ORIGINAL ARTICLES

Lower incidence of unintentional injury with older age in children in China? A meta-analysis

Huiting Yu[1], Chan Nie[1], Yanna Zhou[1], Xue Wang[1], Haiyan Wang[1], Xiuquan Shi*[1,2]

[1]*Department of Epidemiology and Health Statistics, School of Public Health, Zunyi Medical University, Zunyi, Guizhou, China*
[2]*Center for Injury Research and Policy & Center for Pediatric Trauma Research, The Research Institute at Nationwide Children's Hospital, The Ohio State University College of Medicine, Columbus, OH, USA*

ABSTRACT

Objective: The aim of this study was to identify the relationship between children's age and the incidence of unintentional injuries, and giving some basic data on the guidance for the prevention of unintentional injuries in children aged 0 to 18 years in China.
Methods: The literatures on the incidence of unintentional injury in children included in China from 2008 to 2018 were analyzed by meta-analysis method. The data were retrieved according to the guidance of Cochrane Systematic review. A meta-analysis was carried out on homogeneous studies, and then subgroup analysis was conducted according to age group. Publication bias was also evaluated. Stata software (version 15.0) and SPSS software (version 18.0) were used to analyze the gathered information.
Results: A total of 3,303 related pieces of literature were reviewed. Of the 37 that met the inclusion criteria. The meta-analysis showed that total sample size were 77,023, and the pooled incidence of unintentional injury is 20%, 95%CI (17%-23%), ($p <$ .001). Subgroup analysis showed the following results: the incidence are 15%, 23%, 20% and 20% for aged in "0-2", "3-5", "6-11", "12-18" subgroups, respectively. However, the trend of decreased incidence of unintentional injury with older age in children was not significant.
Conclusion: The pooled incidence of unintentional injuries in children is high. Based on accessible literature, the incidence between different age subgroup were not statistically significant. We should pay attention to the incidence of unintentional injuries in children of all age subgroups.

Key Words: Children, Meta-analysis, Unintentional injuries

1. INTRODUCTION

According to WHO (World Health Organization), injury can be defined as "The physical damage that results when a human body is suddenly subjected to energy in amounts that exceed the threshold of physiological tolerance or else the result of a lack of one or more vital elements, such as oxygen".[1] Over 875,000 children under 18 years of age die annually in the world as a result of injuries, mostly in low- and middle-income countries.[2] Therefore injuries constitute a major public health problem worldwide.[3] Unintentional injury of children can cause trauma or disability to children, and disability not only affects normal psychological development of children. In the meantime the disability in childhood brings lifelong physical and psychological challenges to the child and the family and could cause huge economic burdens to the society.[4]

Unintentional injury has become an important factor leading to death and places a huge burden on the public health system in China, the country with the greatest number of children in the world.[5] The direct death cost of injury was estimated to be at least 44 billion RMB (equivalent to US $5.4 billion) each year.[6] Childhood injury is a major public health problem that requires urgent attention.[7] Deaths caused by unintentional injuries, hospitalization and disability have caused heavy burden to every injured child's family, every country and even the whole world. It is of great significance to pay attention to the unintentional injury of children and adolescents to improve the health level of the whole population.

In China, Ren and colleagues[8] drew a conclusion that the unintentional injury in infant group ("0-2") was the highest, and the incidence rate decreased gradually with the increase of age in her study. Wen et al.[9] pointed out that with the increase of grade, the number of students in the lower grade of primary school is gradually reduced by the care of parents and teachers, and the incidence of unintentional injury increases with the grade.

In this study, we aimed to test the hypothesis that it had a decreased trend of unintentional injuries with increased age in children in China just like some literature. In order to evaluate systematically the relationship between age and incidence of unintentional injury of children in China, the relevant documents from 2008 to 2018 were systematically searched and age subgroup analysis was conducted.

