


Household chaos, maternal stress, and maternal health behaviors in the United States during the COVID-19 outbreak

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Abstract

Objectives: Household chaos, including disorder, noise, and crowding within the home, is a risk factor for poor mental and physical health. Household chaos may act upon maternal behaviors of physical activity and sleep, potentially via higher stress. The purpose of this study is to evaluate the relationships among household chaos, maternal stress, and maternal physical activity and sleep, and identify barriers to home organization during the COVID-19 outbreak.

Methods: A cross-sectional study using an online survey of 1721 mothers of preschoolers (ages = 3.0–5.9 years) in the United States was conducted in May 2020 during COVID-19 stay-at-home orders and early reopening. Mothers reported demographic characteristics, household chaos, stress, physical activity and sleep, and barriers to home organization during the outbreak. Mediation models were conducted among household chaos, stress, and physical activity and sleep with adjustment for covariates.

Results: About half of mothers were middle income (48.2%), employed full-time prior to the outbreak (59.1%), and met the physical activity (47.7%), and sleep guideline (49.7%, 7–9 h/day). Household chaos and stress were both negatively related to physical activity and sleep. For every 1 unit increase in mother's current stress, mothers were 11% (95% confidence interval = 6% to 16%) less likely to meet the physical activity guideline and 19% (95% confidence interval = 14% to 23%) less likely to meet the sleep guideline. Household chaos was positively related to stress. Stress partially mediated the relationship between household chaos and physical activity and sleep. Virus concerns, occupational changes (i.e. teleworking), and lack of childcare were barriers to home organization.

Conclusion: During the COVID-19 outbreak, many mothers had poor sleep and physical activity, which was associated with household chaos and stress. Opportunities to promote order at the individual, household, and community level may result in beneficial mental and physical health in mothers of young children during the COVID-19 outbreak and beyond.

Keywords

household, physical activity, preschool, sleep, stress

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Introduction

Adequate physical activity and sleep are important for overall health and are associated with a lower body mass index (BMI).¹ Mothers of young children may be at increased risk of having obesity and poor health, as they are less likely to meet benchmarks for physical activity

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and sleep compared to women without children.^{2,3} Mothers living in chaotic households, which are characterized by disorder, noise, and crowding, obtain less sleep and are at greater risk for obesity.⁴ A potential mechanism to explain the relationship between household chaos and behaviors is stress, as stress is associated with fewer physical activity parenting practices and less sleep.⁵⁻⁷ Examining the relationships among household chaos, stress, and maternal health behaviors may provide evidence to focus on strategies such as reducing stress and promoting routines,⁸ with the goal of mothers achieving adequate physical activity and sleep.

Unfortunately, many households were disrupted during the Coronavirus Disease-19 (COVID-19) outbreak as residents practiced social distancing, which included staying within their home and limiting social gatherings.⁹ Changes during this time, including individual, household, and community level factors,¹⁰ may lead to more household chaos and potentially poor mental and physical health. As shown in a recent scoping review of the COVID-19 outbreak's impact on maternal health, there are both direct and indirect effects of the pandemic on mothers' everyday lives.¹¹ Mothers in high-income countries have experienced disruptions in childcare and increasing domestic demands, and mothers of all countries surveyed have experienced disproportional job loss compared to fathers.¹¹ In a study of 2463 mothers of younger children (1–10 years),¹² differing factors were related to poor maternal mental health within each country, including maternal unemployment and high maternal education (the Netherlands) and poor physical health (Italy and China), whereas having grandparents help serve as caregivers was protective for lowering the risk for poor mental health (China).¹² Across all three countries, family conflict and maternal stress were related to worse maternal mental health whereas resilience was related to better mental health.¹² Taken together, changes from the COVID-19 outbreak have disrupted the daily lives of mothers and order in the home, with implications for maternal mental and physical health.

Recent evidence suggests these changes are differentially impacting mothers of young children. Accordingly, an Italian sample of 520 women assessed before and after the COVID-19 outbreak found mothers of young children reported more disruption in work and housework since the COVID-19 outbreak but not mothers of older children.¹³ Furthermore, a Canadian sample of mothers and fathers of young children conducted during the COVID-19 outbreak found mothers reported more stress and less physical activity compared to fathers.¹⁰ Identifying the individual, household, and community level correlates of home organization may help facilitate healthy behaviors for mothers of young children among the COVID-19 outbreak in the United States and provide country-specific targets for change. Therefore, the purpose of this study was (1) to

evaluate the relationships among household chaos, maternal stress, and maternal physical activity and sleep and (2) to identify barriers to home organization at the household and community level during the COVID-19 outbreak in the United States.

