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Understanding the associations among parents teaching safety rules to children, safety behaviors and unintentional injuries in Chinese preschool children

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ABSTRACT

Child unintentional injuries are one of the most prominent global health threats and parents may play a vital role in these injuries. This study thus aims to explore the associations of parents teaching safety rules with preschool children's safety behaviors and unintentional injuries. A total of 62,922 children registered at 182 kindergartens in Longhua District of Shenzhen, China during the fall semester of 2016, were included in this cross-sectional study. Their parents were invited to complete a self-administered questionnaire covering information about socio-demographics, parents teaching safety rules to children, child safety behaviors and unintentional injuries. Logistic and linear regression models were carried out to test the associations among parents teaching safety rules, child safety behaviors, and child unintentional injuries. Whether child safety behaviors mediated the relationship between parents teaching safety rules and child unintentional injuries was assessed using Hayes' PROCESS macros for SPSS. Regression analyses revealed that the higher scores of both mothers' and fathers' teaching safety rules to children were significantly associated with the reduced risks of child unintentional injuries and the modest improvements in child safety behaviors, after adjusting for potential confounders. Furthermore, mediation analysis illustrated that child safety behaviors mediated 18.1% of the association between mothers teaching safety rules and child unintentional injuries and 30.3% of the association between fathers teaching safety rules and child unintentional injuries, respectively. These findings suggest that parents teaching safety rules to children is beneficial for mitigating unintentional injury risks among Chinese preschool children through improving child safety behaviors.

1. Introduction

Child unintentional injuries represent one of the most prominent global health concerns (Peden, 2008). According to the World Health Organization, > 2000 children die from unintentional injuries daily across the globe, among which 95% take place in low- and middle-income countries. In China, child unintentional injuries accounted for nearly half of all deaths in children under 5 years of age in 2014 (Xiong et al., 2017). Apart from deaths, tens of millions of children require hospital treatment for non-fatal injuries yearly, which may subsequently result in temporary or permanent disability (Peden, 2008). Young children are more susceptible to unintentional injuries, given that their ability to explore the world is not always matched with their capacity to identify and respond to potential danger (Bartlett, 2002; Garzon, 2005). Therefore, injury prevention and control among young children is especially imperative (Qiu et al., 2014).

Previous evidence suggested that parents played a major role in child unintentional injuries and may reduce the injuries through building safe environments, supervising, and teaching safety rules for children (Morrongiello et al., 2004). By the time children reach around 3 years of age and are becoming increasingly independent, parents begin to shift the emphasis from environmental and supervision strategies to teaching children about safety (Gärling and Gärling, 1995; Mulvaney and Kendrick, 2004; Morrongiello et al., 2006, 2014a, 2014b). Several studies ascertained an association between better safety rules advocated and fewer child unintentional injuries sustained

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(Peterson et al., 1990; Peterson and Saldana, 1996; Stewart et al., 2016). Differently, other studies found that teaching safety rules did not affect or even increased the injury risk to young children if they were incapable of complying with the safety rules (Peterson et al., 2002; Morrongiello et al., 2004, 2014a, 2014b). Thus the exact effect of teaching safety rules to young children on their unintentional injuries was inconclusive. Besides, most prior studies were based on the Western population (Peterson et al., 2002; Stewart et al., 2016), while little was known about the Chinese population. Meanwhile, these studies mostly focused on the maternal samples (Peterson and Saldana, 1996; Morrongiello et al., 2004, 2014a, 2014b) rather than the paternal samples, who were also supposed to play a unique and vital role in their children's behaviors and development (Pougnet et al., 2011; Essex et al., 2013). Only a few studies suggested a potentially independent role for fathers in alleviating the injury risk to their children (Fujiwara et al., 2010).