2. METHODS

2.1 Search strategy

Literature addressing unintentional injury in children, whose definition of unintentional injury complied with our own and whose study cohort fell within the age limit were included in the analysis. Literature published between 2008 and 2018, in both domestic (Chinese) and international medical journals, which addressed unintentional injuries in children from 0-18 years old were included in the study. Searched databases included CNKI (National Knowledge Infrastructure), Wanfang Data Resource Systems database, MEDLINE/PubMed database, and VIP (Veipu Database for Chinese Technical Periodicals).

The strategy involved searching for the following key terms in any field within the whole text: ((unintentional injury) or (unintentional injury)) AND ((child*) or (0–18 years old)) AND ((China) or (Chinese)) AND for fuzzy matching. Articles about unintentional injury in children were obtained by computer search combined with reference tracing. The retrieval languages were Chinese and English, and the retrieval

time from Jan.2008 to Apr.2018.

2.2 Inclusion criteria

The criteria for inclusion were as follows: (a) subjects must be Chinese; (b) aged less than 18 years; (c) who had unintentional injury; (d) the definition of unintentional injury is consistent; (e) the time and location of the study is clearly stated; (f) the study method is explicit and similar; (g) the number of unintentional injury and total samples, is reported or can be deduced from existing data.

2.3 Exclusion criteria

The criteria for exclusion were as follows: (a) their age exceeds 18 years; (b) the disabled children; (c) samples are too special to represent the general population, especially those in hospitals or migrant and abandoned children; (d) there are obvious flaws in design or errors in statistics, or the information is incomplete; (e) the literature was repeatedly published or is a summary; (f) the literature was published before 2008; (g) the age of the children in the study is uncertain.

2.4 Data extraction

The database was established in Excel (Microsoft Excel 2007), and the following information was excerpted from included researches: title, year of publication, authors, sample size, number of unintentional injured children.

2.5 Quality control

Total sample size, document searching, screening, excerption of information, and quality assessment were conducted by 2 trained personnel, separately. Any issues that arose during the process were solved by central discussion or consulting a third expert.

Currently, there is not yet a quality evaluation standard for observational studies. The quality evaluation guideline for disease prevalence studies, as proposed by Loney et al.[10] was used to evaluate the included literature. The quality score of the literature included from 5 or 6 points, which was assessed according to the Loney criteria and was of medium quality. The aspects taken into consideration included effectiveness of study methods, rationality of explanation, and suitability scope.

2.6 Statistical analysis

Stata 15.0 was used for the pooled analysis, subgroup analysis, and publication bias diagnosis.

SPSS 18.0 was used for Chi-square analysis of the incidence trend of accidental injuries in children.

3. RESULT

3.1 Eligible studies

The database searches generated a total of 3,300 references, including 1,214 duplicated papers. There are 595 records had no relevant with the topic. 1,541 full-text articles retrieved for further assessment. Based on the strict inclusion and exclusion criteria as we listed, after reading the references in their entirety, only 37 of these matched the inclusion and exclusion criteria (see Figure 1). The general characteristics of the 37 articles are listed in Table 1. According to the document quality score of Loney et al.,[10] 3 articles have 5 points, and 34 articles are 6 points. They are of medium quality.
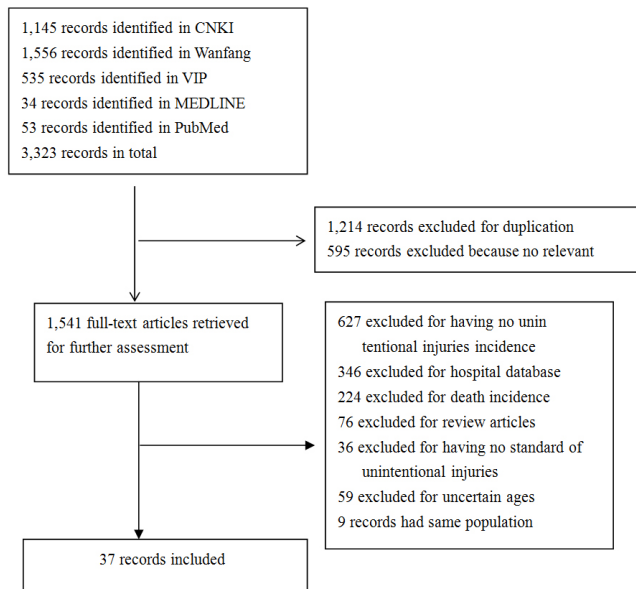