Methods

Participants

A study to measure household dynamics and family health during the COVID-19 outbreak was conducted using an online survey between 1 May and 24 May 2020, in the United States. At this time, most states were ending stay-at-home orders or beginning "Phase 1" periods, which allowed groups of <10 people with few non-essential trips outside the home.⁹ This study sought 2500 participants, in the estimation that 70% would complete the entire survey (1750), and this sample size would be able to detect a difference in child behaviors between low and high household chaos groups based on previous literature.¹⁴ Mothers of young children were recruited via email listservs, paid online advertisements (i.e. Facebook), and word of mouth. Recruitment and survey pictures included a diverse representation, including families of African American and Asian race. Mothers who were ≥ 18 years, had a young child (3.0–5.9 years) who lived with them >50% of the time, and resided in the United States were eligible to participate. Pennington Biomedical Research Center's Institutional Review Board approved the study (IRB: 2020-018). Electronic informed consent was obtained from all study participants prior to completing the survey. This study follows the STROBE guidelines for reporting of observational studies (Supplementary Table 1).

Procedure

Potential participants accessed the consent letter and survey on REDCap, a secure, web-based platform designed to support data capture for research.¹⁵ Mothers who had multiple children in the age range were asked to select one child and complete the entire survey once and only for the selected child. For quality assurance, mothers confirmed their answers to four questions. At the end of the survey, mothers were given the option to provide their email address to enter a lottery for US\$50 compensation, and 20 mothers were randomly chosen for compensation.

Demographic information and COVID-19 factors

Mothers reported their child's age and sex, and their own age, race, ethnicity, pregnancy status, height, weight, state they lived in (representation from all 50 US states, including Washington, D.C.), household size (i.e. number of

adults and children), age range of children, maternal employment (employed = ≥ 30 h/week, part time = < 30 h/week, or unemployed), and household income prior to the outbreak (beginning with 2). Mothers were asked about COVID-19 factors, including individual, household, and community level factors. These factors included concern with someone within your household being diagnosed with COVID-19, mother's teleworking status, change in their employment status, healthcare workers and essential workers in the household (in separate questions), household income changes, stay-at-home order status for their region, and if the child was in non-parental care in the past week (options: not enrolled in non-parental care before outbreak, no non-parental care option, keeping child home, and child enrolled in non-parental care). These factors align with individual, household, and community level concerns raised by other samples of mothers during the COVID-19 outbreak.^{10,13}

Household chaos and maternal stress

The Confusion, Hubbub, and Order Scale (CHAOS) was used to assess household chaos and was previously validated in mothers of young children.¹⁶ Mothers responded to 15 statements related to their current home dynamic, including disorder, noise, and crowding. Questions were scored from 1 to 4, with reverse coding for eight questions. Scores range from 15 to 60, with a higher score indicating more chaos. Mothers were asked to rank their current stress and stress during the last year (January–December 2019) on a scale of 1–10 in separate questions.¹⁷ Mothers were also asked about barriers they faced keeping routine and order within the home at this time, including 10 options (e.g. changing job schedule and lack of childcare).

Physical activity and sleep

Mothers completed the Godin–Shephard Leisure-time Physical Activity Questionnaire, which assessed their physical activity within the past week. This questionnaire was validated in adults.¹⁸ Mothers were asked how many times they performed strenuous, moderate, or mild activity for ≥ 15 min, which were then multiplied by intensity specific constants, and summed to calculate moderate-to-vigorous physical activity (MVPA) and leisure-time physical activity (total physical activity). Meeting the physical activity guideline was defined as > 24.0 units/week of MVPA.¹⁸ Mothers were asked to classify their current physical activity compared to before the outbreak.

