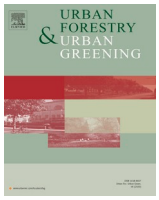
Urban Forestry & Urban Greening 69 (2022) 127497

Contents lists available at ScienceDirect

Urban Forestry & Urban Greening

journal homepage: www.elsevier.com/locate/ufug



Original article

# How to encourage parents to let children play in nature: Factors affecting parental perception of children's nature play

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ARTICLE INFO

Handling Editor: J Jun Yang

*Keywords:*
Childhood nature experience
Urbanization
Parental concerns
Parental permission
Free play in nature

ABSTRACT

Despite the benefits to the children playing in nature being widely recognized, merely enhancing children's interest in nature will not effectively increase their nature experience because children's activity nowadays is increasingly under their parents' supervision. Therefore, to identify effective strategies, it is important to understand parental perceptions of children's nature play and their influencing factors. We explored the impact of factors including parents' childhood nature experience (CNE), nature relatedness (NR), degree of urbanization, and socio-demographic characteristics using the results of an online survey of 516 parents in Japan. We found that most parents acknowledged the importance of children's nature play; however, they expressed their concerns about barriers against it, particularly related to incidents such as accidents and strangers. Although NR and CNE were the key contributors to parents' understanding of nature's benefits, these factors did not decrease their fear of incidents involving their children. Parents were highly unlikely to permit their children to play without adult supervision in green spaces, except parks; this was contrary to the freedom they were given in their childhood. This is probably due to parents' heightened concerns about incidents, even though actual incident rates have been reduced. Therefore, a key approach to encourage parents to allow their children to play in nature is to mitigate their anxiety about incidents. Since parks are the only green space where most parents nowadays allow their children to play unsupervised, enhancing the quality of natural elements in the parks will enrich children's interaction with nature, while alleviating parents' uneasiness about children's safety.

## 1. Introduction

Children's play in nature is accompanied with a raft of developmental, health, and social benefits, which have been well documented in previous studies (Keniger et al., 2013; Chawla, 2015). Research shows that engaging in hands-on nature activities has a positive impact on the development of children's abilities in creativity and problem solving, and of their intellect (Berman et al., 2008). Contact with nature also provides ideal opportunities for them to interact socially with other children and adults, which further builds confidence and self-esteem, and improves their interpersonal skills (Burdette and Whitaker, 2005). More importantly, interactions with nature from the early stages of life significantly correlate with emotional bonds and appreciation for the natural world, which strongly influences the environment-friendly behavior in later life (Cheng and Monroe, 2012).

Despite the significant benefits of playing in nature for children's development, their access to nature is rapidly deteriorating in many countries, especially in developed nations (Zhang et al., 2014; Soga et al., 2018a). The root causes of this trend are associated with the loss of *opportunity* and loss of *orientation* (Soga and Gaston, 2016), which are linked to urbanization and urban lifestyle, respectively (Schuttler et al., 2018). Although the decline in natural environments in urbanized areas has considerably contributed to the reduced access to nature in current society, children's gradual loss of interest in nature seems to be a stronger driver in their declining engagement with it (Soga and Gaston, 2016). These changes affect childhood experiences, as indoor play activities have become more prevalent than outdoor activities (Frost, 2012; Bento and Dias, 2017).

However, it is a misleading perception that children prefer indoor activities because, in modern society, children's choice of activities are often mediated by their parents (Valentine and McKendrick, 1997). For example, parents' fear of strangers significantly limits their children's mobility and outdoor play (Foster et al., 2014). Given that the children are highly dependent on their parents for their daily activities, merely

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https://doi.org/10.1016/j.ufug.2022.127497
Received 30 April 2021; Received in revised form 28 January 2022; Accepted 2 February 2022
Available online 3 February 2022

enhancing children's opportunities and orientation cannot effectively increase their nature experience. Moreover, previous studies have consistently indicated that parental influences, such as their interest in nature (Sugiyama et al., 2021) and their orientation toward nature (Soga et al., 2018a, 2018b;Chawla, 2007; Cheng and Monroe, 2012), significantly contribute to children's connection with the natural environment. Promoting parental support for children's nature play, therefore, could be a promising strategy to reverse the downward trend of nature experience.