Figure 1. Flowchart of article selection

3.2 Meta-analysis with all included studies

Figure 2 shows heterogeneity was clear when compared across the 37 included studies, so random effect model was used. $Q = 20\%$, $I^2 = 99.4\%$, $p < .001$, 95%CI (17%-23%), the total sample of unintentional injuries in children is 77,023. There were 13,309 children suffered from unintentional injuries, and the incidence of unintentional injury is 17%. The total sample size were 1,213, 12,398, 10,322, 33,613, 43,410; and the number of injured children were 225, 2,084, 1,319, 1,739, 7,922 in age subgroup "0-2", "3-5", "6-11", "12-18", "0-18", respectively (see Table 2).

Table 1. Characteristics of included studies

Author	Year	Total sample size	Injured children	Scores
Zeng et al.[14]	2008	2,955	146	6
Yang et al.[15]	2008	980	223	6
Han et al.[16]	2008	1,216	312	6
Guo et al.[17]	2008	1,195	61	6
Liu et al.[18]	2009	3,631	942	6
He et al.[19]	2009	5,477	528	6
Li et al.[20]	2009	873	204	6
Shen et al.[21]	2009	3,019	519	6
Li et al.[22]	2009	3,604	410	6
Chen et al.[23]	2011	1,526	176	6
Zhang et al.[24]	2011	4,668	1,273	6
Wang et al.[25]	2011	3,415	368	6
Xu et al.[26]	2011	553	68	6
Jiang et al.[27]	2011	2,584	675	6
Jiang et al.[28]	2011	2,943	762	6
Chen et al.[29]	2011	4,139	119	6
Pan et al.[30]	2012	941	173	6
Li et al.[31]	2013	1,054	312	6
Jia et al.[32]	2014	475	190	6
Qiu et al.[33]	2014	232	32	5
Shi et al.[34]	2014	2,854	477	6
Qiu et al.[35]	2014	280	113	5
Xiang et al.[36]	2015	1,828	368	6
Deng et al.[37]	2015	3,257	356	6
Zhang et al.[38]	2015	258	64	5
Liu et al.[39]	2015	612	214	6
Mao et al.[40]	2015	501	142	6
Yang et al.[41]	2015	1,231	81	6
Zhang et al.[42]	2015	807	84	6
Peng et al.[43]	2015	6,175	798	6
Xiao et al.[44]	2016	2,564	976	6
Cao et al.[45]	2016	478	145	6
Sheng et al.[46]	2016	1,631	335	6
Huang et al.[47]	2016	2,909	909	6
Zhu et al.[48]	2017	3,000	400	6
Li et al.[49]	2018	2,672	256	6
He et al.[50]	2018	486	98	6