Furthermore, the behavioral mechanism that underlies teaching and injuries is unknown. Previous studies have tied child behaviors with injures (Potts et al., 1995; Little, 2006; Russell et al., 2016), and proposed that parental teaching contributes to the establishment and change of child behaviors (Becker, 1971; MacGregor et al., 1999; Bjørseth and Wichstrøm, 2016). The above evidence indicated that child safety behaviors may play an intermediary role between parents teaching safety rules and child unintentional injuries. However to date, there is no study that evaluates the mediating role of child safety behaviors.

Therefore, the current study aimed to clarify the relations of parents teaching safety rules, safety behaviors, and unintentional injuries among Chinese preschool children based on a large population-based sample including both parents. We hypothesized that: 1) parents teaching more safety rules would be associated with more safety behaviors and fewer unintentional injuries in preschool children; and 2) child safety behaviors would mediate the association between parents teaching safety rules and child unintentional injuries. This study may provide implications for the development of effective child injury prevention strategies.

2. Methods

2.1. Participants and procedure

This study recruited children attending every grade of kindergartens belonging to the Longhua District of Shenzhen, China in the fall semester of 2016 (aged approximately 3 to 6 years old). Both parents of these children were invited to complete a self-administered questionnaire from October 1st through the 10th in 2016. The questionnaire covered information including social demographics, parents teaching safety rules to children, safety behaviors of children, and child unintentional injuries. After excluding those who either refused to participate or had missing essential information, a total of 62,922 children from 182 kindergartens and their parents were eligible for inclusion in analysis (response rate, 91.1%). This study was approved by the ethics committee of the School of Public Health at Sun Yat-sen University, and all participants provided written informed consent.

2.2. Measures

2.2.1. Parents teaching safety rules to children

The safety rules consisted of 10 items that were commonly encountered in daily life, and each item referred to a separate activity or behavior that a child could potentially perform. Selection of these items were based on recommendations in the literature (Peterson and Saldana, 1996; Morrongiello et al., 2001), knowledge of panel experts and our research team, as well as consideration of the China's featured national condition (including the most commonly encountered safety issues by Chinese children, and the rules that were differently applied in China such as walking on the right-hand side). All items began with the sentence “Have you ever taught your children that …?” (details on items are listed in Supplementary Table), and parents answered “yes” or “no” to each of the above questions. All of the answers from parents were converted to scores (1 = yes; 0 = no). The scores were added up for mothers and fathers respectively, with higher scores indicating higher levels of parents teaching safety rules to children.

2.2.2. Child safety behaviors

The information on how children behave in accordance with the 10 safety rules in everyday life were also collected (items of the corresponding safety behaviors are listed in Supplementary Table). Parents were asked to rate their children's frequency of engagement in each behavior during the past two weeks (i.e., “not at all” or “sometimes [once or twice a week]” or “often [more than twice a week]”). All answers were converted into scores: the following two items (“walk up and down stairs on the right-hand side and slowly” and “know that the police emergency number is 110 and the medical emergency number is 120”) were scored as “1” = “often”, and “0” = “not at all” or “sometimes”; while the remaining 8 items were scored as “1” = “not at all”, and “0” = “sometimes” or “often”. The total score of child safety behavior was then calculated by adding up scores of all items for each individual, where a higher score indicates that the child engages in more safety behaviors.

2.2.3. Child unintentional injuries

Parents were asked to report whether their children had an unintentional injury or not during the past two weeks, and a standardized description of unintentional injury was given to parents. Following the definition by Fang et al. (2015) which was considered acceptable and suitable for use in China, an event is considered as an unintentional injury in the present study if any of the following three events occurred: (a) being treated with unintentional injuries at a hospital; (b) receiving emergency treatment or care from family, teachers, or health care doctors; or (c) being absent from class for more than half of a day because of an unintentional injury. The recorded unintentional injury types included: falls, burns, cuts, electric shocks, and others.

2.2.4. Other covariates

We included the following confounding variables in this study that were suggested to impact on parents teaching safety rules to children, child safety behaviors and unintentional injuries in previous literature, i.e., child's age, gender, Shenzhen household register or not, only-child or not, parental age, parental educational level, and family income.