Mothers reported their sleep habits since the outbreak using the Pittsburgh Sleep Quality Index, which is validated in adults.¹⁹ Mothers reported sleep quality, sleep duration (hours of *actual* asleep), and daytime dysfunction (trouble staying awake and keeping up enough enthusiasm

to get things done). Sleep quality and daytime dysfunction questions were scored, ranging from 0 to 3, with a higher number indicating worse sleep quality or more daytime dysfunction. Meeting the sleep guideline was defined as 7–9 h/day of actual sleep similar to other reports.² Mothers were asked to compare their current sleep to their sleep before the outbreak.

Statistical analysis

Participants with complete data for all variables of interest were included in analysis. For Aim 1, Spearman's rank correlation coefficients were used to assess correlations between household chaos, stress, physical activity, and sleep, as household chaos was non-normally distributed. Linear regression models were conducted among household chaos, stress, physical activity, and sleep to test potential mediation paths. Logistic regression models were used to examine the relationship between household chaos and stress with meeting the physical activity guideline and sleep guideline in separate models. Linear and logistic regression models were adjusted for child age, child sex, maternal age, maternal race, household size, BMI, number of children < 2 and > 6 years, US state of residence, maternal employment prior to the outbreak, and household income prior to the outbreak, as these variables were associated with household chaos or identified in prior literature.¹⁴ Two mediation models were conducted to examine the relationship among household chaos (predictor), current stress (mediator), and behavior (outcome), including MVPA (outcome, model 1) and sleep duration (outcome, model 2). Mediation models were conducted using the PROCESS vs3.5 macro with 10,000 bootstrap intervals with unstandardized estimates,²⁰ with adjustment for the same covariates as the linear and logistic regression models.¹⁴ For Aim 2, one-way analysis of variance was used to compare household chaos (outcome) by change in physical activity, sleep, and COVID-19 factors (i.e. concern for household COVID-19 diagnosis, teleworking, reduced hours/lost job, presence of essential or healthcare workers, decreased income, lack of non-parental care, and under stay-at-home order), using a Tukey's post hoc test for pairwise comparisons. COVID-19 factors that significantly differed in household chaos were retained as predictors of household chaos (outcome) in a linear regression model that was adjusted for the same covariates the other models. All analyses were conducted in SAS 9.4 (Cary, NC, USA). Significance was set at $p < 0.05$ and two-sided.

Results

In total, 2635 mothers completed the consent, of whom 2334 participants were eligible, and 1868 provided complete data (80.0% of eligible). Participants with improbable answers ($n = 20$), who were pregnant ($n = 120$), and who

Table 1. Descriptive statistics and correlations among household chaos, maternal health behaviors, and demographics.^a

	Mean ± SD	1	2	3	4	5	6
1. Household chaos	31.18 ± 7.52						
<i>Maternal behaviors</i>							
2. MVPA, units	27.12 ± 28.08	-0.13***					
3. Leisure-time physical activity, units	39.21 ± 31.79	-0.15***	0.94***				
4. Sleep duration, h/day	6.44 ± 1.16	-0.22***	0.09***	0.08***			
5. Sleep quality, range 0–3	1.43 ± 0.73	0.28***	-0.13***	-0.12***	-0.53***		
6. Daytime dysfunction, range 0–3	1.32 ± 0.74	0.40***	-0.13***	-0.15***	-0.27***	-0.36***	
<i>Demographics</i>							
7. Maternal age, years	35.97 ± 4.11	0.02	-0.008	0.32	0.03	0.03	-0.001
8. Child age, years	3.90 ± 0.77	-0.02	0.01	-0.005	0.02	0.04*	-0.01
9. Household size	4.20 ± 1.05	0.16***	0.008	0.02	-0.07**	-0.07**	-0.008
10. Number of children <2 years	0.50 ± 0.58	0.07**	-0.04*	-0.01	-0.13***	-0.06**	-0.02
11. Number of other children 3–5 years	0.28 ± 0.57	0.08***	0.04	0.05*	-0.01	0.04	0.04
12. Number of children 6–10 years	0.39 ± 0.67	0.09***	0.01	-0.004	0.05*	-0.001	0.02
13. Number of children 11–14 years	0.09 ± 0.34	0.04	0.01	0.01	0.01	-0.01	-0.001
14. Number of children 15–18 years	0.03 ± 0.23	0.04	0.005	-0.01	-0.01	0.01	0.003
15. Number of children >6 years	0.52 ± 0.88	0.10***	0.02	0.005	0.03	-0.004	0.009
16. Body mass index, kg/m ²	28.13 ± 7.02	0.03	-0.14***	-0.15***	-0.12***	-0.05*	0.07**
17. Previous stress, range 1–10	5.45 ± 1.87	0.22***	-0.06**	-0.08***	-0.12***	-0.16***	0.20***
18. Current stress, range 1–10	6.90 ± 1.87	0.43***	-0.11***	-0.14***	-0.20***	-0.28***	0.36***

SD: standard deviation; MVPA: moderate-to-vigorous physical activity.

