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"Becoming a shield under a leaky umbrella": a phenomenological study of mothers' experiences caring for preschool children in high fine-dust environments

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ABSTRACT

Purpose: This study explores mothers' lived experiences of caring for preschool children (aged 3–6) in environments affected by fine dust. The study aims to uncover how mothers perceive their protective roles and navigate challenges stemming from environmental health concerns.

Methods: A descriptive phenomenological design guided by Colaizzi's method was employed. Nine Korean mothers with active fine-dust–protection behaviors participated in semi-structured, in-depth interviews conducted between April 2020 and March 2021. Data collection continued until saturation.

Results: Analysis yielded 455 significant statements, 109 formulated meanings, 34 themes, 14 theme clusters, and five overarching categories. The core phenomenon, "Becoming a shield," encapsulates the mothers' relentless commitment to protecting their children. Key themes include awareness of fine dust health risks, active problem solving, serving as a protective barrier, confronting practical limitations, and embracing innovative strategies.

Conclusion: Findings underscore the need for tailored fine-dust response guidelines and educational programs that integrate accurate environmental health information with psychological support for mothers. Healthcare practitioners and policymakers should develop interventions enhancing maternal self-efficacy and resilience, thereby promoting sustained protective behaviors and safeguarding child health in polluted environments.

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Fine dust; maternal experience; preschool child health; phenomenology; environmental protection

Background

Fine dust (particulate matter, PM) is one of the major environmental issues that threatens health to the extent that it has been designated as a Group 1 carcinogen by the International Agency for Research on Cancer (International Agency for Research on Cancer, 2013). It causes cardiovascular disease, respiratory disease, and cancer, increasing mortality worldwide (World Health Organization, 2024). The South Korean government enforced the Special Act on the Reduction and Management of Fine Dust on February 15, 2019 (Special Act on the Reduction and Management of Fine Dust, 2024). By this law, children are defined as a vulnerable group to fine dust, and the government must include in its policies measures to protect vulnerable groups, including children.

Compared to adults, children have a higher respiratory rate per minute proportional to body weight and tend to breathe through their mouths and noses, unlike adults who primarily breathe through their noses. Thus, children can inhale relatively larger amounts of pollutants (Darrow et al., 2014; Lee, 2021). At birth, a child's lungs are immature, with alveoli and epithelial cells developing gradually (Butler et al., 2012; Korten et al., 2017). Exposure to fine dust carries the risk of permanent and fatal harm to children (Gruzieva et al., 2013). Fine dust is directly associated with respiratory illnesses in children. PM10 exacerbates asthma symptoms in children (Jinzhun et al., 2019), and high concentrations of PM2.5 have been associated with

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increased emergency room visits and hospitalizations for upper respiratory tract infections and pneumonia in children (Liu et al., 2019; Wu et al., 2021).

Children aged 3–6 years are vulnerable to fine dust but cannot perform health behaviors independently. Maternal care during this period directly influences children's health, and mothers can serve as role models for forming healthy lifestyle habits later in life (Coto et al., 2019). Furthermore, children aged 3–6 years have high physical energy and desire active outdoor play (Lee et al., 2017). During outdoor play, they are exposed to atmospheric fine dust, and enhanced activity intensity and respiratory rate increase the amount of fine dust inhaled (Christian et al., 2022). Therefore, mothers must perform multiple roles in caring for and educating their children to protect them from fine dust exposure and ensure their healthy growth.

Thus, there is a need for in-depth research into the experiences of mothers caring for their children in fine-dust environments. However, existing studies have focused on quantitative research regarding parental and teacher perceptions of outdoor activities during fine dust events (Kim & Jin, 2019) and parental perceptions related to forest experiences (Kang, 2019). In the study examining the knowledge and coping behaviors related to fine dust among parents raising children under 12 years of age, parents' coping behaviors were only quantitatively measured by using guidelines provided by the Ministry of Environment of Korea (Kwon & Kim, 2020). These quantitative studies do not reveal parents' specific actions toward their children. Therefore, this study explores the experiences of mothers caring for children and concerned about the new environmental problem of fine dust by describing and examining their experiences according to their expressions using Colaizzi's method (Colaizzi et al., 1978).