2.3. Statistical analysis

Means and standard deviations (SD) were used to describe the continuous variables, and numbers and percentages were used for the categorical variables. Chi-square tests and Student's *t*-tests were performed appropriately to examine the differences in social-demographics between the children with and without unintentional injuries. Logistic and linear regression models were used to test the associations of parents teaching safety rules with child safety behaviors and unintentional injuries, after controlling for the aforementioned potential confounders.

To determine whether and to what extent child safety behaviors mediated the association between parents teaching safety rules and child unintentional injuries, a bootstrap with the PROCESS macro for SPSS was undertaken using 5000 resamples (Hayes, 2013). During this procedure, effects were considered statistically significant while the upper and lower bound of the bias corrected 95% confidence intervals (95% *CI*) did not contain zero. The aforementioned potential confounders were included in all regression models. The dichotomous outcomes in a mediation analysis were treated by calculating the direct effect of parents teaching safety rules on child unintentional injuries as the odds ratio (OR^{DE}), and the indirect effect (OR^{IE}) as the exponent of

Table 1
Comparisons of social-demographics between the children with and without unintentional injuries.

Characteristics	Children with unintentional injuries (n = 1212)	Children without unintentional injuries (n = 61,710)	t/x^2	p-Value
	Mean ± SD/n (%)	Mean ± SD/n (%)		
Age (year)	4.48 ± 0.89	4.52 ± 0.87	1.774	0.076
Maternal age (year)	31.14 ± 5.08	31.39 ± 4.43	1.724	0.085
Paternal age (year)	33.54 ± 5.51	33.70 ± 5.21	1.000	0.317
Gender			5.650	0.014*
Male	700 (57.8)	33,578 (54.4)		
Female	510 (42.1)	28,129 (45.6)		
Missing	2 (0.2)	3 (0.0)		
Shenzhen household register			0.034	0.853
Yes	365 (30.1)	18,751 (30.4)		
No	846 (69.8)	42,956 (69.6)		
Missing	1 (0.1)	3 (0.0)		
Only-child			0.066	0.797
Yes	645 (53.2)	28,637 (46.4)		
No	567 (46.8)	33,067 (53.6)		
Missing	0 (0.0)	6 (0.0)		
Maternal educational level			22.186	< 0.001**
Middle school or lower	365 (30.1)	15,809 (25.6)		
High school	401 (33.1)	19,375 (31.4)		
College or higher	440 (36.3)	26,402 (42.8)		
Missing	6 (0.5)	124 (0.2)		
Paternal educational level			17.408	< 0.001**
Middle school or lower	289 (23.8)	12,501 (20.3)		
High school	372 (30.7)	17,636 (28.6)		
College or higher	545 (45.0)	31,355 (50.8)		
Missing	6 (0.5)	218 (0.4)		
Family income (Chinese yuan/month)			31.382	< 0.001**
< 5000	275 (22.7)	10,564 (17.1)		
5000–9999	330 (27.2)	17,386 (28.2)		
10,000–14,999	185 (15.3)	11,755 (19.0)		
15,000–19,999	166 (13.7)	8326 (13.5)		
≥20,000	256 (21.1)	13,676 (22.2)		
Missing	0 (0.0)	3 (0.0)		

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

the product by the partial coefficient of child safety behaviors to child unintentional injuries and parents teaching safety rules to child safety behaviors (VanderWeele and Vansteelandt, 2010). The proportion of mediation was then calculated as follows:

$$\frac{OR^{DE} \times (OR^{IE} - 1)}{OR^{DE} \times OR^{IE} - 1}$$

All p-values were two-sided. Type I errors were set at 0.05. The statistical analysis was conducted using SPSS version 23.0 (Chicago, IL).

3. Results

3.1. Comparisons of social-demographics between the children with and without unintentional injuries

According to the reports from parents in this study, 1212 (1.9%) preschool children had at least one injury event within the past two weeks. The frequencies of reported injury types were as follows: falls (51.7%), burns (3.6%), cuts (1.8%), electric shocks (0.3%), and others (42.6%). As shown in Table 1, compared with children without unintentional injury events, those with unintentional injuries were more likely to be males, raised by less-educated mothers and fathers, and situated in lower-income families. The other characteristics (including child's age, maternal age, paternal age, Shenzhen household register or not, and only-child or not) were quite comparable between the children with and without unintentional injuries.