To enhance parents' encouragement of children's play in nature, it is critical to understand their opinions in this regard (e.g., their thoughts on the importance of nature play for their children's development and their concerns regarding the barriers against it) and the factors affecting their perceptions. For example, parents' belief in the benefits of nature may foster a child's bond with the natural environment (Ahmetoglu, 2019). In contrast, if parents themselves lack understanding of the importance of nature, have little familiarity with nature, or are greatly concerned about the barriers to outdoor play, they are less likely to expose their children to the natural environment (Louv, 2008). However, studies on parental perceptions and influential factors are sporadic. Few studies have suggested the factors affecting parental support for children's nature play, including their emotional connection with nature (McFarland et al., 2014), childhood nature experience (Bixler et al., 2002; Cheng and Monroe, 2012), the degree of urbanization (Lopes et al., 2014), and socio-demographic characteristics (Ahmetoglu, 2019). The extent to which these factors contribute to parental perceptions regarding the importance of and barriers to children's nature play remains unknown. Additionally, there is a growing concern in many developed countries that parents' pessimistic perception of barriers in the outdoor environment prevents their children from freely exploring nature. The decline over generations in the freedom provided to children to play in nature has been documented in the US (Gaster, 1991) and certain European countries, such as Norway (Skar et al., 2016b) and England (England and Marketing, 2009), while such information has not yet been reported in non-Western developed countries such as Japan. Since free play is an essential factor in nurturing children's interest to connect with nature (Skar et al., 2016a, 2016b), it is important to understand the level of parental permission for children's free play in nature and the factors that influence it.

In this study, we aimed to understand parental perceptions of children's nature play and identify their influential factors in Japan. Based on previous studies, the investigated factors were parents' nature relatedness (NR) and childhood nature experience (CNE), socio-demographic factors of parents and children, and the degree of urbanization. To achieve this goal, we conducted a questionnaire survey of parents with children in primary school. We asked how parents perceive the benefits that emerge from children's nature play (Importance) and what prevents them from exposing their children to nature (Barriers). We also investigated for any reduction in parental permission for children's free play in nature (Permission) between participants (current generation) and their parents (previous generation) in Japan, and explored the motives behind their permission.

## 2. Methods

### 2.1. Study participants and research ethics

An online-based survey was conducted via the research company, Macromill Inc., Tokyo, in July 2020. As of 24 January 2022, the company managed over 10 million monitors (http://macromill.com/). The monitors were similar to respondents participating in other nation-wide surveys such as public opinion polls in most socio-demographics and other characteristics, including frequency of involvement in outdoor activities and environmental concerns, but differed in frequency of Internet use (Macromill, 2013). The company uploaded the questionnaire on their web portal and collected the responses from eligible monitors up to the target number (516 in this study). The eligible monitors in this study were parents who lived in Japan with their primary school-aged children (6–12 years old) at the time of the survey. Participants with more than one elementary school-aged child were asked about their older children.

A total of 516 completed responses were collected as the necessary sample size was calculated as 400, according to Yamane (1967)'s formula with a population size of 6,427,867 children in elementary school across Japan as of 2018 (Ministry of Education, Culture, Sports, Science and Technology, 2018) and 5% of precision level. We collected equal number of samples of mothers and fathers (i.e., 258 for each) to avoid gender bias. This study was approved by the Research Ethics Committee of Hiroshima University, Japan (Permission No. HUIDEC-2020−0020).

### 2.2. Questionnaires and measures

#### 2.2.1. Response variables

*2.2.1.1. Perception.* In this study, nature play refers to outdoor play with animals, plants, soil, and water. Specific examples of outdoor play include climbing trees, catching insects, and picking flowers and fruits.

Four questions about Importance covered the benefits of children's nature play in terms of learning, health, family recreation, and making friends (Table S1). These items were selected from an instrument developed by McFarland et al. (2011) to measure parental attitudes toward their child's outdoor recreation (Cronbach's alpha = 0.89 in their study).

There were 11 items of Barriers, namely: accidents, animal attacks, strangers, unfavorable weather, parents' time constraints, child's time constraints, lack of green spaces, lack of playmates, lack of equipment, lack of interest, and infectious diseases (Table S1). All these items, except infectious diseases, have been consistently reported in research on children and nature interactions for children aged 6–12 years (e.g., Skar et al., 2016b). Parents' concerns about infectious diseases were included due to the emergence of the COVID-19 pandemic from 2020.

Participants were asked to what extent they agreed or disagreed with the items. Response options were gauged using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

*2.2.1.2. Permission.* The following two questions were used to examine differences in Permission between generations: (i) "Do you allow your child to play in green spaces without adults?" and (ii) "Did your parents allow you to play in green areas without adult supervision when you were around your child's age?". We asked about Permission for four types of green spaces: (1) forests or woodlands, (2) parks, (3) rivers or ponds, and (4) paddy fields or farms. These green spaces are common in Japan for nature-related activities (Hosaka et al., 2017a). Responses were coded as 0 = no and 1 = yes. Respondents with answers *"I do not know"* (question (i)) and *"I do not remember"* (question (ii)) for each green space were removed from the sample before analyses.