Materials and methods

Study design

This descriptive phenomenological study applied Colaizzi's method (Colaizzi et al., 1978) to explore the lived experiences of mothers caring for children aged 3 to 6 years in a fine-dust environment.

Participants

Participants were mothers of children aged 3 to 6 years who attended kindergarten or daycare and had experience caring for their children in relation to fine-dust exposure. Eligible participants expressed interest in environmental issues and had actively engaged in behaviors aimed at protecting their children from fine dust. Mothers who had primarily resided outside Korea within the previous six months were excluded due to limited domestic exposure. Additionally, children identified as high-risk neonates or diagnosed with respiratory conditions requiring routine medication were excluded, as maternal caregiving responses might have reflected pre-existing health concerns rather than environmental factors. Recruitment was conducted online via posts in one nationwide parenting café (approximately three million members) and two local cafés in the researcher's residential area. Two participants were recruited from the nationwide café, five from local cafés, and two through snowball sampling, resulting in a total of nine participants.

Data collection

In-depth interviews were conducted between April 2020 and March 2021. The research timeline was extended due to COVID–19-related limitations. Each interview began with the prompt, "What is your experience of caring for your child in a fine-dust environment?" Participants were given semi-structured interview questions beforehand to help stimulate recall of relevant experiences. The questions were structured around the characteristics of the phenomenological interview proposed by Seidman, which involved establishing the context of the participants' experience, reconstructing the details, and reflecting on the meaning of the experience (Seidman, 2009). The context of the experience was established by asking questions about what sparked their interest in fine dust, how they obtained information, and what they were actually doing to protect their children from the fine dust. Participants were encouraged to

reconstruct their experiences by asking about the impact of fine dust on their daily lives, the difficulties they faced, their family's reactions, etc. The questions continued to encourage reflection on the meaning of the experiences revealed through the interviews. Interviews were conducted using open-ended formats to facilitate free expression. Initial interviews were conducted face-to-face, lasting an average of 90 minutes (range = 50–110 minutes). Based on initial analysis and data saturation, follow-up interviews were conducted with eight participants (three face-to-face, three by phone, and two via messenger). Face-to-face and phone interviews were recorded and transcribed, including nonverbal data. Messenger interviews were transcribed verbatim.

Analysis

Data analysis followed Colaizzi's phenomenological framework. The interviews were recorded and transcript using MS Word, and the data were systematically managed in MS Excel. Each transcript and recording were thoroughly reviewed to identify thematic content that captured the essence of the participants' lived experiences. Colaizzi's phenomenological method (Colaizzi et al., 1978) was chosen because it allows the researcher to preserve the authenticity of participants' linguistic expressions while systematically identifying the common attributes shared among their experiences. This approach was considered appropriate for revealing the essential structure of the phenomenon while maintaining fidelity to participants' original meanings. Significant statements were extracted, generalized, and formulated into thematic representations. These meanings were organized into themes, theme clusters, and overarching categories. A total of 455 meaningful statements were analyzed and organized into 34 themes across 5 categories. To enhance the study's credibility, participants validated the significant statements, confirming that the findings accurately reflected their experiences. Furthermore, the process of analysis was reviewed by researchers with extensive experience in qualitative research to ensure rigor and trustworthiness. Coding was conducted in Korean, and themes and quotes were professionally translated into English to ensure accuracy. To minimize researcher bias, bracketing was employed, allowing for suspension of prior assumptions and greater focus on lived experiences (Bae, 2014). Trustworthiness was enhanced by adhering to the criteria of credibility, transferability, dependability, and confirmability outlined by Sandelowski (1986). The study complied with the COREQ reporting standards for qualitative research.

Ethical consideration

Ethical approval was obtained from the Institutional Review Board of Chung-Ang University (Approval No. 1041078–202002-HRSB–027–01). Written informed consent was secured from all participants. They were informed of their right to refuse or withdraw from the study at any time without consequences. Anonymity and confidentiality were maintained throughout the research process. All research procedures involving human participants were conducted in accordance with the ethical standards outlined in the Declaration of Helsinki.

Results

The mean age of the participants was 36.7 years, and the number of children ranged from 1 to 3. The lived experience of mothers caring for children aged 3 to 6 years in a fine-dust environment was characterized as "becoming a shield." Mothers viewed themselves as protective figures against fine dust, which they perceived as a threat to their children's healthy development. Despite their efforts, they felt as though they were using a "leaky umbrella," recognizing the realistic limitations of their ability to fully shield their children. The structure of their experience involved accepting these constraints while striving for creative and practical solutions to continue acting as a shield (see Table 1).

