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Perceived Vulnerability to Disease and Children's COVID Behavioral Response: The Role of Health Consciousness and Family Financial Status

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Abstract

This study investigated the impact of family financial status on Chinese children's health-related traits and their behavior in controlling COVID-19. When the children were seven years old, their guardians provided information on family financial status. When the children reached 10 years old, they completed questionnaires concerning their own health consciousness and health status. At age 11, during the COVID-19 pandemic in 2020, they filled out questionnaires on perceived vulnerability to disease and disease control behavior. The findings revealed that higher health consciousness is associated with better health, particularly among children from financially challenged families. Additionally, a greater perception of vulnerability to disease is linked to increased COVID-19 control behaviors, particularly in children with high health consciousness in affluent families. These results contribute to our understanding of how children's personal health-related traits and family financial status interact to shape their response to the COVID-19 pandemic.

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Introduction

The outbreak of the coronavirus disease 2019 (COVID-19) in 2020 was one of the most serious public health crises in recent decades (Syal, 2020). At the outset of the outbreak, no medicine or vaccine was effective in intervening or preventing the coronavirus, and traditional behavioral control measures such as wearing masks, washing hands, using hand sanitizers, and maintaining physical distance from others appeared to be the most effective preventive measures (Anderson et al., 2020; Lu et al., 2021). The practice of behavioral control has revealed group differences due to regional disease prevalence and mortality rates in history (Chang et al., 2021; Lu et al., 2022) and individual differences stemming from life history strategies, political orientation, or adoption of social norms (Chen et al., 2021; Lu et al., 2022; Torrente et al., 2022). However, the impact of individual differences, such as personal health status, health consciousness, and perceived vulnerability to disease, on behavioral control in response to COVID-19 is still largely unexplored. Although these health-related traits have been studied separately and recognized for their relevance in recent research (e.g., Church et al., 2022; Espinosa, 2023), their joint influence on COVID behavioral control has not been investigated. Moreover, extensive evidence has shown that children's health outcomes are closely related to their family's financial status (Baharvand et al., 2021; Chen, 2004), but little evidence has been presented on how family finances specifically affect COVID-19 behavioral control. Furthermore, most studies examining behavioral responses to COVID-19 have primarily focused on adults and adolescents (e.g., Jackson et al., 2022; Korn et al., 2022; Park and Oh, 2022), resulting in limited understanding of children's responses. Therefore, this study aimed to investigate how personal health-

related traits and family finances jointly influence health and COVID-19 behavioral control in middle childhood children.

The Influence of Health Consciousness and Family Financial Status on Health

Parents, schoolteachers, and policymakers share a common concern for children's health. The positive health status of a child can alleviate the financial burden on parents in terms of providing nutrition and healthcare (Baharvand et al., 2021; Larson and Halfon, 2010). Furthermore, enhancing children's physical health can improve their academic performance (Shaw et al., 2015). Additionally, public policy plays a crucial role in directing and shaping social determinants of children's health, including areas such as food safety, healthcare services, housing, and income (Raphael, 2010). Various risk and protective factors are related to children's health, including socioeconomic factors and psychological factors. The former one can be represented by family financial status (Case et al., 2002), parental absence (Zhou et al., 2021), maternal social status (Alami et al., 2020), and neighborhood safety (Christian et al., 2015). The latter one may include self-esteem (Li et al., 2010; Stinson and Fisher, 2020), personality (Smith, 2006), and health consciousness (Piko and Bak, 2006). For example, family financial status determines the quality of food and medical care, the safety of the living environment, and expenditure on physical activities (Case et al., 2002), all of which, in turn, predict the child's health status. In addition, children's health consciousness predicts their motivation to engage in exercises that promote physical well-being (Zhou and Krishnan, 2019). According to the Biopsychosocial Model of health (Engel, 1980), both social

circumstances and psychological traits contribute to a person's health, and their interaction shapes one's motivation to pursue good health. However, previous studies have primarily investigated the socioeconomic and psychological effects on health separately, and the interactive effects of these two components on children's health remain unknown.

