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Prevalence of Stress Hyperglycemia among Iranian hospitalized children: A systematic review and meta-analysis

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Abstract

Introduction: Stress hyperglycemia refers to the transient elevation of the blood glucose in an acute physiological stress in the absence of diabetes (natural hemostasis of glucose before stress).the aim of this systematic review and meta-analysis was to evaluate the Prevalence of Stress Hyperglycemia among Iranian hospitalized children

Methods: The present systematic study has applied developed methods that are in line with accurate instruction of PRISMA checklist. the studies had been collected form international databases (PubMed, Google Scholar, and WOS) and national ones (SID and Magiran) without any time limitation in both English and Persian.

Results: As many as 4 studies conducted on 2675 children were included in the meta-analysis. In asymptomatic children, according to the results of random effects mode, the general Prevalence of Stress Hyperglycemia among Iranian hospitalized children was 5.7% in 2675 children (95% CI: 5, 6.4; I²=98.2%).

Conclusion: stress hypoglycemia with a prevalence of 5.7% is a relatively common phenomenon in Iranian hospitalized children which should be considered in clinical management.

Keywords: Prevalence, Stress Hyperglycemia , infants, children.

Introduction

Stress hyperglycemia refers to the transient elevation of the blood glucose in an acute physiological stress in the absence of diabetes (natural hemostasis of glucose before stress)(1). Stress hyperglycemia occurs at special clinical conditions such as trauma, burn, septicemia, and stroke in adults. The high incidence rate (2-4%) of hyperglycemia has been reported for children suffering from severe gastroenteritis (2-4). The main causes of stress hyperglycemia include increased insulin-resistant hormones (glucagon,

growth hormone, catecholamines, and glucocorticoids) and increased cytokines such as interleukin 1 and tumor necrosis factor (TN) in tissues or blood circulation (5-7). Stress hyperglycemia is a protective function and physiological adaptation (8). Because of stress hyperglycemia, the abovementioned hormones increase glucose delivery to the brain by controlling glucose consumption in peripheral tissues when the brain blood supply has reduced due to the main disease and its resulting shock (burn, trauma, and infections) (9).

Materials and Methods

The present systematic study has applied developed methods that are in line with accurate instruction of PRISMA checklist. However, only observational studies including letters to the editors, journals, poor quality articles (based on HOY tool), and studies conducted on adult participants were removed from the study. It was attempted to include studies only in English and Persian. All observational studies with any sampling and statistical designs have been included in the present systematic study. Two researchers have separately investigated all studies conducted up to May 2019; the studies had been collected from international databases (PubMed, Google Scholar, and WOS) and national ones (SID and Magiran) without any time limitation in both English and Persian. The reference list of the existing studies has been also investigated to find more studies in this regard. Special research strategies have been adopted by a health science librarian (an expert on systematic studies) through applying MESH browsing vocabulary as well as free vocabulary based on PRESS standard (16). Moreover, MEDLINE research strategy has been applied for searching other databases as well. The keywords applied in the research strategy include: Prevalence, Stress Hyperglycemia, infants, children, and Iran that were combined with Boolean operators such as

AND, OR, and NOT. Two researchers have separately investigated the titles and abstracts by considering the qualification criteria. After excluding the repetitive studies, the full texts of the studies were investigated based on the qualification criteria and the required information was extracted. For solving the questions on qualifications, extra information was obtained from the authors whenever needed. Moreover, the required data on conditions, sample size, risk of bias, and the measurement of result were collected as well. The final extracted data were evaluated by using STAT 14.0.

Results

Study selection: In total, as many as 294 studies were selected from the initial research on PubMed, Google Scholar, SID, Magiran, and Web of Science from the beginning to May 1 of 2019. From 286 non-repetitive studies (in terms of title and abstract), as many as 270 studies were excluded in the screening process; their titles were unrelated. From the remaining 16 studies, 4 studies were qualified for having the required criteria. From 12 excluded studies, 3 studies were reviewed, 2 studies didn't have the full texts, and 7 studies didn't meet the minimum quality and standards required to be included in this study (Figure 1).