Table 1. The categories, theme clusters, and themes of the findings.

Categories	Theme clusters	Themes
Perceiving the Harmfulness of Fine Dust to Human Health	Knowing the seriousness of fine dust	Hearing about it through mass media
		Noticing hazy atmospheric conditions visually
	Worrying about the child's health	Child gets sick after fine dust exposure
		The child is a vulnerable being
		Anxiety about getting sick even later
Actively Seeking Information	Checking fine dust concentration	Checking concentration becomes an important part of daily life
		Checking fine dust in other areas as well
		Reconfirming the forecast
	Searching for protection methods	Checking fine dust response guidelines
		Searching for information online
		Sharing information with others
Striving to Become a Shield	Preventing the child's inhalation of fine dust	Restricting outdoor activities
		Mask wearing is basic
		Washing meticulously
	Managing indoor air quality	Thorough cleaning and ventilation
		Using air purifiers
		Preventing indoor entry of fine dust adhering to clothing
	Trying to protect perfectly	Judging levels by strict standards
		Purchasing additional effective products
Realizing Realistic Limitations	Becoming exhausted	Being overwhelmed by increased tasks
		Developing doubts about the effectiveness of coping
	Unable to protect perfectly	No immediate solution available
		Cannot just prevent outdoor activities
	Lack of cooperation from surroundings	Passive attitude of husband
		Insensitivity of grandparents
		Concern about being judged as oversensitive mother
Accepting Limitations and Seeking Breakthroughs	Focusing on what can be done	Choosing sustainable tasks
		Becoming a habit
	Letting go of certain aspects	Becoming lenient towards oneself
		Becoming tolerant of occasional exceptions
	Watching the child's growth	Experiencing the child's healthy growth
		Educating them to cope independently
	Expanding interest to environmental issues	Practicing environmental protection
		Feeling a small sense of accomplishment

Perceiving the harmfulness of fine dust to human health

The experience of knowing the seriousness of fine dust while caring for children aged 3–6 years in a fine-dust environment appeared in two themes: "Hearing about it through mass media" and "Noticing hazy atmospheric conditions visually." Although fine dust particles are not visible, when their concentration in the air becomes dense, they obscure visibility like fog, allowing participants to sense the presence of fine dust vividly. They also learned about the seriousness of the impact of fine dust on health through mass media.

> *"I think I am heavily influenced by the mass media. At some point, the term 'fine dust' started to enter my ears. And once I knew about it, I couldn't ignore it." (Participant 3)*

The experience of worrying about the child's health when exposed to fine dust appeared in three themes: "Child gets sick after fine dust exposure," "The child is a vulnerable being," and "Anxiety about getting sick even later." Children showed symptoms of upper respiratory tract infection when exposed to high concentrations of fine dust. Even if there were no immediate symptoms, participants felt anxious that potential harm might accumulate and arise as the child grew because children are vulnerable beings with weak immune systems susceptible to illness. For this reason, they could not stop worrying about their children's health.

> *"My child has an ear infection (otitis media), and it started with fine dust. About a year ago, when there was a lot of fine dust, the stuffy nose (rhinitis) started, and since then, the chronic ear infection has persisted." (Participant 2)*
>
> *"It's not visible now, but I'm afraid it will accumulate and become a big problem later, so that's why I do [the effort to protect the child] now. I think it's accumulating little by little." (Participant 6)*

"It's heartbreaking for children who have to deal with fine dust since they were young. I think it will accumulate and become a big problem later." (Participant 4)

Actively seeking information

The first piece of information mothers sought to protect their children from fine dust was the level of fine dust concentration. This appeared in three themes: "Checking concentration becomes an important part of daily life," "Checking fine dust in other areas as well," and "Reconfirming the forecast." All participants installed fine dust apps to check the fine dust concentration everywhere and tracked its daily changes.