Study ID	ES (95% CI)	% Weight
Chuanjun Zeng(2008)	0.05 (0.04, 0.06)	2.75
Hanjun Yang(2008)	0.23 (0.20, 0.25)	2.70
Ninghua Han(2008)	0.26 (0.23, 0.28)	2.71
Yuling Guo(2008)	0.05 (0.04, 0.06)	2.75
Fangying Liu(2009)	0.26 (0.25, 0.27)	2.74
Guangli He(2009)	0.10 (0.09, 0.10)	2.75
Ling Li(2009)	0.23 (0.21, 0.26)	2.69
M Shen(2009)	0.17 (0.16, 0.19)	2.74
Shaohua Li(2009)	0.11 (0.10, 0.12)	2.75
Da Chen(2011)	0.12 (0.10, 0.13)	2.74
Chao Zhang(2011)	0.27 (0.26, 0.29)	2.74
Ping Wang(2011)	0.11 (0.10, 0.12)	2.75
Tao Xu(2011)	0.12 (0.10, 0.15)	2.69
Wu Jiang(2011)	0.26 (0.24, 0.28)	2.73
Wu Jiang(2011)	0.26 (0.24, 0.27)	2.74
Yong Chen(2011)	0.03 (0.02, 0.03)	2.76
Fengzhu Pan(2012)	0.18 (0.16, 0.21)	2.71
Guangcai Li(2013)	0.30 (0.27, 0.32)	2.69
Gaizhen Jia(2014)	0.40 (0.36, 0.44)	2.60
Shaojie Qiu(2014)	0.14 (0.09, 0.18)	2.59
Xiu Quanshi(2014)	0.17 (0.15, 0.18)	2.74
Xianyun Qiu(2014)	0.40 (0.35, 0.46)	2.49
Bing Xiang(2015)	0.20 (0.18, 0.22)	2.73
Fangming Deng(2015)	0.11 (0.10, 0.12)	2.75
Guozhen Zhang(2015)	0.25 (0.20, 0.30)	2.53
Huiyan Liu(2015)	0.35 (0.31, 0.39)	2.64
Ping Mao(2015)	0.28 (0.24, 0.32)	2.63
Yulin Yang(2015)	0.07 (0.05, 0.08)	2.74
Yong Zhang(2015)	0.10 (0.08, 0.13)	2.72
Zhonghau Peng(2015)	0.13 (0.12, 0.14)	2.75
Danqiong Xiao(2016)	0.38 (0.36, 0.40)	2.73
Fengmei Cao(2016)	0.30 (0.26, 0.34)	2.62
Jianhua Sheng(2016)	0.21 (0.19, 0.23)	2.73
Ying Huang(2016)	0.31 (0.30, 0.33)	2.73
Jun Zhu(2017)	0.13 (0.12, 0.15)	2.75
Fengjie Li(2018)	0.10 (0.08, 0.11)	2.75
Fengning He(2018)	0.20 (0.17, 0.24)	2.65
Overall (I-squared = 99.4%, p = 0.000)	0.20 (0.17, 0.23)	100.00