In this research, we used family financial status (FFS) and health consciousness (HC) to represent those two factors. FFS was chosen because it determines both family and neighborhood environments (Dong et al., 2021; Zhou et al., 2021), while HC, which refers to "the degree to which someone attends to or focuses on his or her health" (Gould, 1990), was chosen because it is the psychological factor that directly motivates individuals to engage in exercise and health practices (Piko and Bak, 2006). Specifically, in terms of the socioeconomic factor, high FFS was reported to predict a good health status because it facilitates parents in providing sufficient nutrition, quality medical care (Chen, 2004), establishing a favorable family and neighborhood environment for the child (Zhou et al., 2021), and fostering high health literacy in the child (Lastrucci et al., 2019). A large-scale longitudinal study that involved over 2500 participants, spanning from childhood to young adulthood, identified childhood FFS as the most significant predictor of adult health, surpassing other factors such as childhood life events and parental health behaviors (Elovainio et al., 2020). Regarding the psychological factor, a positive relationship was found between high HC and good health outcomes as it enables children to maintain their physical well-being through regular exercise (Zhou and Krishnan, 2019). To explore the combined impact of FFS and HC, we formulated our *first hypothesis*. When FFS is high, children's health is likely to be supported by the abundant resources provided in their lives, thereby

potentially reducing the significance of HC in determining their health status. Conversely, when FFS is low, HC, as a personal psychological factor, may have a greater influence on health by affecting children's motivation to pursue good health.

Health-related Traits, Family Financial Status, and COVID-19 Behavioral Control

Other than health status, this study also focused on children's health behaviors, particularly their control behaviors in response to the COVID-19 pandemic. Health-related traits, such as HC and perceived vulnerability to disease, have been shown to predict people's behaviors in maintaining health and preventing disease. Individuals with high HC exhibit more health-related behaviors, such as engaging in regular exercise, maintaining a healthy diet, and tracking health information, with the purpose of preventing or detecting diseases (Lee et al., 2018; Pu et al., 2020; Ruiz-Palomino., 2020). For example, Pu et al. (2020) reported a positive relationship between HC and engaging in home-based exercise during the pandemic in a sample of 489 adults from various districts in China. The authors explained that individuals with high HC tend to have a good understanding of their own health, pay attention to individual health problems, and take proactive measures to ensure their physical well-being. Perceived vulnerability to disease, which refers to one's perception of personal susceptibility to infectious diseases (Duncan et al., 2009), is another predictor of COVID control behaviors. People who perceive themselves to be more vulnerable to COVID-19 tend to engage more in behaviors such as handwashing, avoiding crowded places, and disinfecting personal belongings, particularly during the COVID-19 pandemic (Church et al., 2022;

Elazab et al., 2023; Stangier et al., 2022; Yıldırım et al., 2021). For example, Stangier et al. (2022) administered the Perceived Vulnerability to Disease Scale to 1358 adults and reported that individuals with higher scores on this scale exhibited higher scores on a COVID preventive behaviors checklist. The authors explained that higher perceived vulnerability to disease may imply higher emotional distress when facing the pandemic, thereby leading to an increase in preventive behaviors as a means to alleviate this distress. This explanation was further supported by other studies reporting that emotional distress, specifically fear, such as fear of COVID consequences (Bianchi et al., 2022) or fear of being contaminated (Cummings et al., 2022), predicted preventive behaviors.

In addition to health-related traits, children's FFS is another influential factor in shaping their health behaviors. Low financial status can present an obstacle to engaging in health actions because certain measures to maintain health and prevent diseases can sometimes be costly (e.g., gym membership fees, expenses for early disease detection tests, purchasing hand sanitizers; Bozhar et al., 2022). By contrast, higher family financial status is associated with increased parental health knowledge, which in turn predicts more health behaviors in children (de Buhr and Tannen, 2020). Regarding health behaviors related to COVID prevention, a higher financial status predicts a greater willingness to stay at home (Irigoyen-Camacho et al., 2020) or receive vaccines (Callaghan et al., 2021).

According to the Health Belief Model, which depicts six risk and protective factors (*perceived susceptibility*, *severity*, *benefits*, *barriers*, *cues to action*, and *self-efficacy*) influencing individuals' adoption of disease preventive strategies (Rosenstock, 1974), low

financial status indicates *perceived barriers* to health behaviors. Health consciousness triggers the factor of *cues to action* because individuals with high HC are more adept at recognizing cues that necessitate health-related actions, while perceived vulnerability to disease represents the factor of *perceived susceptibility*. These factors can interact with each other in determining engagement in health behaviors (Rosenstock, 1974). For example, *perceived susceptibility* interacts additively with *cues to action* in influencing people's engagement in health behaviors. Specifically, individuals with higher perceived susceptibility to disease are more likely to engage in health-improving behaviors when exposed to more external cues, such as advice from others (Han et al., 2019), or internal cues, such as self-awareness of one's health status (O'Connor et al., 2014; Pu et al., 2020).

However, the interaction between the factor of *perceived barriers* and other factors remains unclear. We speculate that these barriers may diminish the intention to engage in health behaviors driven by other factors. Specifically, while high perceived susceptibility may predict a higher likelihood of health-related behaviors, low financial status may limit the diversity (e.g., absence of costly health behaviors such as purchasing hygiene items) or quantity (e.g., limited time for exercise due to extensive work hours) of health behaviors. Therefore, we formulated the *second hypothesis*: when the FFS is sufficiently high to afford hygiene or exercise costs, perceived susceptibility would be positively associated with behavior control in response to the COVID-19 pandemic. However, when the FFS is low, the strength of this association would be weakened due to the narrower range of COVID control behaviors resulting from low FFS.