#### 2.2.2. Explanatory variables

To quantify NR, we asked respondents to indicate their degree of agreement or disagreement (on a five-point scale) on six statements of an NR scale (NR-6) developed by Nisbet and Zelenski (2013).

To measure parents' CNE, we asked respondents to recall their frequency of participation in nature activities and visits to the above-mentioned four types of green spaces during their childhood ($\leq$ 12 years of age). Four main types of nature play were included: (1) catching fish and frogs; (2) playing with grass, flowers, and fruits; (3) climbing trees or playing tag/hide-and-seek using a tree; and (4) touching or catching insects. These nature activities have been common in Japan for at least the past seven decades (Kamihogi, 2009). Respondents provided their answers based on a five-point scale (1 = not at all, 2 = less than once a year, 3 = about once a year, 4 = about once a month, 5 = at least

once a week). Since the Cronbach's α of these items was 0.87, we calculated the mean of the combined items to measure CNE for each respondent.

To calculate the degree of urbanization, we used postal codes of respondents' addresses and calculated the proportion of impervious areas within a 2 km radius of each postal point. This radius was selected because 90 % of the movements of primary school children were within 2 km (Matsushita et al., 2010). Impervious areas include buildings, roads, train lines, and artificial land. Land use data were obtained from the Land Use Fragmented Mesh Data for 2016 (MLIT, 2018). All spatial analyses were performed using ArcGIS 10.3.1, software (Esri Trademarks, USA).

We also asked parents if they have each four green spaces within walking or cycling distance from their homes (i.e. availability of green spaces).

Data on socio-demographic factors for parents and their children were also collected. Parental attributes included educational level, age, household income, and gender. The children's attributes were gender and grade in primary school. The classification for each socio-demographic variable was coded as follows: gender (0 = male, 1 = female), educational background (0 = without university degree, and 1 = with university degree including junior and professional training college), child's grade (from grade 1–6), and annual household income (1 = under 2 million yen to 9 = over 20 million yen).

To ensure respondents' understanding of the questions, and relevance of question items and options, a pilot test was conducted with five parents before implementing the survey on a large scale.

### 2.3. Data analysis

Among the 516 responses, 452 data were complete, representing a validity rate of 87.6 %. The incomplete samples pertained to 64 respondents who replied "Do not know" to the question about their household income; thus, they were excluded from the analyses that included household income.

We conducted an explanatory factor analysis (EFA) to classify the factors of Barriers on scores for each item. To verify the optimal number of groups, we applied the Very Simple Structure method and varimax rotation for maximum likelihood factor analysis. Based on the results of the EFA, 11 items of Barriers were divided into three groups: incident concerns (three items), health concerns (three items), and lack of opportunity (four items) (Table 2).

After EFA, we examined the factors affecting Importance and Barriers using generalized linear models (GLMs) with a Gaussian distribution. The mean scores of all items of Importance and Barriers and those of each incident and health concern were used as response variables in GLMs. The explanatory variables were NR, CNE, degree of urbanization, and six socio-demographic factors. No strong correlations were found among the explanatory variables ($r < 0.28$). We also examined the effects of these explanatory variables on the score of each item of Importance and Barriers using cumulative link models (CLMs).

We considered that certain items of lack of opportunity (that is, child's lack of interest, playmates, time, and green spaces) were unlikely to be explained by parent-related factors; therefore, only children's grade and gender, and the surrounding environment were used as explanatory variables in GLMs and CLMs.

To determine the existence of a significant difference in the proportion of Permission (0 = no, 1 = yes) of children's free play between generations, we performed Chi-square analyses for each type of green space.

To identify the factors affecting Permission, we constructed a GLM with a binomial distribution. Permission for each green space was used as the response variable. The mean scores of the incident and health concerns were used as explanatory variables. Preliminary analyses showed that parents' gender, child's grade, and availability of green spaces significantly affected Permission (Fig. S1, S2, S3), these variables were also included in the GLM to eliminate confounding effects.

We computed standardized regression coefficients for GLMs and CLMs to compare the relative sizes of effect among the explanatory variables. The coefficient of determination ($R^2$) for GLMs with Gaussian distribution, and McFadden's pseudo-$R^2$ for GLMs with binomial distribution, and CLMs were calculated to evaluate model fitness to the data.

All analyses were performed with R 4.0.3 (R Development Core Team, 2020). The packages "psych" and "ordinal" were used for factor analysis and CLM, respectively.

## 3. Results

### 3.1. Descriptive statistics

Most respondents were middle-aged (35–49 years old, 78.5 %), with moderate socio-economic status (annual household income = 4–10 million JPY, 67.7 %), and had a university degree (73.6 %) (Table 1). The proportion of parents with children in grade 4–6 (58.7 %) was higher than that with children in grade 1–3 (41.3 %). The percentage of parents with daughters (52.9 %) was slightly higher than parents with sons (47.1 %). The degree of urbanization around the residents ranged from 1.5%–99.8% (mean = 66.7 %, SD = 25.5).