"I check the fine dust levels every day. The weather forecast immediately shows the fine dust levels. If you look here [shows the widget installed on her phone background], it shows up right away." (Participant 8)
"I installed the app and set the alarm [shows the alarm setting on her cellphone] to come every morning." (Participant 5)
"When I wake up in the morning. I check the level of fine dust every day while looking at the weather." (Participant 2)
"The fine dust level varies greatly depending on the region. If I have a place I need to go, I'll check there too. I also check where my family lives." (Participant 6)

The act of searching for coping methods that participants could actually implement to care for children in fine-dust environments appeared in three themes: "Checking fine dust response guidelines," "Searching for information online," and "Sharing information with others." Participants obtained information through mass media or searched to find more effective coping methods, and shared with others through group chats on mobile messengers.

"Internet search or social media. When my eldest was young, I really used to look it up every night before bed." (Participant 7)
"My friends also share [information] with each other. In group chats. 'Perfect time to ventilate! Right now!,' Or, 'This air purifier is great! This mask is on sale!' Sharing information like this takes up a lot of our conversations." (Participant 2).

Striving to become a shield

Mothers' efforts to prevent the inhalation of fine dust from outside when high concentrations occurred appeared in three themes: "Restricting outdoor activities," "Mask wearing is basic," and "Washing meticulously." When the fine dust concentration is high, participants primarily restricted outdoor activities and emphasized that wearing masks when going out was necessary. After going out, they washed their children more carefully than usual to remove fine dust that might have adhered to their bodies.

"Absolutely mask when going out. No exceptions. If we are in a situation where we absolutely have to go out, put on a KF94 or 80 one.[a mask with a filter that blocks fine dust]" (Participant 2)
"I feel uncomfortable because fine dust will stick to hair and body. I tried to wash it off perfectly." (participant 9)

Mothers' efforts to prevent outdoor fine dust from entering the house appeared in three themes: "Thorough cleaning and ventilation," "Using air purifiers," and "Preventing indoor entry of fine dust adhering to clothing." They wiped floors and window frames with a wet cloth, ventilated at least once a day, and operated air purifiers indoors. While these were routine household chores, they became tasks that had to be performed carefully on days with high fine-dust concentrations. They also washed clothes immediately to prevent fine dust from adhering to them and polluting the indoor air.

"I ventilate often. Even when the fine dust is severe, they say it's better to ventilate, so I ventilate thoroughly once, close it, and run the air purifier. I worked hard. and wet mopping." (Participant 3).
"(on the day with high-concentration fine dust) "I ventilate, close the door, and turn on the air purifier before the children wake up." (participant 4)

Participants' efforts to protect their children even more perfectly by strictly managing fine dust and increasing expenses were expressed through two themes: "Judging levels by strict standards" and "Purchasing additional effective products." Participants judged the dangerous concentration of fine dust more strictly than the official fine dust warnings or advisories issued by the government. They also purchased products claimed to be effective in blocking or removing fine dust (vacuum cleaner filters, fine mesh screens, and clothes refreshers) or purchased additional air purifiers for rooms or cars.

"They say the WHO standard is more sensitive. So I use an app set to the WHO standard. I don't use the Ministry of Environment's 'Good' as the standard." (Participant 1)
"I try to clean thoroughly by using a vacuum cleaner with a water filter. Have you heard of that? A forced ventilation system (showing a ventilation system installed in a window) I feel less stressed after installing this." (Participant 7)

Realizing realistic limitations

This theme was emerged from subthemes of "Being overwhelmed by increased tasks" and "Developing doubts about the effectiveness of coping." Participants complained of being simultaneously physically and mentally exhausted as the number of things they had to take care of increased. One participant compared herself trying to maintain daily life in response to fine dust to a swan constantly paddling its feet to stay afloat on the water. As the removal of fine dust is not visible, they sometimes doubted whether their efforts were effective.

"Just too busy. Too busy to be tired. So much to do. The number of things I need to pay attention to is increasing, isn't it? So I'm so tired. So tired." (Participant 6)
"Since the direct causal relationship isn't clear. I worry that I'm wasting my time. I ask myself, am I expending too much energy?" (Participant 8)

The experience of realizing that they could not perfectly protect their children from fine-dust exposure appeared in two themes: "No immediate solution available" and "Cannot just prevent outdoor activities." Participants said that the occurrence of fine dust would not decrease and seemed likely to worsen. They mentioned that they could not avoid exposure to fine dust without moving their residence, and they even dreamed of immigrating to another country. However, they were accepting the limitations of reality. They chose to selectively restrict their children's outdoor activities, as this would affect their physical and social development. Especially if the fine dust concentration was not extremely high, outdoor activities planned by kindergartens and daycare were allowed.