Furthermore, HC moderates the relationship between perceived vulnerability to disease and the adoption of health behaviors. Higher HC strengthens this relationship, while lower HC weakens it (O'Connor et al., 2014; Pu et al., 2020). This is because heightened awareness of one's health status enables individuals to prioritize their health and allows other health-related factors to have a stronger influence on health behavior. Conversely, when someone has low HC, they tend to disregard their health status regardless of other health-related traits. Based on this understanding, we formulated our *third hypothesis* concerning the interaction among FFS, HC, and perceived vulnerability to disease on health behaviors: the impact of FFS and perceived vulnerability to disease on health behavior should be more pronounced when HC is high.

The Present Study

This study was derived from a longitudinal investigation on the effects of the early childhood environment on child developmental outcomes. FFS was reported by the parents regarding the family's financial conditions during their children's early childhood years, when the children were around 7 years old. Early childhood FFS, instead of middle childhood FFS, was recorded because previous studies have demonstrated that the childhood environment in the first 5-7 years of life is more predictive of child outcomes than the environment during middle childhood or early adulthood (Belsky et al., 2012; Simpson et al., 2012; Szepsenwol et al., 2017). Children's HC and health status were measured when they were around 10 years old, and perceived vulnerability to disease and COVID behavioral

control were measured when the children were around 11 years old during the outbreak of the COVID-19 pandemic in 2020. In the present study, our aim was to investigate how FFS, HC, health, and perceived vulnerability to disease interactively affected children's behavioral response to COVID-19.

Method

Participants

A total of 318 children and their guardians participated in this study over a period of five years. The children were recruited through convenient sampling from primary schools and communities in four counties located in the central district of China. In Year 1, when the children were seven years old (M_{age} = 6.96, SD = 0.78), the guardians (68.6% parents, 29.8% grandparents, 1.6% other adults) completed a questionnaire regarding the family's financial status. In Year 4, the children completed a questionnaire regarding their health consciousness and health status. In Year 5, during the COVID-19 outbreak in 2020, the children completed questionnaires regarding their own vulnerability to infectious diseases and their behavioral styles in response to COVID-19. This study was approved by the Institutional Review Board of the authors' university. Verbal consent was obtained from the children for their participation in the study, while the guardians provided their consent by signing a written consent form, indicating their approval for their children's participation as well as their own participation. The participants have the right to decide whether to continue participating in the study, and they can withdraw at any time without facing any consequences.

Confidentiality measures were strictly followed for all collected data. Each participant was assigned a unique ID, and any personal information that could potentially identify them was securely stored in a locked cabinet. A monetary reward was provided to each family as a compensation of time for their participation.

Measures

Family Financial Status (FFS). Each children's family financial status was measured with a 10-item self-constructed scale that focuses on the family's ability to pay for living cost. Guardians rated on a 4-point Likert scale (from *0 never* to *3 almost always*) for how often they were short of money. The ten items were: "not having enough money to see a doctor when sick," "having to bargain for prices while buying," "having to purchase cheaper products of the same kind," "facing situations of unbalanced income and expenses," "struggling to make ends meet," "experiencing unstable incomes," "not having enough money to cover expenses," "being unable to pay all bills on time," "feeling pressured to repay debts if borrowed money from others," and "relying on government subsidies." The items were reversely coded with higher scores indicating better financial status. The internal consistency reliability of this measure is 0.73.

Health Consciousness (HC). We adopted the 9-item Health Consciousness Scale (HCS) to measure how the children monitored and attended to their health conditions. The scale was developed by Gould (1990) and applied to various populations (e.g., Espinosa, 2023; Marsall et al., 2021) including older children and adolescents (e.g., Castonguay et al., 2022; Mushtaq,

2018). Sample items include "I reflect about my health a lot" and "I notice how I feel physically as I go through the day." The children rated on a 5-point Likert scale from *1 not at all describe me* to *5 describes me very well* for each item. Higher scores indicate higher attention to health. The internal consistency reliability of this scale in the present study is 0.89.

Health Status. The children's health status was measured by the general evaluation of one's health condition, using the sum score of two items: "In general my health is..." with the rating scale from *1 very poor* to *5 very good*, and "In the past one month, the number of times that you did not feel well physically" with the rating scale being *1 never* to *6 almost every day*. The second item was reversely coded with higher sum scores indicating better health. The correlation of the two items is $r = 0.44$, $p < .001$.