### 3.2. Perception

#### 3.2.1. Importance and barriers

A significant proportion (≥ 78 %) of parents agreed or somewhat

**Table 1**
Demographic characteristics of the participants and their children (n = 516).

| Variable | Percentage |
|---|---|
| Parent's income | |
| Under 2M | 0.9 % |
| 2–4M | 10.8 % |
| 4–6M | 28.3 % |
| 6–8M | 23.9 % |
| 8–10M | 15.5 % |
| 10–12M | 8.2 % |
| 12–15M | 2.7 % |
| 15–20M | 1.8 % |
| Over 20M | 0.9 % |
| don't know | 7.1 % |
| Parent's age | |
| 25–29 | 0.8% |
| 30–34 | 9.3% |
| 35–39 | 22.9% |
| 40–44 | 33.0% |
| 45–49 | 22.7 % |
| 50–54 | 8.5% |
| 55–59 | 2.3% |
| over 60 | 0.6% |
| Parents' Education | |
| With university degree (including junior and professional training college) | 73.6 % |
| Without university degree | 26.4 % |
| Child's gender | |
| Male | 47.1 % |
| Female | 52.9 % |
| Child's grade | |
| 1 | 13.4% |
| 2 | 14.2% |
| 3 | 13.8% |
| 4 | 18.2 % |
| 5 | 22.1% |
| 6 | 18.4% |
| M: million JPY | |

**Table 2**
Factor loadings (≥ 0.35) for each statement and grouping of barriers based on the Likert scores.

| | Factor1 | Factor2 | Factor3 |
|---|---|---|---|
| *Incident concerns* | | | |
| Accidents | 0.94 | – | – |
| Animal attacks | 0.47 | – | – |
| Strangers | 0.46 | – | – |
| *Health concerns* | | | |
| Unfavorable weather | – | 0.68 | – |
| Infectious diseases | – | 0.54 | – |
| Lacking suitable equipment | – | 0.48 | – |
| *Lack of Opportunity* | | | |
| Child's lack of playmates | – | – | 0.68 |
| Child's lack of interest | – | – | 0.65 |
| Child's time constraints | – | – | 0.44 |
| Lacking green spaces | – | – | 0.42 |
| Parents' time constraints | – | – | – |

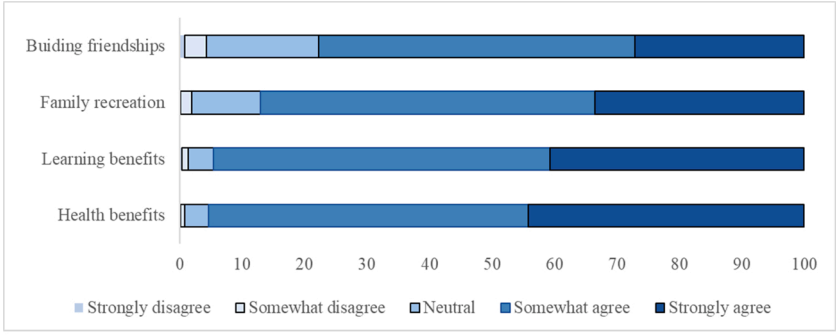
agreed with the four statements of Importance, generating high mean scores (4.2) for all items. The mean score was the highest for health benefits (4.4) and lowest for building friendships (4.0) (Fig. 1a, Table S2).

In contrast, parents' responses to Barriers varied, with mean scores for the suggested items ranging from medium (2.5) to high (4.1). The greatest concerns were related to incidents such as accidents (mean = 4.1) and animal attacks (3.8). The lowest concerns were related to children's characteristics, such as children's time constraints (2.8) and lack of interest (2.5) (Fig. 1b, Table S2).