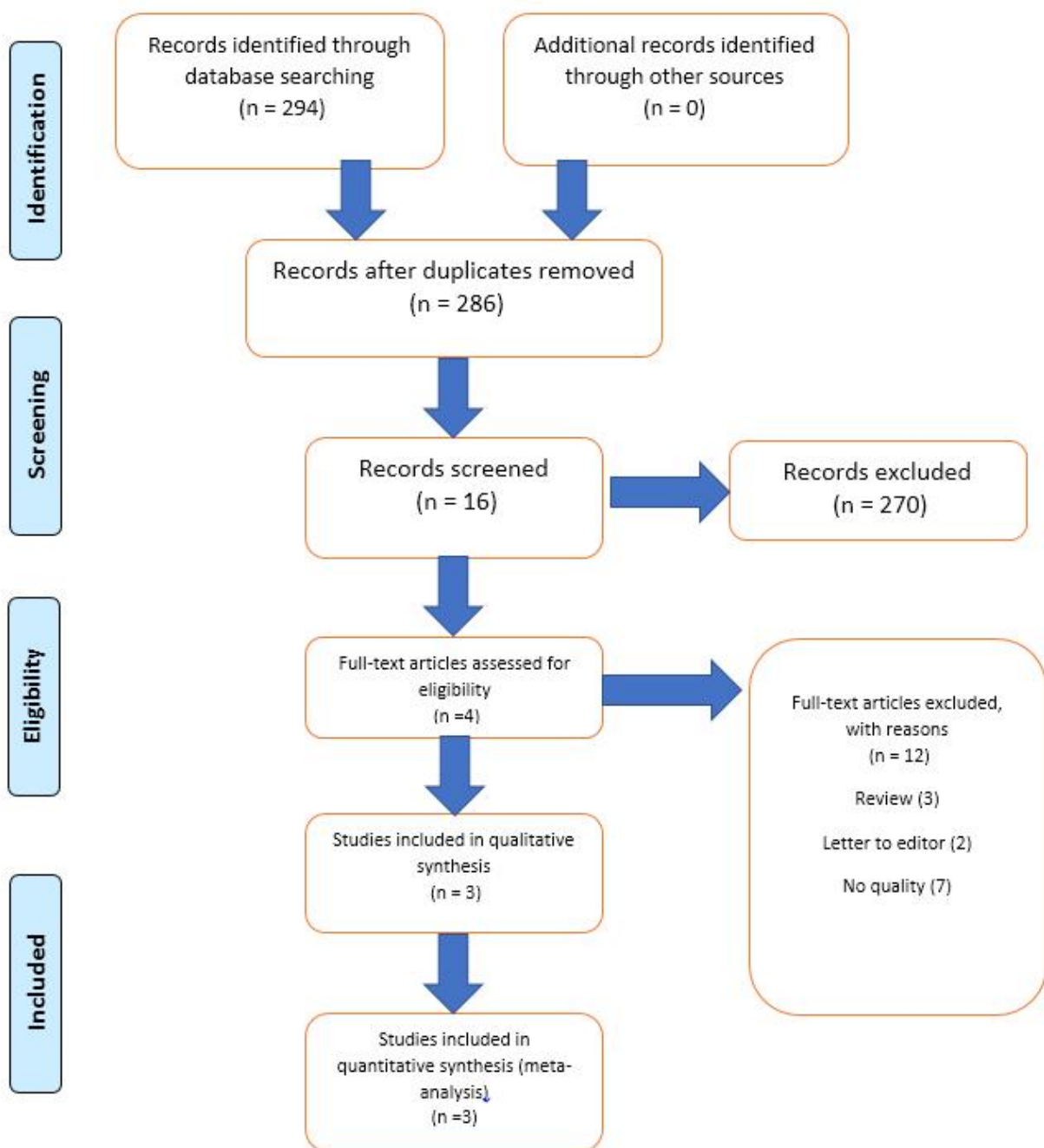


Fig 1.PRISMA flow diagram

Research characteristics:

These 4 studies had been conducted on 2675 Iranian aged <14 years. From these 4 studies, 2 studies have provided cross-sectional data, and 2 studies were in prospective design. From these Moreover, each of Mashhad, Shiraz ,Isfahan and

Hamadan provinces accounted for one study. The most common sampling method applied was convenience sampling method (n=4). More than 50% of the studies had low risk of bias. Hospital was the most prevalent place for conducting the studies (n=4).

The Prevalence of Stress Hyperglycemia among Iranian children:

As many as 4 studies conducted on 2675 children were included in the meta-analysis. In

asymptomatic children, according to the results of random effects mode, the general Prevalence of Stress Hyperglycemia among Iranian children was 5.7% in 2675 children (95% CI: 5, 6.4; $I^2=98.2\%$) [Table 1].

Table 1: Characteristics of final included studies

Author	year	province	N	ES	95% conf. Interval		Weight%	Bias
					Low	Up		
Mohammadzade ⁽¹⁷⁾	2003	Mashhad	1430	0.030	0.021	0.039	67.48	low
Hashemipour ⁽¹⁸⁾	2002	Isfahan	291	0.254	0.204	0.304	2.11	low
Karamifar ⁽¹⁹⁾	1998	Shiraz	1620	0.127	0.111	0.143	20.92	Moderate
Razavi ⁽²⁰⁾	2003	Hamadan	334	0.051	0.027	0.075	9.48	low
Pooled ES	-----	-----	2675	0.057	0.050	0.064	100	-----