Perceived Vulnerability to Disease. The 15-item perceived vulnerability to disease scale was adopted to measure one's perceived susceptibility to infectious diseases and aversion to pathogen in contexts where pathogen transmission is likely to occur (Duncan et al., 2009). Sample items include "In general, I am very susceptible to colds, flu and other infectious diseases" and "It really bothers me when people sneeze without covering their mouths." This scale has been applied to older children and adolescents (e.g., Magallares et al., 2015; Prokop & Fančovičová, 2011). The items have been read by schoolteachers and administered to several older children aged 10-11 to ensure that the wording of the scales was comprehensible to this age group. The children rated on a 7-point Likert scale from *1 strongly*

disagree to *7 strongly agree* for each item. Higher scores indicate more vulnerable to disease. The internal consistency reliability of this scale is 0.75.

COVID-19 Behavioral Control. A total of 6 items were adopted to measure the children's hygiene behaviors (e.g., "wearing face masks when going out") and information checking (e.g., "news about the spread of the COVID-19"; Lu et al., 2022) during the COVID-19 pandemic. The children rated the frequency in the past two weeks for each item on a 4-point scale ranging from *1 once a week or fewer* to *4 multiple times a day*. Higher scores indicate a behavioral style being more risk-averse and vigilant to COVID-19. The internal consistency reliability of this measure is 0.74.

Data Analysis

Multiple regressions analyses were adopted to examine the impact of FFS and HC on health status. Additionally, the interactive effects of FFS, HC, and perceived vulnerability to disease on COVID control behaviors were examined. Interaction terms were created by multiplying the standardized scores of the predictors. In the case of a significant interaction, a simple slope analysis was conducted to examine the relationships between a predictor and the outcome variable when the moderator was high (1 standard deviation, SD, above the mean) and low (1 SD, below the mean). This analysis provided insights into how the predictor's effect on the outcome variable varied based on the level of the moderator.

Results

Descriptive statistics of all variables and their correlations are shown in Table 1. We examined whether family financial status (FFS) would moderate the relationship between health consciousness (HC) and health status. Results showed a significant moderating effect (β = -0.18, p = .001, 95% Confidence Interval (C.I.) = [-.28, -.07]). Specifically, when FFS is high, children's HC is unassociated with their health (β = 0.08, p = .31, 95% C.I. = [-.07, .23]), whereas when FFS is low, children's HC is associated with their health status (β = 0.43, p < .001, 95% C.I. = [.29, .47]; Figure 1). These results suggest that for children whose family economic status is not good, their health consciousness predicts health status and therefore, increasing children's concerns and care on their health would help improve their health conditions.

We also examined how FFS, HC, health, and perceived vulnerability to disease would affect children's behavioral control in response to the COVID-19 pandemic. The results revealed a main effect of health status, indicating that children with better health demonstrated more COVID control behaviors (β = 0.13, p = .036, 95% C.I. = [.01, .25]). There was also a marginal main effect of perceived vulnerability to disease (β = 0.12, p = .063, 95% C.I. = [.00, .24]), suggesting that children who perceived themselves as highly vulnerable to disease displayed more COVID control behaviors. Additionally, a two-way interaction between FFS and perceived vulnerability to disease (β = 0.14, p = .035, 95% C.I. = [.01, .27]) indicated that the impact of perceived vulnerability to disease on COVID control behaviors was significant among children from fluent families, but not among those from less

fluent families. Furthermore, a three-way interaction between FFS, HC, and perceived vulnerability to disease (β = 0.13, *p* = .041, 95% C.I. = [.01, .25]). Simple slope analyses showed that when HC is high, there is an interaction between FFS and perceived vulnerability to disease (β = 0.20, *p* = .006, 95% C.I. = [.06, .35]; Figure 2a). More specifically, when FFS is high, perceived vulnerability to disease is positively associated with COVID behavioral control (β = 0.35, *p* = .001, 95% C.I. = [.16, .55]) whereas when FFS is low, perceived vulnerability to disease is unrelated to children's behavioral (β = -0.12, *p* = .380, 95% C.I. = [-.37, .14]). When HC is low, there is no interaction between FFS and perceived vulnerability to disease (β = -0.04, *p* = .636, 95% C.I. = [-.21, .13]; Figure 2b). The results indicate that, in general, children with better health status or a higher self-perceived vulnerability toward infectious diseases tend to exhibit greater behavioral control in response to the COVID-19 pandemic. Moreover, the relationship between perceived vulnerability to disease and behavioral control is influenced by children's health consciousness and family economic status. It is noteworthy that if children do not prioritize their health, the impact of perceived vulnerability to disease and family economics on their response to COVID-19 is diminished. However, when children are concerned about their health, the effect of perceived vulnerability to disease on COVID behavioral control becomes significant, but only among those with good family financial status. Specifically, when health consciousness is high, children from affluent families who perceive themselves as vulnerable to infectious diseases demonstrate more COVID control behaviors. On the other hand, children from less wealthy families exhibit similar levels of behavioral control toward COVID-19, irrespective of their self-perceived vulnerability to disease.