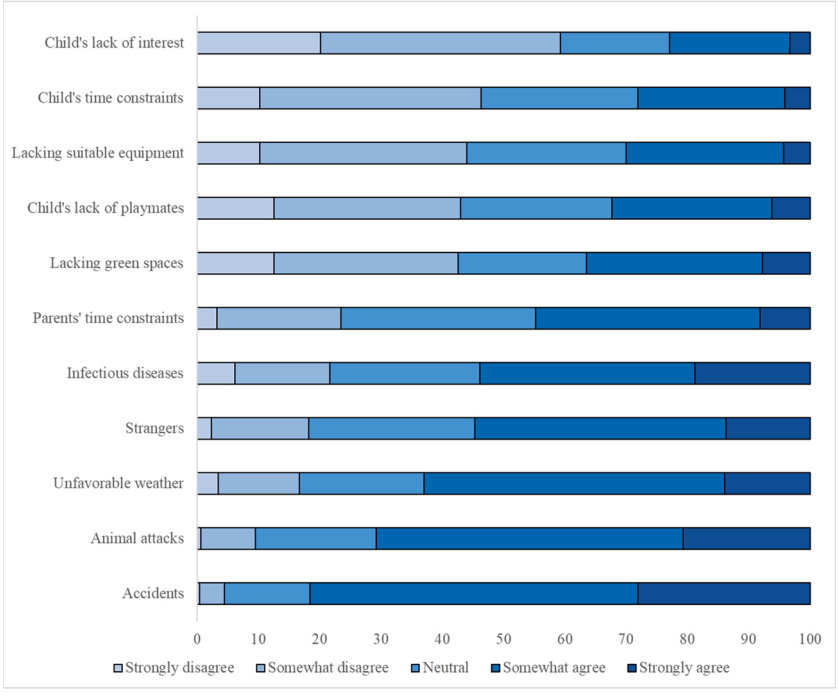
### 3.2.2. EFA of barriers

Out of the 11 barrier items, 10 were classified into three groups based on EFA (Table 2). Items with factor loadings above 0.35 were grouped together. "Parents' time constraint" failed to load on any factor, and thus, did not belong to any group.

The three groups of Barriers were labeled as incident concerns, health concerns, and lack of opportunity. The first group represented parental anxiety about the potential dangers of letting children play in nature, including accidents, animal attacks, and strangers. The second group reflected parents' concerns about environmental conditions that may create health risks for their children, including unfavorable weather, infectious diseases, and lack of specific gear (e.g., suitable clothing to play in nature) that protect children from environmental risks. Lack of opportunities comprised children's lack of interest, friends, time, and green space.




a




b

**Fig. 1.** a Proportions of parental perceptions on importance of children's nature play. b Proportions of parental perceptions on barriers to children's nature play.

#### 3.2.3. Factors affecting importance and barriers

The factors NR and CNE were the most and second most significant, affecting the level of Importance, followed by two socio-demographic factors: child's grade and parents' education (Table 3). Parents' education, NR, and CNE positively affected the mean scores of Importance, while child's grade affected it negatively. Parents' age, income, child's gender, and degree of urbanization were insignificant on Importance.

For Barriers, parents' gender had significant effects on incident and health concerns. Furthermore, CNE was negatively significant for health concerns, but not for incident concerns. Degree of urbanization was significant for lack of opportunity, but not for incident and health concerns except for "infectious diseases" (Table 3). Parents' education negatively affected health concerns. Child's grade was positively correlated with lack of opportunity, particularly to "lack of interest and time" Additionally, NR had a negative impact on "animal attacks." In contrast, parents' age, income, and child's gender revealed no significant correlation with any barrier items.

The model fitness $R^2$ for importance was 0.28, for incident, health, and lack of opportunity concerns were 0.05, 0.09, and 0.04, respectively.

### 3.3. Permission

#### 3.3.1. Differences in permission between generations

According to the participants' retrospective responses, there was a significant difference in Permission between them and their parents (Fig. 2). Most respondents (60–94 %) stated that their parents allowed them to play unsupervised in all studied green spaces when they were in primary school. However, nowadays, only a small proportion (10–22 %) allows their children to play independently in such spaces, except for parks (78 %). Although the percentage of the participants who allowed their children to play freely in parks was the highest than other green spaces, it was nonetheless significantly lower than the level of freedom provided to them in their childhood ($p < 0.001$).

#### 3.3.2. Factors affecting permission

Permission was negatively affected by incident concerns for all green spaces, except in the case of farms (Table 4); however, this was not significantly affected by health concerns. The most significant explanatory variable for Permission was a child's grade for forests and parks, incident concerns for rivers, and parents' gender for farms. Permission was invariably higher in children with higher grades. Mothers' permission was consistently lower than that of fathers. The availability of green spaces had a significant positive effect on Permission in all green spaces, except for parks, though its effect was lower than that of child's grade, parents' gender, and parents' incident concerns. Again, the model fitness, McFadden's pseudo-$R^2$ was not very high for all the models (0.15–0.23).