NOTE: Weights are from random effects analysis

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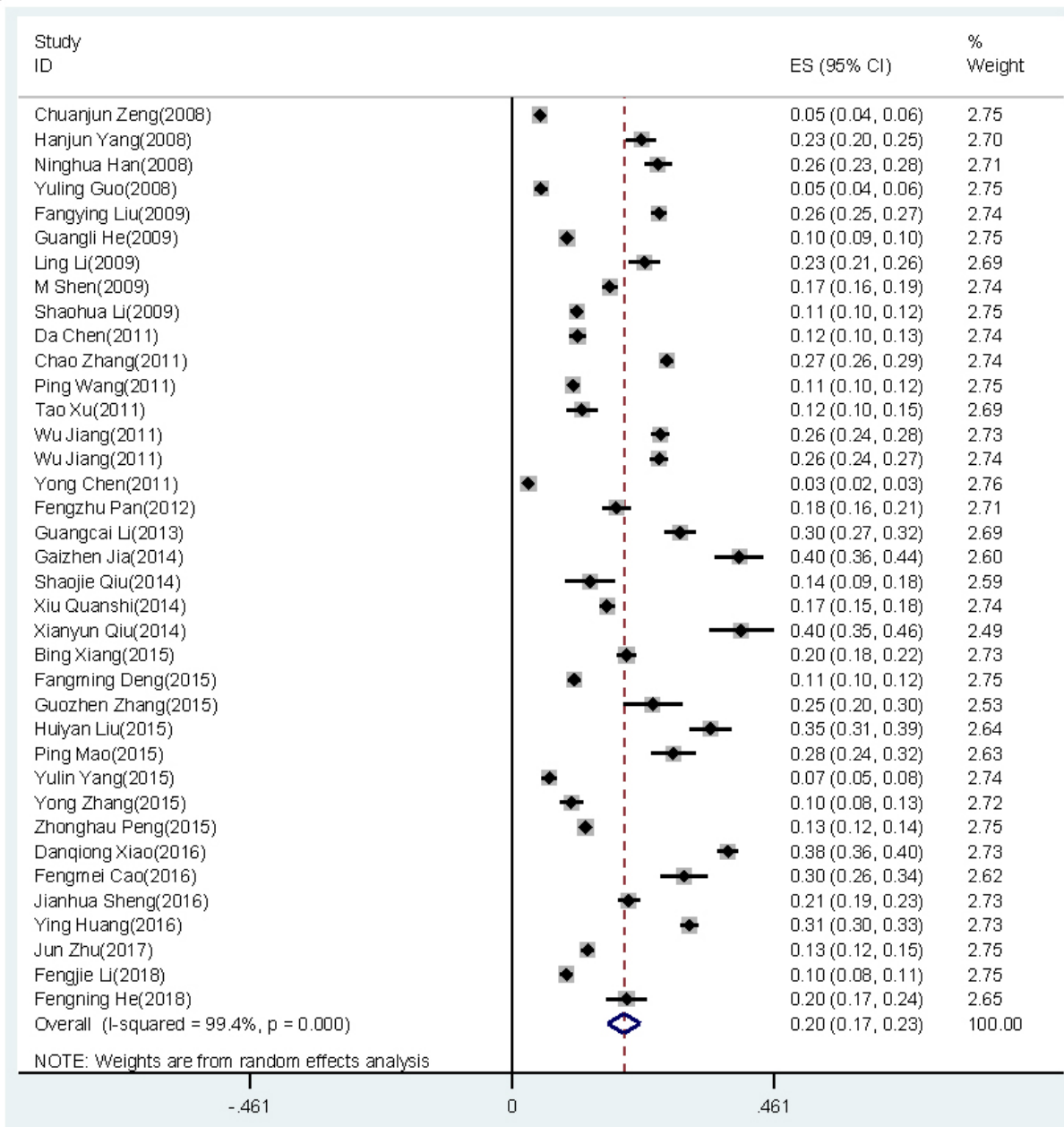
Figure 2. Forest plot of the included records

Table 2. Statistics of injury and non-injury in different age groups

Age subgroup*	Injured	Not injured	Injured incidence (%)#	Total
0-2	225	988	18.5%	1,213
3-5	2,084	12,290	16.8%	12,398
6-11	1,319	9,003	12.7%	10,322
12-18	1,739	7,942	18.0%	9,681
Total	5,387	30,223	16.1%	33,613

#This is a raw injured incidence (not adjusted by the weight in meta-analysis), and the result of trend test of injured incidence with age is Chi-square = 0.195, p for trend = .659.