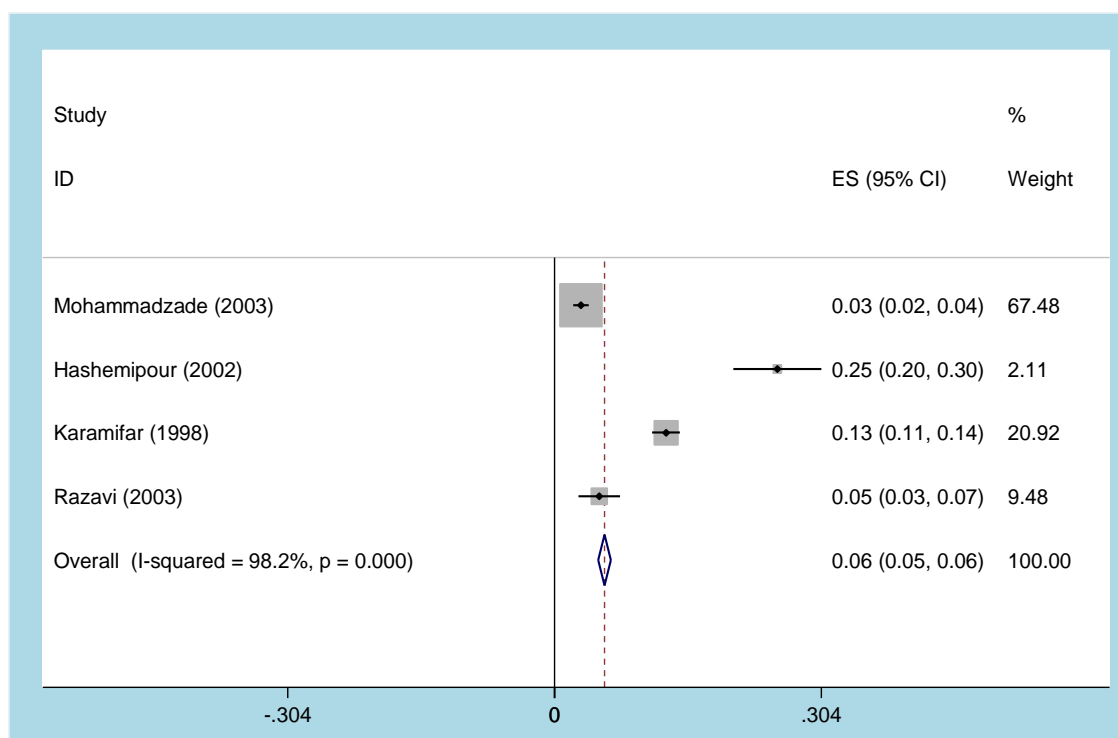


Fig. 2 : Prevalence of Stress Hyperglycemia among Iranian children and its 95% interval for the studied cases according to the year and the city where the study was conducted based on the model of the random effects model. The midpoint of each section of the line estimates the% value and the length of the lines showing the 95% confidence interval in each study. The oval sign shows Prevalence of Stress Hyperglycemia among Iranian children

Discussion

As many as 4 studies conducted on 2675 children were included in the meta-analysis. In asymptomatic children, according to the results of random effects mode, the general Prevalence of

Stress Hyperglycemia among Iranian children was 5.7% in 2675 children (95% CI: 5, 6.4; $I^2=98.2\%$). Stress hyperglycemia has been frequently reported for adults in clinical conditions such as burn, strokes, heart attacks, and patients hospitalized in the ICU for any other reason (10).

Moreover, stress hyperglycemia has been frequently reported for children in cases including feverish diseases and severe gastroenteritis (11). The doctors' familiarity with such conditions prevents the application of unnecessary and even dangerous medical methods (12). However, patients who suffer from stress hyperglycemia in the course of an acute clinical condition are very likely to suffer from diabetes in the future. Thus, the follow-up provided for these patients is of high significance; all patients suffering from stress hyperglycemia are required to be followed up in terms of diabetes incidence in the future (13). There is a significant relationship between the severity of the initial disease, high temperature (fever), dehydration percentage, and unstable vital signs with the incidence rate of stress hyperglycemia (14). The studies conducted indicate that the main criterion of hyperglycemia is the blood glucose of higher than 200 mg/dl in adults and the blood glucose of over 150 mg/dl in children. Patients suffering from stress hyperglycemia without any prior history of diabetes are divided into two main categories: 1. those who suffer from prior undiagnosed diabetes; and 2. Patients that suffer from increased blood glucose in the absence of diabetes and under the disease stress. For distinguishing these two groups, HbA1C test is helpful (15). Few studies have been conducted to distinguish these two groups based on HbA1C level. It is necessary to determine the frequency of stress hyperglycemia in children admitted for the evaluation and treatment of their acute disease (16). The doctors' unfamiliarity with this disease and its incidence rate is likely to result in the application of hurried and even risky treatments as well as additional diagnoses in patients suffering from stress hyperglycemia.

Conclusion

Stress hypoglycemia with a prevalence of 5.7% is a relatively common phenomenon in Iranian hospitalized children which should be considered in clinical management.

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