"I have to think whether to send my kids to daycare for sports day or field trips. If it rains, it gets canceled, but I don't think it was ever canceled because of fine dust. It wasn't canceled, but I can't send them, can I?. Children have their own social lives and have the right to have fun, too." (Participant 5)

Situations where participants could not elicit empathy from others and concern about nervousness appeared in three themes: "Passive attitude of husband," "Insensitivity of grandparents," and "Concern about being judged as oversensitive mother". Participants hoped their husbands would actively respond to fine dust as fathers; nevertheless, they felt disappointed, saying husbands only "react to my requests." It was even more difficult to persuade grandparents to overcome differences in opinion regarding fine dust. In relationships with people outside the family, they worried about appearing to be an oversensitive mother.

"Adults definitely have less sense of caution. Grandmothers and grandfathers just take them out to play even when the weather is bad." (Participant 4)
"I worry if I'm making too much of a fuss about taking care of this. I worry about looking fussy." (Participant 6).

Accepting limitations and seeking breakthroughs

The experiences of participants in selecting a manageable level of coping behavior for the long-term problem of fine dust, consistently performing it in daily life, and the behavior becoming ingrained appeared

in two themes: "Choosing sustainable tasks" and "Becoming a habit." Participants coped with fine dust within the limits of their available time and effort, adopting actions at a manageable and sustainable level.

"I'm so stressed out because I care so much. I think that's why I let go of myself a little bit. Maybe mopping less." (Participant 9)
"I think fine dust has become a part of my life. It's up to me to live even though it's hard. I think it's become a habit." (Participant 1)

One participant used the metaphor of holding a leaky umbrella to describe herself as doing her best to block as much dust as she could, although she could not protect her child perfectly [Figure 1].

"It's raining. But I put an umbrella over my child so they don't get wet. I'm walking with my child under an umbrella, but there's a hole in the umbrella. (Omitted) But I can't stop this rain, the sky. Anyway, although it's a leaky umbrella, I just walk with it.? Just doing as much as I can." (Participant 5).

The process by which participants decisively gave up on things they could not do while coping with fine dust and took a step back appeared in two themes: "Becoming lenient towards oneself" and "Becoming tolerant of occasional exceptions." In the prolonged fine-dust situation, the participants applied slightly more lenient standards to themselves as adults and sometimes went ahead with necessary outings, thinking that one or two exposures would not significantly affect the child.

"I know it's not good for me too, but I rather have to protect the kids more than myself.?" (Participant 4)



Figure 1. Shielding My Child with a Leaky Umbrella. Note: This illustration depicts a mother's profound effort to shield her child from fine dust. Despite the "leaky umbrella" symbolizing the limitations of current protections, she embraces her masked child, embodying an unwavering commitment. The hazy background emphasizes omnipresent environmental threats, highlighting maternal anxiety and resilience.

"Actually, realistically, you can't not send them to kindergarten just because the find dust lever was bad. Then there would be no days to send them. (laughs a little dejectedly) And even on days with outdoor activities, not going out just that one time doesn't make them very healthy either." (Participant 2)

The process whereby participants expected their child's body and immune system to mature as they grew appeared in two themes: "Experiencing the child's healthy growth" and "Educating them to cope independently." Although there were innate individual differences among the children, they felt that their children were getting fewer minor illnesses compared to when they were younger. They were also educating their children to be able to protect themselves from fine dust when they grew older.

"I think they've also gained some immunity as they've gotten a bit older." (Participant 6).
"I hope they do it even if I don't take care of it. They'll do it themselves when they're bigger, right?" (Participant 4)

The participants' experience of realizing that fine dust is ultimately linked to environmental problems and their interest expanding appeared in two themes: "Practicing environmental protection" and "Feeling a small sense of accomplishment." Participants became interested in environmental issues, such as recycling and reducing waste, and participated in it. They felt a sense of accomplishment and satisfaction that they had largely been unable to feel while coping with fine dust.