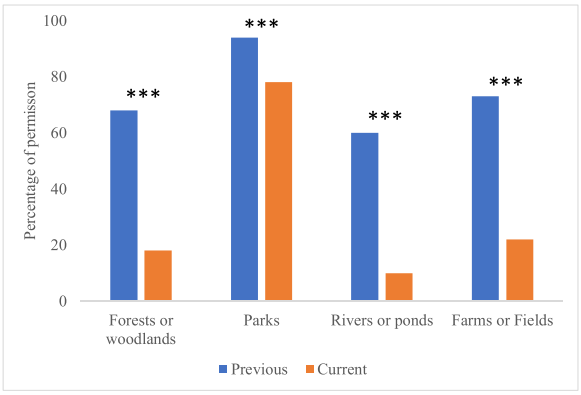



**Fig. 2.** Difference in Permission between two generations (***$p < 0.001$).

## 4. Discussion

### 4.1. Importance and affecting factors

In this study, a substantial proportion of parents surveyed agreed that nature play is beneficial to children. Similar to Chinese parents' perceptions, the most perceived benefit was related to health, followed by learning, family values, and building friendships (Wang et al., 2018). However, this pattern differed from the perceptions of American parents who valued the importance of "quality time with friends and family" for young people in outdoor recreational activities most highly (Larson et al., 2013). Although parents from these various societies and cultures have different perspectives on the importance of the benefits that nature brings to their children, they seem to consistently believe that playing in natural environments contribute to children's healthy growth and development (Gundersen et al., 2016; Larson et al., 2013; Wang et al., 2018). Therefore, high values of children's play in nature may have been common among parents in developed countries. To develop a complete picture of parental recognition of nature's benefits toward their children, studies in developing countries are also required.

Factors affecting Importance corroborate with the findings of previous studies, demonstrating that parents' views of children's nature play are positively associated with their feelings toward the natural world (McFarland et al., 2014), nature experience in childhood (Cheng and Monroe, 2012; Schuttler et al., 2018), and education levels (Ahmetoglu, 2019). In addition to these factors, we found that Importance is negatively correlated with child's grade. Furthermore, our results revealed that the effects of parents' NR and CNE were higher than parents' education levels and child's grade. Hence, strengthening emotional connection and contact with nature from early ages might be an effective approach to increase people's understanding of the benefits of nature play, not only for themselves but also for their children.

**Table 3**
Mean scores and standardized regression coefficients for factors to predict Importance and Barriers and the fitness of the model $R^2$ and Mc Fadden R.

| | Mean | NR | CNE | Urbanization degree | Parent's gender | Parent's age | Household income | Parents' education | Child's gender | Child's grade | R2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Importance | 4.22 | 0.34*** | 0.29*** | −0.01 | −0.03 | 0.02 | −0.04 | 0.10* | 0.01 | −0.14** | 0.28 |
| Barriers | | | | | | | | | | | |
| *Incident concerns* | 3.78 | −0.04 | 0.01 | 0.04 | −0.20** | 0.04 | −0.08 | −0.03 | −0.01 | −0.05 | 0.05 |
| *Health concerns* | 3.27 | 0.01 | −0.19*** | 0.09 | −0.16** | 0.08 | −0.01 | −0.10* | −0.03 | −0.05 | 0.09 |
| *Lack of opportunity* | 2.74 | – | – | 0.13** | – | – | – | – | −0.02 | 0.14** | 0.04 |

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

**Table 4**
Standardized regression coefficients for Barriers to explain Permission and the fitness of Mc Fadden $R^{2.}$

| Green spaces | Incident concerns | Health concerns | Parents' gender | Child's grade | Availability of green spaces | McFadden's pseudo-$R^2$ |
|---|---|---|---|---|---|---|
| Forests or woodland | −0.45** | −0.17 | −0.51*** | 0.67*** | 0.29* | 0.17 |
| Parks | −0.36* | −0.12 | −0.25 | 1.20*** | 0.21 | 0.23 |
| Rivers or ponds | −0.52** | −0.08 | −0.45* | 0.48** | 0.36* | 0.15 |
| Paddy fields or farms | −0.25 | −0.14 | −0.51*** | 0.48*** | 0.47*** | 0.14 |

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

### 4.2. Barriers and their affecting factors

Although highly appreciative of the positive effects of nature on children's play, respondents expressed high levels of anxiety about the negative aspects of children being in nature. Compared with Norwegian parents (Skar et al., 2016b), parents in this study reported higher levels of concern about all the shared barriers. Despite Japan's actual crime rates being lower than Norway's (Nation Master, 2014) and registering a relatively low number of traffic accidents (OECD, 2019), incident-related issues, such as accidents and strangers, are the most common concerns among Japanese parents. This indicates that parents in Japan are more pessimistic about the risk levels of the surrounding environment than those in Norway. Additionally, while unfavorable weather was also a prevailing concern in Japan, this was the least mentioned barrier by parents in Norway. This is likely due to differences in climatic conditions between the two countries; while pleasant summer weather in Norway (the average temperature from 1949 to 2020 was 14.2 °C) is beneficial for children to play outdoors (Worlddata.info), extremely hot weather (> 35 °C) and heat stroke has become common during summers in Japan (Ministry of Environment, Japan, 2018). Conversely, while Japanese parents mentioned their children's time constraints less, this was the key barrier to children's experience of nature in Norway, although, the level of concern between parents in the two countries was similar. Overall, these findings highlight the similarities and differences in parental perceptions between the two countries, which will contribute to understand global patterns of parental perception of children's nature play. The highly perceived barriers of Japanese parents toward children's nature play could be a prime factor negatively affecting their children's natural exposure (V. Truong, unpublished data).