3.3 Age subgroup analysis

Figure 3 shows heterogeneity was significant when different age subgroup compared across the 37 included studies, so random effect model was used. Age subgroup "0-2": Q = 15.0%, I^2 = 86.9%, $p < .001$, 95%CI (9%-22%). Age subgroup "3-5": Q = 23.0%, I^2 = 98.4%, $p < .001$, 95%CI (18%-29%). Age subgroup "6-11": Q = 20.0%, I^2 = 98.1%, $p < .001$, 95%CI (16%-25%). Age subgroup "12-18": Q = 20.0%, I^2 = 98.8%, $p < .001$, 95%CI (18%-29%). The mixed group "0-18": Q = 19.0%, I^2 = 99.4%, $p < .001$, 95%CI (15%-23%).
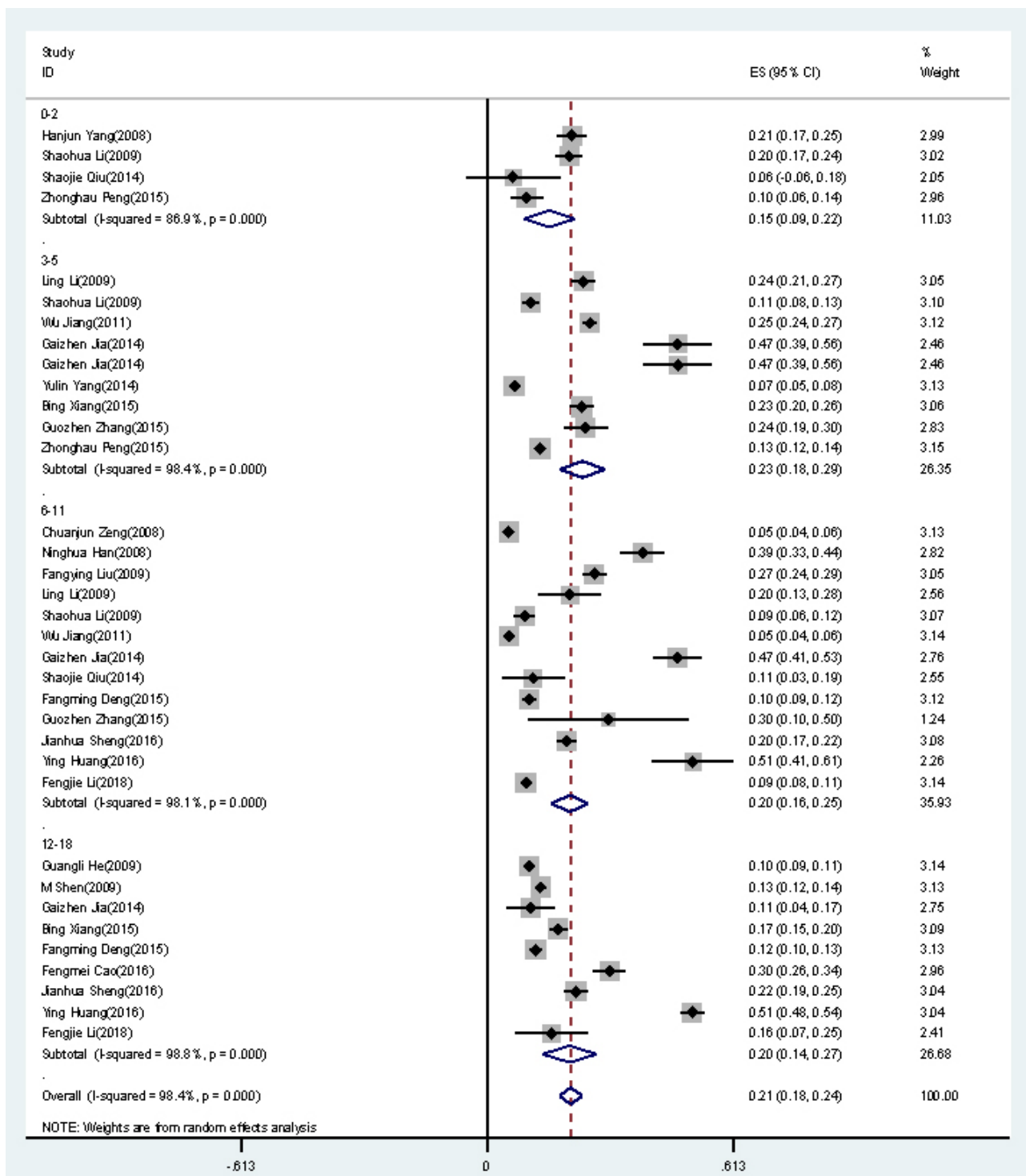
Figure 3. Forest plot of the age subgroup analysis of pediatric unintentional injuries

When we used Chi-square analysis to conduct incidence of unintentional injuries in children in different age subgroups, there were no significant difference in age subgroups (Chi-square = .195, p for trend = .659). We also found a change in a trend the unintentional injury rate was the highest (18.5%) in age subgroup "0-2", followed by age subgroup "12-18" (18.0%); and age subgroup "3-5" (12.7%). The unintentional injury rate was the lowest (12.7%) in age subgroup "6-11". The incidence of unintentional injuries in children decreases with age before 12 years old, while there is an upward trend after the age of 12. However, there was no statistical significance (see Table 2).

