosis was further stratified by sex

Table 1. Characteristics of the total study sample and distribution of the characteristics according to self-reported COVID-19 diagnosis status

	Total sample	Self-reported COVID-19 diagnosis	
	% (n)	yes, % (n/total)	p value [†]
Overall	100.0 (2,355)	4.8 (114/2,355)	–
Sex			
Male	31.7 (741)	5.1 (38/741)	0.705
Female	68.3 (1,595)	4.8 (76/1,595)	
Missing, (n)	(19)	–	
Age-group, years			
21–29	31.6 (744)	5.1 (38/744)	0.554
30–39	25.7 (605)	5.8 (35/605)	
40–49	18.5 (436)	4.6 (20/436)	
50–59	16.6 (390)	3.6 (14/390)	
≥60	7.6 (180)	3.9 (7/180)	
Nationality			
Kuwaiti	90.7 (2,126)	4.6 (97/2,126)	0.034
Non-Kuwaiti	9.3 (218)	7.8 (17/218)	
Missing, (n)	(11)	–	
Employment status			
Employed	64.4 (1,513)	6.0 (90/1,513)	<0.001
Unemployed*	35.6 (838)	2.9 (24/838)	
Missing, (n)	(4)	–	
Educational attainment			
High school or less	7.1 (167)	9.0 (15/167)	0.011
Diploma [#]	12.7 (299)	6.0 (18/299)	
Bachelor's degree	62.0 (1,460)	3.8 (56/1,460)	
Graduate/medical degree	18.2 (428)	5.8 (25/428)	
Missing, (n)	(1)	–	

[†] Calculated using χ^2 tests. * Includes unemployed subjects, retired individuals, and students. [#] Refers to a 2-year associate degree post-high school.

and age (21–29 years vs. ≥30 years) of the participants. Among males aged 21–29 years (aPR: 2.10, 95% CI: 0.82–5.37) and aged ≥30 years (aPR: 3.92, 95% CI: 0.93–16.53), having children aged <18 years was associated with a trend of increased prevalence of self-reported COVID-19 diagnosis (Table 3). However, having children aged <18 years was associated with an increased prevalence of self-reported COVID-19 diagnosis only among females aged 21–29 years (aPR: 2.96, 95% CI: 1.08–8.74; Table 3).

Discussion

The findings of this study showed that young adults with children are more likely to experience COVID-19 than young adults with no children. However, this association was not evident among older adults. Moreover, results of the analysis stratified by sex and age (Table 3) showed that young (aged 21–29 years) males and females with children aged <18 years were more likely than subjects with no children or with children aged ≥18 years to self-report CO-

VID-19 diagnosis. Hence, indicating that the observed association between having children and experiencing COVID-19 among young adults was not modified by the sex of the participants. Such observations can be explained by the fact that young adults mainly have young children who are usually in close contact with parents and, hence, more likely to transmit infections to parents than older children. This hypothesis is supported by the fact that none of the participants aged 21–29 years reported having children aged ≥18 years. Nonetheless, we observed an elevated prevalence of self-reported COVID-19 diagnosis that is related to having children aged <18 years among males aged ≥30 years, but not among females aged ≥30 years. This observation of a sex-specific association among older adults warrants further corroboration. In general, our epidemiological observation suggests that children potentially play a role in spreading COVID-19.

Our findings contradict prior investigations that reported that pediatric COVID-19 patients account for a small proportion of familial transmission of the infection [6]. Nevertheless, these studies were based on symptom-

Table 2. Associations between having children <18 years of age and self-reported COVID-19 diagnosis in the total study sample and stratified according to participants' age