"I try to do recycling accurately. I remove all the labels from the plastic bottle and remove all the tape from the delivery box and throw it away." (Participant 2)
"I'm trying to reduce the use of plastic. I rarely use straws even though it's hard to carry a multi-use cup every time."(Participant 7)
"I try hard to separate trash well (omitted). It feels rewarding. The trash decreases, and I feel like I've done something." (Participant 1)

Discussion

This study employed a phenomenological experiential research method to explore the experiences of mothers caring for children aged 3–6 years in a fine dust environment. The mothers' experience, as examined through this research, was identified as 'becoming a shield'.

The mothers' fine-dust coping behaviors were based on the "Seven Coping Tips for High Concentration Fine Dust" provided by the Ministry of Environment of Korea (Ministry of Environment of Korea, 2019). Parents of children aged 3–5 years commonly responded to fine dust by avoiding outdoor activities and washing thoroughly after going out (Kim et al., 2017). For those raising children under 12 years, coping behaviors appeared in the following order: personal hygiene management (maintaining cleanliness), interest in fine dust, and restricting outdoor activities (Kwon & Kim, 2020). These coping behaviors were also evident in the present study. Mothers primarily focused on preventing the inhalation of high concentrations of outdoor fine dust by their children and maintaining comfortable indoor air quality. Although the Ministry of the Environment of Korea (Ministry of Environment of Korea, 2019) recommends consuming sufficient amounts of water and vitamins, this behavior was rarely observed in this study and consistently found to have a low level of practice in previous research (Kim et al., 2017; Kwon & Kim, 2020).

The mothers experienced "Becoming Exhausted" while trying to protect their children perfectly from fine dust in this study. Although the damage caused by fine dust is not a health problem with sufficient high severity to feel immediately life-threatening, as it must be dealt with over the long term while maintaining daily life as much as possible, it can be compared with the experiences of mothers caring for children with atopic dermatitis or allergic diseases. The exhaustion experienced by mothers in this study can be understood in a context similar to the burden of caregiving felt by parents of preschoolers with food allergies, who have to spend more time preparing meals and be cautious when going out (Choi, 2018),and the "worn-out life" experienced by mothers caring for children with atopic dermatitis due to excessive housework performed to maintain a clean environment (Lee & Kim, 2018). This prolonged exhaustion and adaptive coping is not unique to the context of fine dust exposure but has also been observed in other studies exploring maternal experiences through phenomenological approaches. This finding also resonates with previous phenomenological research employing Colaizzi's method. Kim et al. (Kim et al., 2018) reported themes such as "Fail to care of two kids," "Body and mind be broken," and "Do our best to

balance work and parenting," which parallel the present subthemes "Becoming exhausted" and "Focusing on what can be done." Likewise, the study about the burden of working mothers (Kim et al., 2013) identified "Burnout and emotional exhaustion" and "Having a sense of comfort for ensuring a better future for her child," which align with "Becoming exhausted" and "Watching the child's growth." Together, these parallels highlight that despite persistent fatigue, mothers strive to reinterpret their challenges and sustain adaptive caregiving for their children.

Planning outdoor activities is a significant obstacle among the various difficulties experienced by mothers. Currently, most children aged three and above in South Korea attend kindergarten and daycare (Kwen & Shin, 2018), and it is recommended to secure sufficient play time of at least two hours during the day,including outdoor play (Korean Institute of Child Care and Education, 2020) However, according to the fine-dust response manuals, outdoor classes should be shortened or restricted when the fine-dust concentration is high. Children aged 3–6 require sufficient physical activity, and children themselves want active play. Mothers also consider active children to be healthy (Christian et al., 2022; Coe, 2020; Munifah & Ivan, 2020). Nevertheless, when the fine-dust concentration rises, planned outdoor activities must be canceled, and children must stay indoors, difficulties such as children's irritability and fights becoming more frequent have been reported (Ji & Kim, 2018). The mothers eventually accepted that they could not simply prevent their children's outdoor activities in long-term fine-dust situations and showed signs of allowing a certain level of outdoor activity.