Discussion

This study aimed to examine the impact of FFS and HC on children's health and how these factors, along with perceived vulnerability to disease, interactively influenced their behavioral control in response to the COVID-19 pandemic. Supporting the *first hypothesis*, the results revealed that HC was positively associated with health when FFS was low, whereas HC showed no significant relationship with health when FFS was high. These findings suggest that, for children from less affluent families, but not those from more affluent families, a higher level of health awareness may contribute to better overall health. Moreover, these findings indicate that enhancing HC could potentially improve the health status of children from economically disadvantaged backgrounds. In addition, the results demonstrated that better health or a higher perceived vulnerability to disease was associated with increased behavioral control in response to the COVID-19 pandemic. Notably, a significant three-way interaction was observed among HC, FFS, and perceived vulnerability to disease on COVID control behaviors. Specifically, when HC was high, FFS and perceived vulnerability to disease interactively influenced COVID response. In this scenario, higher perceived vulnerability to disease predicted a greater adoption of COVID control behaviors only when FFS was high. Conversely, when FFS was low, perceived vulnerability to disease did not significantly impact COVID response. By contrast, when HC was low, perceived vulnerability to disease did not significantly affect COVID response, regardless of whether FFS was high or low. These findings suggest that children's perceived vulnerability to

disease influences their behavioral response to the COVID-19 pandemic, but only when they are attentive to their health and come from economically advantaged backgrounds that enable the adoption of costly preventive measures such as purchasing masks and hand sanitizers.

The findings of this study shed light on the significance of HC in determining the health status of children, particularly those with low FFS. These results contribute to a deeper understanding of the impact of FFS on children's health. Existing literature has emphasized the importance of high FFS in maintaining good health among children as children from well-off families can have access to sufficient food and nutrition, quality medical care, and financial support for costly sports activities (see Baharvand et al., 2021; Case et al., 2002; Chen, 2004 for reviews). This finding may be discouraging since children have limited control over their FFS. However, the present study presents an encouraging approach for children from low FFS families. It highlights the potential for improving their health by enhancing their HC. Parents and teachers can educate children to observe and monitor their own health status and maintain vigilance towards any changes in their health. The practical implication of this finding is that, even with limited financial resources, children can adopt simple and low-cost preventive measures to preserve their health. For instance, they can wear an extra layer of clothing to avoid catching a cold or engage in costless exercises to maintain a strong body. Therefore, irrespective of their low FFS, children can still attain a good health status if they develop a heightened consciousness of their health. This finding offers a more optimistic outlook by emphasizing the role of individual health awareness in promoting well-being among children from economically disadvantaged backgrounds.

The results of this study also revealed potential interactions among the risk and protective factors influencing individuals' disease preventive behaviors. Previous studies have primarily focused on how individual or multiple factors within the Health Belief Model such as *perceived susceptibility*, *severity*, *benefits*, *barriers*, *cues to action*, and *self-efficacy*, influence health behavior. However, interaction effects among these various factors have been largely overlooked. For instances, previous research has shown that individuals are more likely to engage in disease preventive behaviors, such as wearing face masks and using hand sanitizers, when they perceived a higher *severity* of COVID-19 (Neto et al., 2021; Tagini et al., 2021), greater vulnerability to COVID-19 (González-Castro et al., 2021), or when they perceive more *benefits* (e.g., being exempted from unnecessary medication expenses) and fewer *barriers* (e.g., easy accessibility to masks) associated with adopting preventive behaviors (Fathian-Dastgerdi et al., 2021). However, very few studies have examined the interaction effects among different factors on health behavior, with only a handful of exceptions exploring how *self-efficacy* (González-Castro et al., 2021) or *cues to action* (Han et al., 2019; O'Connor et al., 2014) interacted with *perceived susceptibility* in affecting health behaviors. For example, O'Connor et al. (2014) reported that individuals with a higher perceived vulnerability to disease were more likely to seek help for the sake of their health, but this effect was observed only among individuals with high health consciousness. The present study further revealed that perceived *barriers* (e.g., FFS) interacted with *cues to action* (e.g., HC) in moderating the relationship between *perceived susceptibility* and adoption of health behaviors. Specifically, when health consciousness was high, facilitating the easy perception of cues related to health, and there were fewer barriers