3.4 Publication bias

It is easy to publish papers with positive results but is difficult to publish those with negative results. We also use Begg's test ($p < .05$) and Egger's test ($p < .001$) to evaluate publication bias. The results showed that publication bias can not be thoroughly excluded.

4. DISCUSSION

In our study, we found that the incidence of unintentional injury in age subgroup "3-5" was the highest (23%), followed by "6-11" (20%) as well as "12-18" (20%). Incidence of injury in children under 3 years old is lowest (15%). But we cannot draw a conclusion that children in age subgroup "3-5" are more prone to get injured. It is easy to understand that the incidence of injury in children under 3 years old is lower than in other age groups. Compared with other age subgroup, the activities of children under 3 years old are mainly at home, and their parents spend lots of time with them, parents will take good care of them at any time to prevent them from getting hurt. Accord to Liu et al.[11] study, falls is a common accidental injury in infancy, including falling on the ground and falling from a height. The common injuries are mainly caused by falling bed, tripping, running, falling down, etc. When an infant begins to learn to walk, he has risk of fall, the most important place of activity for infants is at home, and the chance of accidental injury is naturally higher. Considering that create a safe environment for children was an important safety strategy for parents within the home.[12]

Children in "3-5" group, most of them are in kindergarten age. They are more curious about the things around them and lack of awareness of unintentional injuries prevention, so they are more vulnerable to unintentional injuries, thus there is an upward trend in unintentional injuries. The most common types of injuries are falls, bruises, and the cause of the bruises was basically a child running fast against another child. For children in "3-5" group the focus on preventing accidental injuries should be in kindergarten. The teacher should pay attention to them when they played with each other, and telling them to slow down in case of falls and bruises. When they get injured, they can not deal with unintentional injury independently. It is essential for kindergarten teachers acquire first aid knowledge for unintentional injuries.

Children in "6-11" group, which can also called school age children. As they get older, they know more about unintentional injuries, Due to importance of the school and parental supervision. The school age children have the ability to avoid many accidental injuries, so the tendency for them to get unintentional injuries falls.

When we focus on children in "12-18" age group, as teachers and parents believe that teenagers can take care of themselves, so they reduce their care for adolescents. As it is well known that children in "12-18" are more impulsive, and they prefer to new things. With the development of the internet, they are more likely to be exposed to unintentional injuries. Unfortunately, they have ability to cope with accidental injuries. With the development of economy and the increase of motor vehicles, and they are more likely to have traffic accidents.

The unintentional injury of children brings a great burden to the family and society. As the country with the largest population in the world, China has a huge base number of children and unbalanced development.[5] With the two-child policy, which means a family can have more than one child. There will be more children in China in the future. It is of great essential to pay attention to accidental injuries to children, Children of different ages have different emphasis on prevention of accidental injury. About infancy, parents should play a strict supervision to protect children and reduce children unintentional injuries.[13] Children in preschool and school-age, prevention of unintentional injury should be more focused on schools. For children in "12-18" years old, they should be focused on strengthening health education about unintentional injury. The prevention of accidental injury in children requires the joint efforts of the family, school and society.

Limitation

A limitation of the study is that we can not exclude the publication bias for all included articles published in different regions of China with large and small samples through the recent 10 years. Most data are obtained from schools or parents, thus recall bias can not be avoiding in original studies. We should focus on collecting more extend data in the future study. Compared with other group like similar school-age children, unintentional injury data on infants are not available.

CONFLICTS OF INTEREST DISCLOSURE

The authors of this article declare that they have no conflict of interest.

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