Mothers living in areas with high fine dust levels showed greater depressive symptoms, which mediated the negative effects on caregiving behaviors (Joo & Chung, 2020). To manage this stress, they adjusted their acceptance of discomfort according to psychological capacity, reflecting psychological flexibility—the ability to accept negative emotions while pursuing valued goals (Hayes et al., 2006). Enhancing psychological flexibility through educational interventions on fine dust could reduce mothers' stress and exhaustion, as similar programs have effectively alleviated stress in parents of children with asthma (Chong et al., 2020). Moreover, mothers reported a sense of accomplishment through environmental protection activities—an emotion that was often limited during periods of intense coping. This increase in self-efficacy positively influenced children's engagement in health-promoting behaviors (Benedetto & Ingrassia, 2018). Such positive experiences may serve as motivating factors for mothers who hold pessimistic views about the future, enabling them to maintain hope and continue caregiving practices to protect their children. This finding is consistent with previous phenomenological studies using Colaizzi's method. A study on mother-to-mother peer supporters (Nakashima et al., 2025) found that engagement in supportive activities fostered renewed confidence and transformation in maternal roles. In a similar context, the mothers derived a sense of mastery and resilience from participating in meaningful environmental actions. Such experiences appear to reinforce self-efficacy and sustain positive caregiving behaviors, even in challenging environmental conditions.

Participants anticipated that their children's maturing respiratory and immune systems would reduce sensitivity to fine dust. They also observed fewer illnesses with age, especially noting that older children experienced improved health after starting school. Exposure coefficients for Korean children were used to estimate children's exposure to environmental pollutants (Risk Assessment Division, National Institute of Environmental Research, 2016). Findings indicated that average daily fine-dust exposure declined as children's age increased. This trend is attributed to the disproportionate growth in body weight compared to respiratory rate—resulting in reduced fine-dust exposure per unit of body weight (Jeong et al., 2021). Additional studies have demonstrated that some children may naturally outgrow food allergies as they age, thereby lowering parental stress (Choi, 2018). These findings suggest that, despite persistent exposure to fine dust, mothers gain reassurance and motivation by witnessing their children's healthy development, placing trust in them, and maintaining hope.

Participants frequently reported fatigue and lethargy while striving to protect their children from fine dust. Interestingly, even those who felt overwhelmed expressed curiosity about how other mothers were coping and showed readiness to adopt better strategies if available. At the same time, many broadened their concerns about environmental issues and found unexpected meaning in contributing, however modestly, to a better future. While they recognized the limitations of addressing such a large problem individually, they nevertheless demonstrated steady commitment in their roles as mothers and grew alongside their children.

Strengths and limitations

While prior research has identified parental awareness and general coping strategies regarding fine dust, it has not adequately addressed the emotional reality of daily caregiving. This study adds significant depth by exploring mothers' lived experiences, using a phenomenological approach to capture the psychological strain and resilience involved in protecting preschool children. Specifically, it introduces the concept of "becoming a shield" and highlights the need for tailored support in environmental health education and maternal mental well-being. By applying Colaizzi's method, the research provides a structured yet empathetic understanding of how environmental stress translates into caregiving behaviors and maternal identity formation.

Like many qualitative studies, this research has certain limitations. It reflects the subjective experiences of a small number of mothers, which makes it difficult to generalize the findings to a broader population. In addition, with the exception of one participant, all others resided in the metropolitan area, where fine dust levels are particularly high. As a result, the study could not capture the perspectives of mothers living in regions with comparatively lower levels of fine dust. Future studies could expand the participants to include diverse social and geographic contexts, or apply longitudinal or mixed-method designs to explore how mother's experience evolves over time.

Conclusion

The participants in this study strived to protect their young children, whose bodies and immune systems were immature, against the uncontrollable health threat of fine dust. Although exposure to fine dust is difficult to prevent at an individual level, participants accepted their limitations, focused on what they could sustain, and expanded their interest in environmental issues to continue caregiving for their children in a fine-dust environment. Based on this study, we suggest the development of tailored fine-dust response guidelines applicable to vulnerable groups and the inclusion of psychological support for mothers in fine-dust education programs to help them cope efficiently with fine dust and care for their children.

Declarations

Ethics approval and consent to participate: This study was approved by the Institutional Review Board of Chung-Ang University (Approval No. 1041078–202002-HRSB–027–01). Prior to participation, all individual participants received an information sheet outlining the study's purpose, procedures, voluntary nature, and their rights, and provided written informed consent through signed consent forms, which were securely stored by the research team.

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Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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