Numerous scientific studies indicate that being familiar with nature can mitigate negative attitudes such as dislike, disgust, fear, and perceived dangers toward nature and wildlife (Soga et al., 2020; Sugiyama et al., 2021; Hosaka et al., 2017a, 2017b, 2018; Bixler et al., 2002). In contrast, people who have fewer experiences in nature tend to overestimate the negative effects of the natural environment (Sugiyama et al., 2021). However, contrary to these earlier findings, we found that NR had no effect on Barriers, and CNE only affected health concerns, although both factors were the main determinants of Importance. Perhaps, frequent contact with nature during childhood can only reduce parents' concerns about the children's health effects but not their fear of incidents. Parents might tend to supervise and protect their children from any state of danger, although the chances of such events occurring are statistically low (Boyd and Hargittai, 2013). Therefore, only promoting parents' NR and CNE may not be effective in reducing their concerns about incidents of their children's exposure to nature.

The most significant concern of parents – incidents, however, was only influenced by parents' gender, suggesting a significant difference in levels of anxiety between mothers and fathers. This finding supports earlier studies indicating that women tend to express greater concern about potentially dangerous environments than men (Hosaka et al., 2017b; Zinn and Pierce, 2002). The difference between mothers and fathers' apprehension may lie in how and how much time parents spend together with their children. According to National Women's Education Center of Japan (National Women's Education Center of Japan (NWEC), 2007), mothers spend more time with children than fathers in Japan, and mothers are primarily involved in childcare activities (e.g., bathing and sleeping). As primary caretakers of children, mothers feel more pressured and tend to be more overprotective to ensure their safety (Valentine and McKendrick, 1997). In contrast, fathers are more inclined to play with their children than mothers do (NWEC, 2007), and tend to stimulate their children to undertake risky but not overly dangerous behaviors (StGeorge et al., 2015). This may lead to less pessimistic views of fathers regarding barriers. Notably, the difference between Japanese fathers and mothers in time spent with their child is greater than in other countries, such as the US, France, Sweden, and other Asian nations (NWEC, 2007), and this may have widened the gap in perception between mothers and fathers in Japan.

Degree of urbanization is also a significant factor hindering parents' exposure of their children to nature. Previous research indicated that the lack of green space in urban areas was the main motive in reducing children's opportunities to play in nature (Soga et al., 2018a, 2018b). Furthermore, our results showed that residents living in more urbanized areas expressed greater concerns about COVID-19 and other infectious diseases. This reflects the high COVID-19 infection rates in densely populated cities at the time of survey. The emergence of the COVID-19 pandemic may be a novel barrier against children's play in urban green spaces. We, however, should note that peoples' concerns toward COVID-19 can drastically change with the changes of pandemic situations and peoples' habituation within a short time (Lin, 2020).

Parents' concerns about their child's time constraints and lack of interest were significantly heightened with children's age. Children's time spent on homework and screen-based activities gradually escalated as their grade increased in Japan (National Institution for Youth Education(NIYE), 2016). The screen-based world seems to turn children inward and contribute globally to children's detachment from the outdoor environment in modern life (Pergams and Zaradic, 2006). The adverse effects of children's academic pressure may be relevant in Japan, where a majority of children (75 % of elementary students and 83 % of middle school students) spend additional hours after school attending extracurricular classes to prepare for their entrance exam for admissions into prestigious universities (NIYE, 2016). Given that a loss of interest in interactions with nature at higher grades is linked to their indifference toward nature in adulthood (Soga and Gaston, 2016), we need to develop effective interventions to promote interest in nature at this age.

### 4.3. Permission and its associated factors

Based on respondents' retrospective reports, there has been a significant decline in parents' permission for children's free play in nature over the past two generations. Similar trends have also been reported in other countries, such as the United States (Gaster, 1991) and England (England and Marketing, 2009). Japanese parents showed higher restrictions in both generations than British parents (England and Marketing, 2009). In particular, 13–27 % of British parents in the previous generation restricted their children's play in woods, farms, rivers, and wild spaces; while for the Japanese, it was 28–40 %. For the current

generation, this restriction significantly increased to 67–86 % in England and 78–90 % in Japan. The difference in the percentage of parental restriction between the two generations ranged from 50 % to 60 % in both countries. However, notably, these retrospective data must be interpreted with caution due to limitations in information accuracy caused by the failure to recall and restructuring of memory (Wells and Lekies, 2006). Ideally, we should use a longitudinal dataset that assesses the level of parents' permission at the time of the survey with the same questions, although such data are rarely available.