to taking action (such as a high financial status in this study), a positive relationship emerges between perceived vulnerability to disease and behavioral response to COVID-19. On the other hand, when barriers to action existed (e.g., a lack of financial support to take any action), children's adoption of health behavior was unrelated to their perceived susceptibility to disease. By contrast, when health consciousness was low, children's health behavior was unrelated to perceived vulnerability to disease, FFS, or their interaction. These results supported the *second hypothesis* (i.e., a two-way interaction between FFS and perceived vulnerability to disease) and the *third hypothesis* (i.e., a three-way interaction between HC, FFS, and perceived vulnerability to disease). One possible explanation for the additional moderating effect of FFS is that the availability of economic resources enables children to engage in a wider range of proactive actions, ranging from costless measures like maintaining distance from crowds to more costly ones like purchasing masks and hand sanitizers. This broader range of options allows for a greater variation in COVID control behaviors, contingent upon the perceived vulnerability to disease. This effect of FFS aligns with existing studies that have shown individuals in poor economic conditions generally tend to forgo COVID preventive behaviors, such as purchasing pandemic prevention materials (Shin et al., 2021) or seeking COVID-related information online (Guo et al., 2021). In our study, perceived vulnerability can only exert an influence on COVID control behaviors when children demonstrate a heightened concern for their health and possess the necessary resources to afford proactive actions. The practical implication of these findings underscores the interplay of various health-related factors in promoting children's disease control

behaviors. A heightened awareness of children's health enables the influence of other health-related factors in shaping their disease control behaviors.

The findings of our study also revealed that children with better health status exhibited more COVID control behaviors. Intuitively, one might assume that individuals with poorer health would invest more effort in dealing with infectious situations to maintain their physical well-being. Similarly, a previous study reported that better health could lead to less adaptive behaviors during the pandemic (Stangier et al., 2022). However, the results of our study appeared counterintuitive, demonstrating that children with better health actually engaged in more control behaviors in response to the COVID pandemic. One possible explanation is that children with better health status come from wealthier families, enabling them to afford the costs associated with preventing COVID disease. These costs include purchasing masks and hand sanitizers, as well as accessing TV and the internet for searching COVID-related information. Additionally, children with better health may have higher HC that motivates them to maintain vigilance about their health status (Gould, 1990) and engage in regular exercise to maintain their well-being (Piko and Bak, 2006; Zhou and Krishnan, 2019). Higher HC also motivates children to perform more preventive behaviors against diseases (Lee et al., 2018; Pu et al., 2020). Therefore, our observation that children with better health status were more likely to engage in COVID control behaviors can be attributed to these factors. The practical implication of this finding is that we should not assume that individuals with lower health would naturally exhibit greater concern for their physical well-being and engage in more disease control behaviors. Therefore, it is important to pay closer attention to individuals with lower health when promoting disease prevention behaviors. By recognizing

that individuals with better health are already engaging in more disease control behaviors, efforts can be directed towards providing support and resources to those with lower health to ensure they are equally empowered to take preventive measures.

There are several limitations of this study. First, data of perceived vulnerability to disease were collected during the outbreak of the COVID-19 pandemic, possibly leading to a high attention to infectious diseases. Should the perceived vulnerability to disease data had been collected before the outbreak of the COVID pandemic, the data could better represent the participants' self-perceived susceptibility to disease at normal time. Secondly, while FFS captured economic information during children's early childhood, it did not account for their economic condition specifically during the COVID-19 pandemic. Given the prevalence of unemployment and downward economic conditions experienced by many families during this period, future studies could examine the impact of current FFS on children's health and related behaviors. Third, perceived vulnerability to disease includes two distinct components, germ aversion and perceived infectability disease, representing emotion-based and belief-based perception of vulnerability to disease, respectively. We did not disentangle these two components in the main analyses. However, we performed further analyses to examine the effect of these two components separately in the supplementary materials. Previous studies have shown that germ aversion, rather than perceived infectability, significantly influences behavioral response to the COVID-19 (Church et al., 2022; Prawira et al., 2022). This can be partly attributed to germ aversion being an intuitive appraisal of transmission risks (Duncan et al., 2009) and closely associated with direct experiences and emotions related to previous infections (Treharne et al., 2022). Our further analyses have also revealed that germ aversion,

in general, influences COVID control behaviors, while perceived infectability, which represents a rational appraisal of infection risks (Duncan et al., 2009), interacts with FFS and HC in determining COVID control behaviors (refer to supplementary materials). Future research should explore how the belief-based perception of vulnerability to disease interacts with other potential predictors in influencing disease control behaviors. Fourth, COVID-19 control behavior is a special type of disease preventive behavior as it involves an instant response to the outbreak of a worldwide infectious disease, and it is nonintrusive compared to methods like taking vaccines (Wong et al., 2021). The behavior is sometimes costly because of purchase of anti-pandemic items which are necessary for preventing the disease. The results of this study may not be able to be generalized to other preventive behaviors to diseases which are chronic and possibly preventable with long-term unexpensive exercises. Future studies can investigate other health behaviors. Despite these limitations, the present study is among the first ones that revealed how children's behavioral response to the COVID-19 pandemic were interactively influenced by their family financial status and personal traits related to health.