^aAssessed using Spearman's rank correlation coefficients.

Boldface indicates statistical significance (* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$).

missed ≥ 3 data quality checks ($n = 7$) were excluded, and 1721 participants remained for analysis. Compared to those not included in analysis, included mothers in this study had slightly fewer hours of sleep (6.4 ± 1.2 vs 6.7 ± 1.5 , respectively, $p = 0.03$), were less likely to meet the sleep guideline (49.7% vs 59.2%, respectively, $p = 0.02$), were slightly older (35.9 ± 4.1 vs 35.3 ± 4.0 years, respectively, $p = 0.001$), and had slightly more people in the household (4.2 ± 1.0 vs 4.0 ± 1.0 , respectively, $p = 0.02$). Included mothers had more additional children between ages 3–5 years in the household than those not included (0.3 ± 0.6 vs 0.1 ± 0.4 , respectively, $p = 0.001$) but fewer younger children (<2 years, 0.5 ± 0.6 vs 0.9 ± 0.5 , respectively, $p = 0.001$) or older children (>6 years, 0.5 ± 0.8 vs 1.2 ± 1.5 , respectively, $p = 0.001$).

Most mothers were white (90.5%) and middle income (US\$70,000–US\$139,000; 48.2%), and some lived in a lower-income household (US\$<70,000; 19.0%). Over half of mothers were employed full-time (59.1%), with some employed part-time (18.3%) or not employed (22.6%) prior to the COVID-19 outbreak. All 50 U.S. states and Washington D.C. were represented in the survey.

Aim 1: household chaos, stress, and physical activity and sleep

Mothers reported an average of 27.2 ± 28.1 units of MVPA and slept for 6.4 ± 1.2 h/day (Table 1). About half (47.7%)

met the physical activity guideline and the sleep guideline (7–9 h, 49.7%). No participant reported over 9 h of actual sleep, so those who did not meet the sleep guideline were short sleepers (<7 h). Mothers' current stress (6.90 ± 1.87) was higher compared to their stress in 2019 (5.45 ± 1.87 , $p < 0.01$). Household chaos was negatively associated with MVPA, leisure-time physical activity, and sleep duration, and associated with worse sleep quality and more dysfunction in unadjusted models ($p < 0.001$ for all). Household size, along with more children in the home of younger ages, was associated with more household chaos ($p < 0.05$ for all). Specifically, number of children ages <2 years, other children ages 3–5 years, children ages 6–10 years, and overall number of older children (>6 years) were associated with more household chaos ($p < 0.05$ for all).

After adjustment, household chaos was still negatively associated with MVPA and sleep duration ($p < 0.001$ for each, Table 2). Household chaos was positively associated with stress and explained 19% of the variance when evaluated without covariates in the model. Stress was also negatively associated with MVPA and sleep in adjusted models ($p < 0.001$ for both). Household chaos and stress were both negatively associated with meeting the physical activity and sleep guideline ($p < 0.001$ for all). For every 1 unit increase in mother's current stress, mothers were 11% (95% confidence interval (CI) = 6% to 16%) less likely to meet the physical activity guideline and 19% (95% CI = 14% to 23%) less likely to meet the sleep guideline.