3.2. Associations of parents teaching safety rules with child safety behaviors and child unintentional injuries

After controlling for the potential confounders, higher scores of mother's and father's teaching safety rules to children were independently associated with the alleviated risks of child unintentional injuries (mother's: adjusted OR = 0.815, 95% CI = 0.787–0.843; father's: adjusted OR = 0.937, 95% CI = 0.907–0.968; $p < 0.001$) (Table 2). Meanwhile, a one-point increase in the score of child safety behaviors was significantly associated with the reduced risk of child unintentional injuries (adjusted OR = 0.839, 95% CI = 0.816–0.863; $p < 0.001$). Children's more engagement in safety behaviors was associated with the higher scores of mother's teaching safety rules to children (b = 0.309, SE = 0.007; $p < 0.001$) and the higher scores of father's teaching safety rules to children (b = 0.152, SE = 0.005; $p < 0.001$).

3.3. Mediation effect of child safety behaviors on the association between parents teaching safety rules and child unintentional injuries

Adjusting for the potential confounders, an increasing score of mother's teaching safety rules to children was significantly associated with a decreasing risk of child unintentional injuries ($\beta_2 = -0.205$, $p < 0.001$). When child safety behaviors was added to the previous model, the association between score of mother's teaching safety rules to children and child unintentional injuries remained significant ($\beta_2' = -0.174$, $p < 0.001$), however the strength of their relationship was attenuated. The significant indirect effect of child safety behaviors was observed in the association between mother's teaching safety rules and child unintentional injuries ($\beta = -0.043$ (SE = 0.006), 95% CI:

Table 2
Association matrix of scores of parents' teaching safety rules to children, child safety behaviors and child unintentional injuries.

	Partial correlation coefficient (pr; standard error)			Child unintentional injuries (adjusted *OR*; 95% *CI*)
	Score of mother's teaching safety rules to children	Score of father's teaching safety rules to children	Child safety behaviors	
Score of mother's teaching safety rules to children[a]	1	0.500 (0.006)**	0.309 (0.007)**	0.815 (0.787, 0.843)**
Score of father's teaching safety rules to children[b]		1	0.152 (0.005)**	0.937 (0.907, 0.968)**
Child safety behaviors[c]			1	0.839 (0.816, 0.863)**
Child unintentional injuries				1

[a] Adjusted for child's age, gender, Shenzhen household register or not, one-child or not, maternal age, paternal age, maternal educational level, paternal educational level, family income, and score of father's teaching safety rules to children.
[b] Adjusted for child's age, gender, Shenzhen household register or not, one-child or not, maternal age, paternal age, maternal educational level, paternal educational level, family income, and score of mother's teaching safety rules to children.
[c] Adjusted for child's age, gender, Shenzhen household register or not, one-child or not, maternal age, paternal age, maternal educational level, paternal educational level, and family income.
** $p < 0.001$.

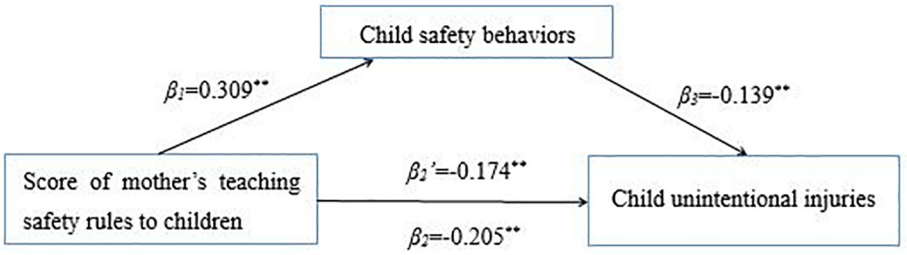

Fig. 1. Simple mediation model for the relationship between score of mother's teaching safety rules to children and child unintentional injuries, as mediated by child safety behaviors: Coefficients are shown for each path and models included the control variables (i.e., child's age, gender, Shenzhen household register or not, one-child or not, maternal age, paternal age, maternal educational level, paternal educational level, family income, and score of father's teaching safety rules to children).
**: $p < 0.001$.