	Have children <18 years of age [†]	Self-reported COVID-19 diagnosis		
		yes, % (n/total)	aPR [‡] (95% CI)	p value
Total sample	No	4.3 (53/1,242)	1.00 (ref)	–
	Yes	5.5 (61/1,113)	1.46 (0.99–2.14)	0.056
Age 21–29 years	No	4.1 (27/652)	1.00 (ref)	–
	Yes	12.0 (11/92)	2.50 (1.21–5.20)	0.014
Age 30–39 years	No	6.2 (11/178)	1.00 (ref)	–
	Yes	5.6 (24/427)	0.92 (0.45–1.88)	0.823
Age 40–49 years	No	5.2 (5/96)	1.00 (ref)	–
	Yes	4.4 (15/340)	0.94 (0.29–2.47)	0.850
Age 50–59 years	No	3.1 (6/195)	1.00 (ref)	–
	Yes	4.1 (8/195)	1.34 (0.43–4.17)	0.612
Age ≥60 years	No	3.3 (4/121)	1.00 (ref)	–
	Yes	5.1 (3/59)	1.38 (0.32–5.98)	0.667

[†] Participants with no children and those with all of their children aged ≥18 years were grouped together for this analysis, and were reported in the “no” category. The “yes” category included participants with children aged <18 years. [‡] In the total sample analysis: adjusted for age, sex, nationality, educational attainment, and employment status of the participant. In the age stratified analyses: adjusted for sex, nationality, educational attainment, and employment status.

Table 3. Associations between having children <18 years of age and self-reported COVID-19 diagnosis according to participants' age and sex

	Have children <18 years of age [†]	Self-reported COVID-19 diagnosis		
		yes, % (n/total)	aPR [‡] (95% CI)	p value
Males, age 21–29 years	No	7.1 (13/183)	1.00 (ref)	–
	Yes	19.2 (5/26)	2.10 (0.82–5.37)	0.124
Males, age ≥30 years	No	1.2 (2/168)	1.00 (ref)	–
	Yes	5.0 (18/364)	3.92 (0.93–16.53)	0.063
Females, age 21–29 years	No	3.0 (14/465)	1.00 (ref)	–
	Yes	9.1 (6/66)	2.96 (1.08–8.74)	0.042
Females, age ≥30 years	No	5.8 (24/417)	1.00 (ref)	–
	Yes	5.0 (32/647)	0.79 (0.47–1.30)	0.348

[†] Participants with no children and those with all of their children aged ≥18 years were grouped together for this analysis, and were reported in the “no” category. The “yes” category included participants with children aged <18 years. [‡] Adjusted for nationality, educational attainment, and employment status.

atic children, whereas the majority of children does only develop unrecognizable or no symptoms, and still can spread the infection [4]. Therefore, the prior studies are limited by only investigating the role of children who develop COVID-19 symptoms; hence, these results may underestimate the role of asymptomatic patients, which has been deemed to be important in the spread of COVID-19

[7]. In support of our findings, a study showed that children aged 0–14 years had the highest rate of transmitting SARS-CoV-2 infection to contacts as compared to other age-groups [8]. Another study concluded that children are as likely as adults to transmit SARS-CoV-2 in household setting [9]. Moreover, a large retrospective cohort study showed that among adults aged ≤65 years, living

with children was associated with an increased risk of recorded SARS-CoV-2 infection and COVID-19-related hospitalization [10]. These findings further support our observation of an association between having children and having had COVID-19. The higher viral load detected in young children compared to older children and adults further highlight the potential role of children in SARS-CoV-2 transmission [4, 11].

A limitation to our study is the lack of information on the number and exact age of children. Our findings should be considered as exploratory and corroborated by future studies. Given that most countries are opening up or planning to open schools, protocols are needed to reduce transmission while children are in school as they have the potential to spread the infection to their household and community.

Conclusion

Results of this report further our understanding of the role of children in the COVID-19 pandemic and highlight the need for preventive measures that aim to contain the potential spread caused by children.