Conclusion

Health consciousness influenced the health status of children from less affluent families, but not those from more affluent families. This finding suggests that for children who have limited resources to maintain good nutrition and health, fostering their health consciousness can empower them to take cost-free actions that improve their health status. In addition,

children's perceived vulnerability to disease affected their health behaviors, including their COVID control behaviors. However, this effect was only observed when children had high health consciousness and came from affluent families. These children, who cared deeply about their health and had abundant resources, were able to adapt their COVID control behaviors based on their perceived vulnerability to disease.

Data availability statement. The data that support the findings of this study are openly available in Open Science Framework at https://doi.org/10.17605/OSF.IO/P6CUV

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Table 1. *Means, Standard Deviations, and Correlations of Variables used in the Study*

	1	2	3	4	5
1. Family Financial Status	-				
2. Health Consciousness	.10†	-			
3. Health Status	.12*	.27***	-		
4. Perceived Vulnerability to Disease	.05	.11†	-.05	-	
5. COVID-19 Behavioral Control	.00	.03	.12*	.16**	-
Mean	1.92	3.40	8.92	3.91	3.02
Standard Deviation	.49	.96	1.78	.83	.71

† $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

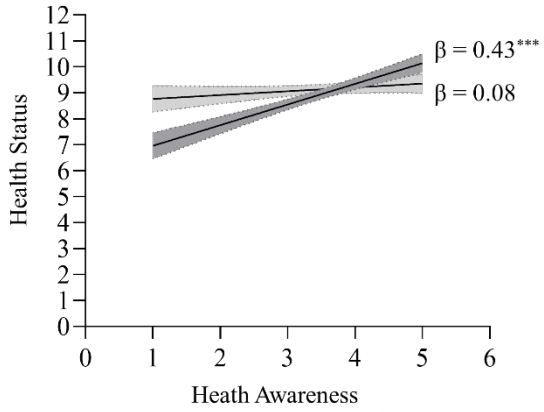

Figure 1. Simple slopes and 95% confidence bands of the regression of health status on health consciousness at 1 SD above (light) and 1 SD below (darkened) the mean of family financial status.

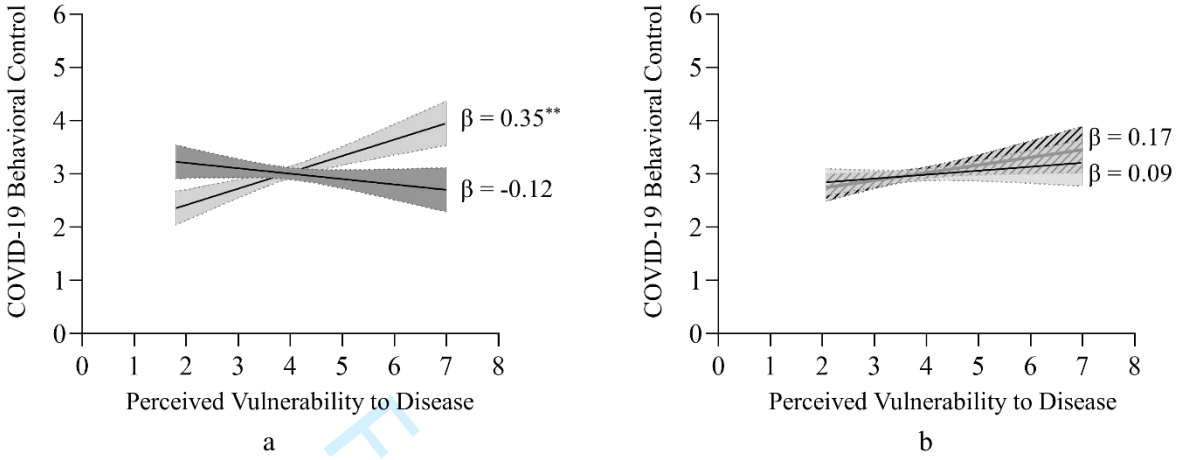

Figure 2. Simple slopes and 95% confidence bands of the regression of COVID-19 behavioral control on perceived vulnerability to disease at 1 SD above (light) and 1 SD below (darkened or slash) the mean of family financial status when health consciousness is high (Figure 2a) or low (Figure 2b).