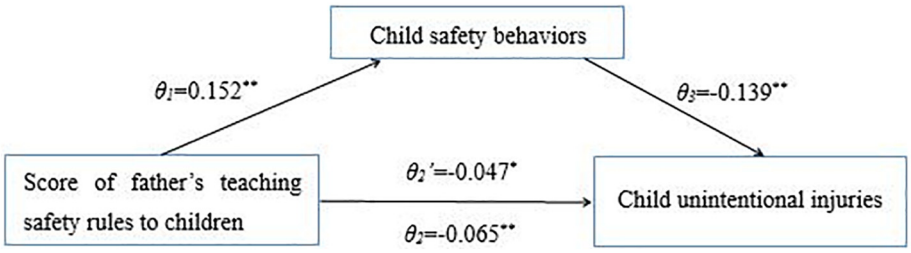

Fig. 2. Simple mediation model for the relationship between score of father's teaching safety rules to children and child unintentional injuries, as mediated by child safety behaviors: Coefficients are shown for each path and models included the control variables (i.e., child's age, gender, Shenzhen household register or not, one-child or not, maternal age, paternal age, maternal educational level, paternal educational level, family income, and score of mother's teaching safety rules to children).
*: $p < 0.01$; **: $p < 0.001$.

−0.054, −0.032), with a mediation effect reaching 18.1% (see Fig. 1). Similarly, there was a significant association between higher scores of father's teaching safety rules to children and lower risks of child unintentional injuries ($\theta_2 = -0.065$, $p < 0.001$), and the association strength decreased after introducing child safety behaviors into the initial model ($\theta_2' = -0.047$, $p < 0.01$). Child safety behaviors mediated the above association ($\theta = -0.021$ ($SE = 0.003$), 95% *CI*: −0.026, −0.016), and its mediation effect was 30.3% (see Fig. 2).

4. Discussion

The present study found that parents teaching safety rules to children was beneficial for improving safety behaviors and mitigating injury risks in the preschool children. Child safety behaviors mediated the association between mothers or fathers teaching safety rules and child unintentional injuries, with the intermediate effects being 18.1% and 30.3%, respectively. These findings suggested that parents teaching safety rules to children were likely to prevent child unintentional injuries through improving child safety behaviors.

Several previous studies have focused on the potential effects of parents teaching safety rules on child injuries. For example, one study showed that the number of family rules advocated by mothers was negatively correlated with the unintentional injuries of 8-year-old children (Peterson and Saldana, 1996). A case-control study including 1776 children under 5 years old observed the reduced odds ratio of a scald in families where parents taught children safety rules in the kitchen (Stewart et al., 2016). However, a prospective study revealed that greater use of safety rules teaching actually predicted an increased frequency of unintentional injuries for young children (Morrongiello et al., 2004). Our study found that both mothers and fathers teaching safety rules to children were significantly associated with the lower risks of unintentional injuries for preschool children. The inconsistencies of these studies may be owing to differences in the study population and child's age, as well as varieties in the contents of safety rules taught. Furthermore, in our study, the protective effect of mothers seemed a little bit stronger than that of fathers, which may be attributed to different parenting style and teaching strategy (Morrongiello et al., 2006). In the Chinese cultural context, mothers usually adopt gentle and warm parenting style that are more acceptable by young children, while fathers tend to be strict and harsh (Wang and Fu, 2005).

The relationship of individual behaviors and unintentional injuries of children has been well documented. Several prior studies provided coincident evidence that a majority of unintentional injuries occurred following children's engagement in risk-taking behaviors (Potts et al., 1995; Little, 2006; Dong et al., 2011; Russell et al., 2016). Similarly, this study found that better performance in safety behaviors significantly decreased the risk of unintentional injuries in preschool children.