The significant decrease in permission between the two recent generations is probably due to its association with the emergence of safety-obsessed culture and parents' concern for their children worldwide (Brussoni et al., 2012; Valentine and McKendrick, 1997). In this study, we found that incident concerns were the main contributors to parents' hesitance in providing their children freedom to play in the investigated green spaces, after controlling the effects of parents' gender or child's grade. In contrast, statistics show that modern Japanese society is safer than before; the number of recorded accidents, including traffic accidents, falling, drowning, and suffocating (Ministry of Health, Labor, and Welfare, Japan 2009), and crime cases involving children (National Police Agency, Japan, 2019) have significantly declined over recent years. The reason behind parents' overestimation of the dangers in the environment in modern society may be attributed to the widespread information in electronic media, which influences public opinion more than the official statistics. Hamai and Ellis (2008), stated that the abundant information regarding crime and victimization involving children has profoundly provoked incident-related fears and concerns among Japanese parents since the late 1990s. Therefore, parents now supervise their children more than before, resulting in free play in childhood becoming less prevalent than in the previous generations. An increase in parents' concerns about children's safety to play in the natural environment could make children more alienated from nature play.

Of the studied green spaces, parents' permission for children to play independently in parks was the highest (78 %), while it was low (10–22 %) for other green spaces. Also, parents are less likely to let their children play in the other green spaces when these are apart from their home. These results depict a clear picture in which parks emerge as the most favorable green spaces for parents to let their children play unsupervised, while untouched natural places (rivers or ponds, forests or woodland), and agricultural areas (paddy fields or farms) were rarely preferred. This trend could be due to the influence of society's desire to protect children from any danger (Guldberg, 2009). As mentioned by certain parents in our interviews, they consider that organized parks are designed for children's safety, and witnessing other children in the parks convinces them to let their children play without supervision.

## 5. Conclusion and future research directions

Our study showed that most parents were aware of the benefits of exposing their children to nature. However, they were reluctant to allow their children to play independently in nature, mainly due to incident concerns about the natural environment. Although having emotional connection and childhood experience with nature were the most important contributors to parents' appreciation of nature play for their children, it did not alleviate their concerns about the likelihood of incidents involving their children. Therefore, today's children are less likely to have freedom to play in nature compared to those a generation ago, although the environmental security has improved.

Since incidents were the most concerning issues for parents in our study, strategies that help alleviate parents' fear of their children's safety are crucial to enhance parental support for children's free play in nature. First, it is important to help parents understand that the current society is much safer than before by updating them about the safety of the social environment. Second, enhancing safety and visibility (e.g., better street lighting and more pedestrian-friendly roads) and improving social cohesion (e.g., having neighborhood watch campaigns and broader communities to guard children) might be efficient measures to mitigate parents' unease about the surrounding environment (Foster et al., 2014). In contrast, it should be noted that recognizing risks and learning how to overcome risks from an early age are necessary for children's development. Thus, promoting parents' recognition of the necessity of children taking appropriate risks for their stage and reducing parents' interference in children's free play is also important (Niehues et al., 2015; Brussoni et al., 2012). Considering incident concerns were more prevalent in mothers than in fathers, it is essential that these strategies are more targeted to assuage mothers' fear, which further improves their confidence to give children more freedom to play in nature. Finally, since parks are where a majority of parents let children play independently, improvement in the quality of natural elements in the parks (e.g., enrichment of vegetation including natural regrowth, retaining fallen leaves and branches, creation of aquatic biotopes, and retaining topographic variation) will be effective in enriching children's interactions with nature, while ensuring safe environments.

Future studies should focus on social, cultural and environmental background of parents' increasing restrictiveness in children's free play in nature and green spaces. Such studies would be beneficial to find more specific solutions to reduce parents' concerns and promote children's free play in nature. Further, this work should be extended to parents in other countries, especially in developing nations, to gain insights into global patterns of parental perception toward children's nature play.

## Data availability

Data will be made available on request.

## Author statement

**Mai Van Truong**: Conceptualization, Data analysis, Writing- Original draft preparation

**Miyabi Nakabayashi**: Data collection, Writing - Review & Editing

**Tetsuro Hosaka**: Conceptualization, Data collection, Writing - Review & Editing, Supervision

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Acknowledgement

We thank the parents for participating in the pilot survey and the interview.

## Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.ufug.2022.127497.

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