Statement of Ethics

The study was approved by the Health Sciences Center Ethics Committee for Students Research at Kuwait University (No. 754/2020). Completing the questionnaire was an indication of

consent to participate. The study was conducted in accordance with principles and guidelines of the Declaration of Helsinki for medical research involving human subjects.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

S.A., Z.A., H.A., B.A., D.A., Y.A., W.A., and S.A. conceptualized and designed the study, designed the data collection instrument, collected data, and contributed to initial manuscript drafting. W.K. contributed to conceptualization and design of the study, contributed to data interpretation, and critically reviewed and revised the manuscript for important intellectual content. A.H.Z. contributed to conceptualization and design of the study, contributed to designing data collection instrument, supervised data collection, analyzed and interpreted the data, and drafted the initial manuscript. All authors have reviewed, revised, and approved the final manuscript.

Data Availability Statement

The dataset used and analyzed during the current study is available from the corresponding author on reasonable request.

References

- 1 Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (covid-19) outbreak in China: summary of a report of 72314 cases from the Chinese center for disease control and prevention. *JAMA*. 2020 Apr 7;323(13):1239–42.
- 2 Bi Q, Wu Y, Mei S, Ye C, Zou X, Zhang Z, et al. Epidemiology and transmission of covid-19 in 391 cases and 1286 of their close contacts in Shenzhen, China: a retrospective cohort study. *Lancet Infect Dis*. 2020 Aug; 20(8):911–9.
- 3 Gaythorpe KAM, Bhatia S, Mangal T, Unwin HJT, Imai N, Cuomo-Dannenburg G, et al. Children's role in the covid-19 pandemic: a systematic review of early surveillance data on susceptibility, severity, and transmissibility. *Sci Rep*. 2021 Jul 6;11(1):13903.
- 4 Yonker LM, Neilan AM, Bartsch Y, Patel AB, Regan J, Arya P, et al. Pediatric severe acute respiratory syndrome coronavirus 2 (sars-cov-2): clinical presentation, infectivity, and immune responses. *J Pediatr*. 2020 Dec;227: 45–52.e5.
- 5 Alqudeimat Y, Alenezi D, AlHajri B, Alfouzan H, Almokhaizeem Z, Altamimi S, et al. Acceptance of a covid-19 vaccine and its related determinants among the general adult population in Kuwait. *Med Princ Pract*. 2021 Jan 22;30(3):262–71.
- 6 Lei H, Xu X, Xiao S, Wu X, Shu Y. Household transmission of covid-19-a systematic review and meta-analysis. *J Infect*. 2020 Dec;81(6): 979–97.
- 7 Kronbichler A, Kresse D, Yoon S, Lee KH, Effenberger M, Shin JI. Asymptomatic patients as a source of covid-19 infections: a systematic review and meta-analysis. *Int J Infect Dis*. 2020 Sep;98:180–6.
- 8 Fateh-Moghadam P, Battisti L, Molinaro S, Fontanari S, Dallago G, Binkin N, et al. Contact tracing during phase I of the covid-19 pandemic in the Province of Trento, Italy: key findings and recommendations. *medRxiv [Preprint]*. 2020.
- 9 Grijalva CG, Rolfes MA, Zhu Y, McLean HQ, Hanson KE, Belongia EA, et al. Transmission of sars-cov-2 infections in households: Tennessee and Wisconsin, april–september 2020. *MMWR Morb Mortal Wkly Rep*. 2020 Nov 6; 69(44):1631–4.
- 10 Forbes H, Morton CE, Bacon S, McDonald HI, Minassian C, Brown JP, et al. Association between living with children and outcomes from covid-19: opensafely cohort study of 12 million adults in England. *BMJ*. 2021 Mar 18;372:n628.
- 11 Heald-Sargent T, Muller WJ, Zheng X, Rippe J, Patel AB, Kociolek LK. Age-related differences in nasopharyngeal severe acute respiratory syndrome coronavirus 2 (sars-cov-2) levels in patients with mild to moderate coronavirus disease 2019 (covid-19). *JAMA Pediatr*. 2020 Sep 1;174(9):902–3.