Table 2. Adjusted associations among household chaos, maternal stress, and maternal physical activity and sleep ($n = 1721$).^a

	Maternal stress		MVPA units		Sleep duration, h/day	
	β (95% CI)	<i>p</i> -value	β (95% CI)	<i>p</i> -value	β (95% CI)	<i>p</i> -value
Household chaos	0.11 (0.10, 0.12)	0.001**	-0.50 (-0.68, -0.32)	0.001**	-0.02 (-0.03, 0.02)	0.001**
Maternal stress			-1.55 (-2.27, -0.85)	0.001**	-0.14 (-0.17, -0.11)	0.001**
	Physical activity guideline		Sleep guideline			
	OR (95% CI)	<i>p</i> -value	OR (95% CI)	<i>p</i> -value		
Household chaos	0.97 (0.96, 0.98)	0.001**	0.95 (0.94, 0.97)	0.001**		
Maternal stress	0.89 (0.84, 0.94)	0.001**	0.81 (0.77, 0.86)	0.001**		

MVPA: moderate-to-vigorous physical activity; CI: confidence interval; OR: odds ratio.

^aAssessed using linear regression (or logistic regression for guidelines) with adjustment for child age and sex, along with maternal age, race, household size, maternal body mass index, number of children below 2 years of age in the home, number of children older than 6 years of age in the home, US state of residence, maternal employment prior to the outbreak, and household income prior to the outbreak.

Physical activity guideline was defined as >24.0 units of MVPA, and sleep guideline was defined as 7–9 h/day of actual sleep.

Boldface indicates statistical significance (** $p < 0.01$).

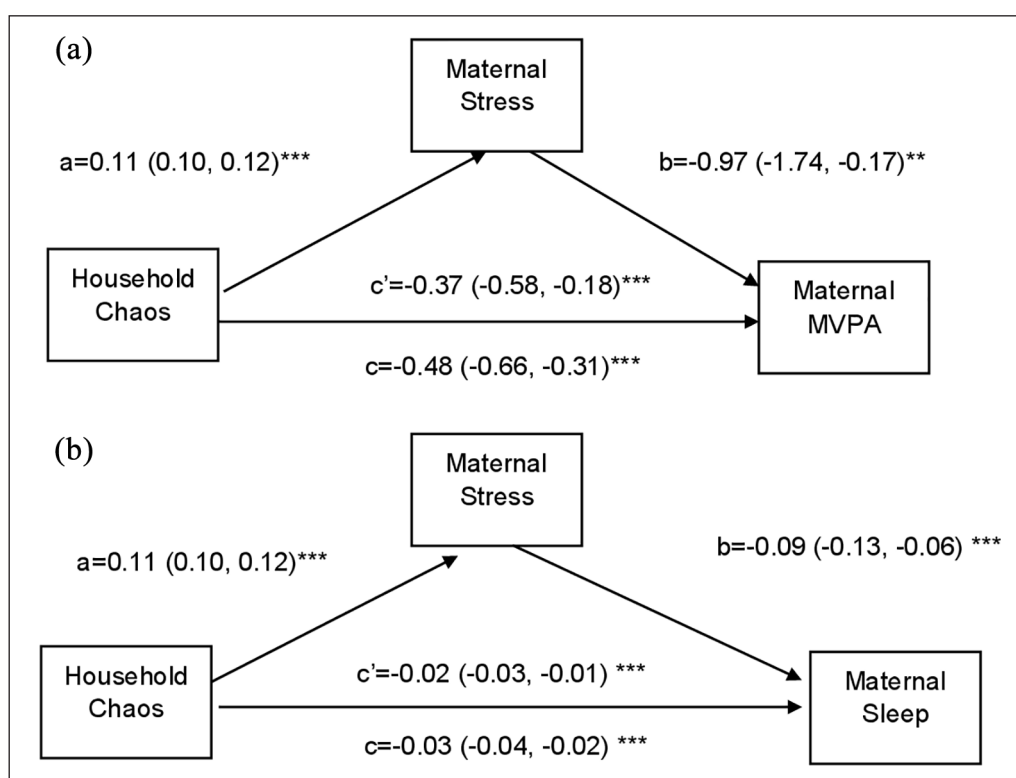


Figure 1. (a) Mediation model of household chaos, maternal stress, and maternal MVPA. (b) Mediation model of household chaos, maternal stress, and maternal sleep.

MVPA: moderate-to-vigorous physical activity.

Estimates shown are unstandardized coefficients with 95% confidence intervals.

a: effect of household chaos and maternal stress, b: effect of maternal stress and maternal behavior, c': direct effect of household chaos and maternal behavior, and c: total effect (direct and indirect effects) of household chaos and maternal stress on maternal behavior.

Boldface indicates statistical significance (** $p < 0.01$; *** $p < 0.001$).