There is abundant evidence that parental teaching contributes to the establishment of child behaviors in different degrees (Becker, 1971; MacGregor et al., 1999; Bjørseth and Wichstrøm, 2016). Similarly, our study found that both mothers and fathers teaching safety rules to children were associated with modest improvement in safety behaviors for their children. Notably, some other research has pointed out that it is hard for young children to comply with all safety rules at all times. For instance, one prior study reported that children were compliant with their parents teaching only about 70% of the time (Morrongiello et al., 2014a). Another study revealed that from the perspective of parents they taught the children only to do certain risk behaviors under certain circumstances, but from the perspective of children they may misunderstand as those risk behaviors were allowed under any circumstances (Morrongiello et al., 2014a, 2014b). The extent of improvement in child safety behaviors that was caused by parental teaching safety rules would vary depending on children's understanding and compliance. However, even so, a minor progress in child behaviors by parental teaching could make a significant impact on injury prevention because of a strong relationship between child behaviors and injuries.

So far, there is no study to evaluate child behaviors serving as an intermediary in the effect of parents teaching safety rules on child unintentional injuries. In the present study, we attempted to use a cross-sectional design to examine the behavioral mechanisms that underlie teaching and unintentional injuries. Our results showed that child safety behaviors partially mediated the association between parents teaching safety rules and child unintentional injuries. Some established theoretical models concerning behavioral development might account for the above mechanism and promote understanding of approaches to injury prevention, such as the traditional “Knowledge-Attitude-Belief-Practice” model (Cust, 1980). When their children are being injured, are almost injured, or are doing something that indicates they are vulnerable to injury, it delivers the message that their children are at risk of injury which motivates parents to teach and enforce safety rules to children. According to Vygotsky's sociocultural theory of development, these parent-child interactions can be regarded as a transfer of knowledge and skills from older, more experienced individuals to younger, less experienced individuals, while the internalization of shared social interactions paves the way to self-regulation of behavior and thinking (Vygotsky, 1978). Finally, the safety rules become a guiding voice that directs children to adopt safety behaviors and avoid unintentional injuries under future risky circumstances.

4.1. Limitations

Several limitations should be addressed in this study. First, the current study was strictly cross-sectional, so that any causal relationships among parents teaching safety rules to children, child safety behaviors and child unintentional injuries were not possible. Second, our study recruited all of the children that were enrolled in all kindergartens in the Longhua District of Shenzhen, but the same-age children who did not attend kindergartens were excluded. Selection bias may be unavoidable, which could limit the generalizability of our findings. Third, information concerning parents teaching safety rules to children, child safety behaviors, and child unintentional injuries were reported by parents, which may introduce the social desirability bias and recall bias. To diminish the recall bias, the recall period for safety behaviors and unintentional injuries was limited to the past two weeks. Fourth, we lacked specific information about the strategy and frequency that parents employed to teach safety rules as well as the position and magnitude of child unintentional injuries, which should be examined in the future study. Fifth, other factors including environmental measures (e.g., keeping dangerous objects out of reach, restricting access to certain areas, locking windows) and parental supervision are also associated with child unintentional injuries (Morrongiello et al., 2004). However, this study did not collect information relating to the above, which hindered us from comprehensively evaluating the associations of those factors with child unintentional injuries. Last, the mediation effect of child safety behaviors on the relationship between parents teaching safety rules and child unintentional injuries was only partial, and other pathways were not included such as child's understanding about parental teaching safety issues.

5. Conclusions

In summary, parents teaching safety rules to children could be beneficial for mitigating unintentional injury risks among Chinese preschool children through improving child safety behaviors. This study extends our understanding of the behavioral mechanism for teaching and injury risk and provides implications for developing effective strategies to prevent child unintentional injuries.

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Conflict of interest statement

The authors have no conflicts of interest to declare.

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