Supplementary Materials

Separate Data Analysis for *Germ Aversion* and *Perceived Infectability* Subscales in the Perceived Vulnerability to Disease Scale.

For *Germ Aversion*, we conducted a multiple regression analysis to examine its impact, along with those of Family Financial Status (FFS), Health Consciousness (HC), and their interactions on children's behavioral control during the COVID-19 pandemic. The results revealed a significant main effect of germ aversion only (β = 0.19, p = .001, 95% C.I. = [.08, .30]), without any other main effects or interactions. This finding indicates that children with a higher aversion to germs exhibited greater COVID control behaviors, irrespective of their family financial status or health consciousness.

For *Perceived Infectability*, a similar multiple regression analysis showed a three-way interaction between it, FFS, and HC (β = 0.14, p = .014, 95% C.I. = [.03, .26]). When HC is high, simple slope analyses revealed an interaction between FFS and perceived infectability (β = 0.22, p = .017, 95% C.I. = [.04, .41]). Specifically, when FFS is high, there is a positive association between perceived infectability and COVID behavioral control (β = 0.26, p = .015, 95% C.I. = [.05, .47]). However, when FFS is low, perceived infectability is not significantly related to children's behavioral control (β = -0.18, p = .192, 95% C.I. = [-.46, .09]). Conversely, when HC is low, there is no interaction observed between FFS and perceived infectability (β = -0.07, p = .426, 95% C.I. = [-.24, .10]; Figure S1). The results indicated that when children are

not particularly concerned about their health, the combination of perceived infectability and family economics does not significantly impact their response to COVID-19. However, when children exhibit higher levels of health consciousness, the influence of perceived infectability on COVID behavioral control is contingent upon their family's financial status. Specifically, among children with good family financial status, those who perceive themselves as more vulnerable to infectious diseases tend to demonstrate more behavioral control in response to COVID-19. On the other hand, children from less affluent families exhibit similar controlling behavior towards COVID-19, regardless of their self-perceived infectability.

These findings suggest that Germ Aversion and Perceived Infectability may serve different roles in predicting COVID control behaviors. Germ aversion is associated with strong emotional responses, such as disgust and anxiety towards germs and disease (Duncan et al., 2009; Makhanova and Shepherd, 2020). It drives disease control behaviors regardless of the situation. On the other hand, perceived infectability reflects rational beliefs about the likelihood of being infected and does not play a central role in driving health behaviors (Church et al., 2022). However, it may influence health behavior in specific circumstances. In our study, we found that perceived infectability interacted with family financial status and health consciousness among children. When children had a high level of health consciousness, indicating they cared about their health, and came from affluent families, meaning they had the resources to take preventive actions, their belief in their susceptibility to infection influenced their disease control behaviors.

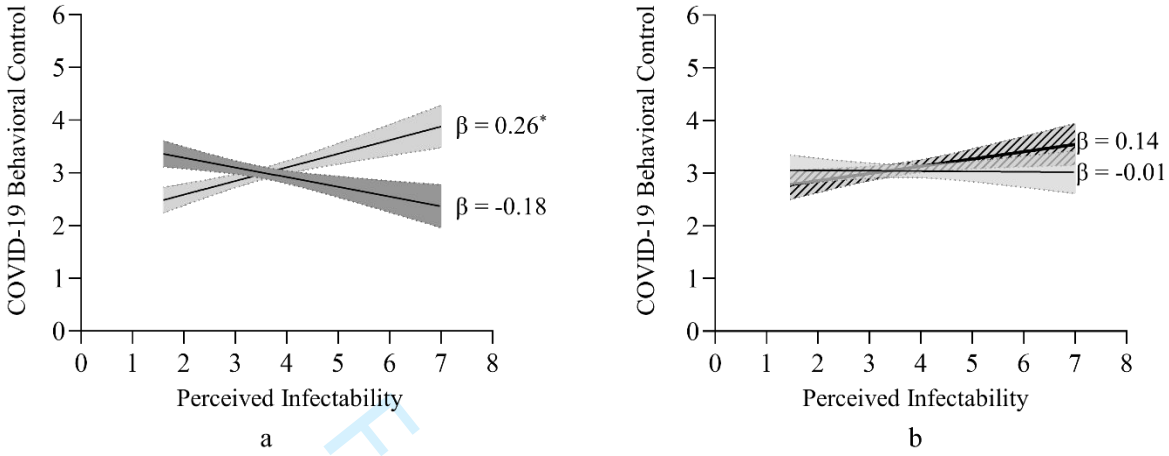

Figure S1. Simple slopes and 95% confidence bands of the regression of COVID-19 behavioral control on perceived infectability at 1 SD above (light) and 1 SD below (darkened or slash) the mean of family financial status when health consciousness is high (Figure a) or low (Figure b).