Models adjusted for child age, child sex, maternal age, maternal race, household size, maternal body mass index, number of children below 2 years of age in the home, number of children older than 6 years of age in the home, US state of residence, and maternal employment prior to the outbreak, and household income prior to the outbreak.

Both mediation models were significant ($p < 0.001$ for model fit for both, Figure 1). The total effect (sum of direct and indirect effects) of household chaos with the outcomes

was also significant in both models ($p < 0.001$ for both). The indirect path of stress between household chaos and MVPA (-0.11 , 95% CI = -0.19 to -0.01) and sleep (-0.01 ,

Table 3. Household chaos score by changes in maternal physical activity, sleep, and COVID-19 factors ($n = 1721$).^a

Maternal changes	<i>n</i>	%	Household chaos score	<i>p</i> -value
<i>Change in physical activity</i>				<0.001***
More active now	544	31.6	30.0 ± 7.3	
The same	429	24.9	30.3 ± 7.2	
Less active now	748	43.4	32.4 ± 7.6	
<i>Change in sleep</i>				<0.001***
Sleep longer or better now	230	13.3	28.9 ± 7.0	
The same	490	28.4	29.0 ± 6.9	
Sleep for a shorter amount of time or worse	1001	58.1	32.7 ± 7.5	
COVID-19 factors				
<i>Maternal concern for household virus diagnosis</i>				
Not concerned	231	13.4	30.9 ± 8.4	0.006**
Mildly concerned	944	54.8	30.7 ± 7.2	
Very concerned	546	31.8	32.0 ± 7.6	
<i>Maternal telework status</i>				<0.001***
No telework	739	42.9	30.6 ± 7.5	
Part-time or full-time	982	57.1	31.6 ± 7.5	
<i>Maternal employment changes</i>				0.17
Still employed	1295	75.3	31.0 ± 7.5	
Reduced hours or lost job	426	24.7	31.6 ± 7.5	
<i>Essential worker in home</i>				0.95
No	1111	64.5	31.2 ± 7.5	
Yes	610	35.5	31.2 ± 7.5	
<i>Healthcare worker in home</i>				0.02*
No	1408	81.8	31.0 ± 7.5	
Yes	295	17.2	32.0 ± 7.4	
<i>Household income change</i>				<0.001***
Increased or stayed the same	1146	66.5	30.4 ± 7.3	
Decreased	575	33.5	32.6 ± 7.6	
<i>Non-parental care status</i>				<0.001***
Has non-parental care option	959	55.7	30.4 ± 7.3	
Non-parental care option no longer available	762	44.2	32.1 ± 7.7	
<i>Stay at home order in region</i>				0.31
No stay at home order	849	49.3	30.9 ± 7.2	
Stay at home order	872	50.6	31.3 ± 7.2	

^aAssessed using one-way analysis of variance.

Boldface indicates statistical significance (* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$).

95% CI = -0.01 to -0.007) were significant ($p < 0.001$ for both). Together, household chaos was negatively related to MVPA and positively related to stress, and stress was related to less MVPA ($p < 0.001$ for all paths). Household chaos was negatively related to sleep, and stress was related to less sleep ($p < 0.001$ for all paths). These results indicate partial mediation of household chaos on maternal behaviors through stress, as household chaos was still significantly related to maternal behavior with the stress indirect path.

Aim 2: barriers to home organization during the COVID-19 outbreak

As shown in Table 3, mothers who reported they were less physically active and mothers who had worse sleep (duration

or quality) since the outbreak reported more chaos compared to other categories ($p < 0.05$ for each comparison). Mothers who were concerned about a household member being diagnosed with the virus, were teleworking, had a healthcare worker in the household, whose household income had decreased, and who no longer had a non-parental care option reported more chaos relative to other options ($p < 0.05$ for all, Table 3), and these factors were retained in investigation in adjusted linear regression models. Of those who no longer had a non-parental care option ($n = 762$), most reported their childcare provider was closed temporarily (87%, $n = 661$), a small portion reported their non-parental care option closed permanently (11%, $n = 84$), and all others reported other situations (2%, $n = 17$).

In the adjusted linear regression model with retained COVID-19 factors, the following were associated with

higher level of household chaos: being very concerned for household virus diagnosis compared to not concerned for household virus diagnosis ($\beta = 1.14$ (0.01–2.28), $p = 0.04$), teleworking ($\beta = 1.10$ (0.15–2.05), $p = 0.02$), decreased household income ($\beta = 2.07$ (1.32–2.83), $p = 0.001$), and lack of non-parental care ($\beta = 1.60$ (0.89–2.32), $p = 0.001$). Conversely, having a healthcare worker in the home ($\beta = 0.71$ (–0.24 to 1.67), $p = 0.14$) or mild concern for household virus diagnosis (mildly concerned: $\beta = -0.11$ (–1.17 to 0.94), $p = 0.82$) were not significantly associated with household chaos. The most frequently reported barriers to routines were lack of non-parental care (43.2%), changing job schedule (38.0%), uncertainty in future (36.8%), child behavior problems (36.3%), and lack of family support in the area (31.6%). All other options (unpredictable childcare, lack of spouse support, overcrowding, limited resources, and job uncertainty) were less frequently reported (<15%).

Discussion

This study adds to the scientific evidence that household chaos is related to maternal physical activity and sleep directly and indirectly via maternal stress. Specifically, mothers with higher stress levels were significantly less likely to meet physical activity or sleep guidelines compared to mothers with less stress. This study also identified potential risk factors for household chaos during the COVID-19 pandemic within a US sample and the mothers' reported barriers to home organization, including individual, home, and community level impediments.

The current sample of mothers of young children reported comparable household chaos scores to mothers from low-middle income households that were measured pre-pandemic.¹⁴ Furthermore, the current sample reported a similar proportion of mothers being physically active but twice as many mothers with short sleep duration compared to pre-pandemic samples.^{21,22} Household chaos and stress were both negatively related to MVPA and sleep duration in the current sample. These findings add to the evidence that stress is linked to the mother's own habitual physical activity, expanding upon previous research that stress is inversely related to parental support of child physical activity.⁷

With these observed relationships among household chaos, stress, sleep, and physical activity, focusing on multi-level interventions that support mothers in building routines into daily family life⁸ and reducing maternal stress may result in beneficial amounts of both physical activity and sleep in mothers. Incorporating daily routines and planning have produced promising results for improving mothers' physical activity and sleep, as found in a physical activity planning intervention which resulted in additional parent physical activity²³ and child physical activity (ages = 6–12 years).²⁴ Another intervention in 54 parent-child

dyads (ages = 2–5 years) that specifically targeted home routines resulted in lower household chaos and more child sleep,²⁵ which may be promising for also facilitating maternal sleep. Still, programs should be pragmatic so participation does not add to the mother's current stress.²⁶ Potential options to reduce mother's stress and promote healthy behaviors may include participating in physical activity with their child,²⁷ mindfulness programs,²⁸ and proper sleep hygiene for themselves.²⁹

Individual and household level factors were related to household chaos, including concerns about a virus diagnosis in their household and coping with occupational changes. Mothers are at greater risk than fathers for loss of employment and reduced work hours during the COVID-19 pandemic.¹¹ Despite one quarter of our sample losing their job or reducing their work hours (24.7%), this factor was not related to more household chaos. While reduced work hours allow for more time to be dedicated to caregiving, the potential adverse effects on household chaos may take longer to materialize. Over time, the reduced work contributes to a decreased household income, which in turn was related to more household chaos in the present analysis.

Mothers who were teleworking reported more household chaos than those who were not teleworking during the COVID-19 pandemic. This finding has broad implications, as mothers of young children (<12 years) are more likely to telework compared to fathers and compared to mothers of older children, as shown in a sample of 11,867 employed Japanese citizens.³⁰ The association between teleworking and household chaos contradicts an assumption that a flexible work environment may promote less household chaos and stress, and one study even found that teleworking was related to more physical activity in a convenience sample of 4376 US adults (52 ± 15 years), although these were not exclusively parents or mothers.³¹ However, for mothers who are teleworking, their work time competes against household demands and caretaking responsibilities for young children, which have fallen mainly on mothers.¹³ Balancing caregiving demands with telework may create additional household chaos from shifting schedules, such as working outside of typical hours, which in turn creates chronic stress and limits mothers' time and bandwidth to dedicate to their own physical activity or sleep.¹⁰

At the community level, changes in non-parental care were associated with more household chaos. Other studies conducted during the COVID-19 pandemic suggest that fathers may be helping with childcare duties during confinement, including an Australian sample of 2772 dual-income households³² and Italian sample of mothers,¹³ but fathers still spend significantly less time providing childcare compared to mothers (~1.5 h/day difference).³² Fathers may be helping with childcare at home, but both reports find mothers are dissatisfied with their current

balance of housework, childcare, and paid work.^{13,32} Childcare centers and other non-parental care options (e.g. nannies and grandparents) may not have been available during the time of the survey due to stay-at-home orders and social distancing requirements. Furthermore, grandparents providing childcare was related to better maternal mental health in China but no other countries, likely due to the high proportion of this caregiving option within China (53.6%) relative to Italy (9.4%) and the Netherlands (18.3%).¹² Thus, stay-at-home order status may indirectly influence childcare center availability and other non-parental care options but did not significantly differ in household chaos. Still, more children in the home, namely, ages 10 years and younger, was associated with more household chaos in this sample, demonstrating the importance of providing care and support for parents of young children during this time. As mothers' concerns about virus diagnosis within the household were significant, providing safe non-parental care options that do not contribute to viral transmission is important for promoting both home organization and maternal health.

Strengths of this study include a large sample size and geographic diversity across the United States, validated questionnaires, and survey administration during a peak period of COVID-19 infection. There are also limitations to this study. These limitations center around the population recruited and generalizability to other populations. Although household chaos did not differ between mothers included and not included in analysis, those who did not complete the entire questionnaire may be experiencing more household chaos and demands on their time and not captured in this analysis. Furthermore, this sample was predominately White and middle income, like other research using social media recruitment methods,³³ despite the attempt to appeal to diverse respondents with the use of advertisements that included photographs of minority families. Therefore, results of this study may not be generalizable to lower resourced households, who may experience more chaos because of depleted time and financial resources.^{4,14} Another limitation is that this survey was confined to the United States and may not represent other countries at this time. Nevertheless, many women reported disruption to their daily lives from the COVID-19 pandemic, namely, in their childcare duties and employment status, which has been demonstrated in mothers in other countries.^{11,12} Finally, one limitation is the current sample was recruited through listservs, social media, and other electronic means, and may be at risk for more distress from pandemic-related media exposure compared to others.³⁴ Considering current stress in this sample (6.9 ± 1.9 , May 2020) is comparable to a Canadian sample of 253 mothers of young children during the pandemic who were recruited without social media methods (6.8 ± 1.9 , April 2020),¹⁰ it may be that mothers' stress levels are high regardless of recruitment strategy.

This study provides three main points for future study and consideration among researchers and practitioners. First, supporting mothers at the individual and household level is critical for facilitating adequate physical activity and sleep, and multi-level interventions are warranted to improve maternal health behaviors. Innovative solutions are needed to support mothers as caregivers and earners, as they are disproportionately affected by job loss and work schedule demands (i.e. telework), which was associated with more household chaos. Second, promoting safe and feasible non-parental care options is vital to support both organization within the home and maternal health. At the time of this survey, some mothers reported their non-parental care provider was temporarily closed and a few had permanently closed. Even so, more non-parental care providers may permanently close as the pandemic and resulting economic adjustments continue. Third, continuing rigorous and relevant COVID-19 research, along with creating suitable public health messages,³⁴ may help appropriately address maternal concern for household virus diagnosis and challenges to maintaining an organized home.

Overall, amid the COVID-19 outbreak, household chaos was related to poorer maternal behaviors, and stress was a mediator of this relationship. Results of this study support providing safe and affordable non-parental care options and developing inventive ways to reduce mothers' stress and promote routines at home. Supporting mothers at the individual (reducing stress), household (promoting routines and work-life balance), and community (providing non-parental care) levels may help them to obtain sufficient physical activity and sleep during the COVID-19 outbreak and beyond.

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Author contributions

C.L.K. contributed to the conceptualization, data curation, formal analysis, investigation, methodology, project administration, software, writing—original draft, and writing—review and editing. P.T.K. contributed to the conceptualization, methodology, and writing—review and editing. A.E.S. contributed to the conceptualization, methodology, and writing—review and editing.

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Supplemental material

Supplemental material for this article is available online.

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