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Sociodemographic risk factors for febrile seizures: A school-based study from Izmir, Turkey

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ABSTRACT

Purpose: Despite the fact that socioeconomic and environmental factors of a population are changing over time, there are few studies focusing on the effects of sociodemographic factors on the prevalence of febrile seizures (FS). This study was designed to find out the prevalence of FS and to investigate the effect of socio-cultural and economic factors on this prevalence among the Turkish school children.

Methods: A school-based, cross-sectional study was conducted in first and second-class children. Data were collected through a questionnaire from the parents who agreed to be involved in the study. The survey had questions about some socioeconomic and demographic features of the children and febrile seizure episodes.

Results: 3806 children and parent pairs accepted to participate in the survey. Febrile seizure prevalence was 4.8%. It was found that the prevalence of FS was significantly associated with the chronic illnesses of a child that requires continuous medication, developmental delay of a child, NICU history, gestational hypertension history of a mother, and lower educational level of a mother. Recurrence of FS was observed in 32.9% of children. Children whose first FS was seen below the 39 °C had 1.9 times more recurrence risk.

Conclusion: FS prevalence rate has declined from 9.7% to 4.3% in our study population within ten years. It was thought that advancing healthcare systems in our country might be decreased the prevalence. Our study enabled us to find out sociodemographic risk factors of FS, but further studies are needed in order to confirm the effect of sociodemographic factors on FS prevalence.

1. Introduction

Febrile seizures (FS), which are accompanied by a fever greater than 38 °C with no other seizure-provoking causes, are the most common type of seizure in childhood. FS are seen in children younger than 5 years of age and are classified as either simple or complex [1–3]. Simple FS are generalized (i.e., without a focal component) tonic–clonic seizures, which last for a maximum of 15 min. On the other hand, complex FS are prolonged (> 15 min), focal, or occur more than once in 24 h [2]. Although FS are usually benign and self-limiting, they are a cause of great concern to parents. No definite long-term adverse effects of simple FS have been reported. However, although some conflicting results have been reported, mesial temporal sclerosis and temporal lobe epilepsy were shown to be associated with complex FS in childhood [4–6]. In addition, the risk of one's developing epilepsy after complex FS is about 3–7% compared with an estimated risk of ~1.5% in the general population, which makes such seizures a significant health problem [7–9].

The reported prevalence rates of FS vary in different parts of the world, although methodological differences may be an underlying factor in these regional variations [2]. The prevalence of FS is known to be associated with genetic, environmental, and sociodemographic factors [2,7,8]. Although socioeconomic and environmental factors change over time, few recent studies have examined the effects of sociodemographic factors on the prevalence of FS. It is important to identify additional potential risk factors for the prevention, improved prognosis, and management of FS. However, no recent studies have addressed the sociodemographic risk factors associated with FS among Turkish children.

This study was performed to determine the prevalence and risk factors of FS among children 6–7 years old in elementary schools in the center of Izmir City, Turkey. In addition, this study investigated the effects of changes in sociocultural and economic factors in our country over the last 10 years on the frequency of FS based on the risk factors

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defined by Aydın et al. [10].

2. Methods

This descriptive cross-sectional study was performed in first and second grade elementary school children in the metropolitan area of Izmir, Turkey. The information on the study population was obtained from the Bureau of Statistics of the Provincial Education Administration of Izmir. The sample consisted of 65,866 elementary school students (grades 1 and 2 students) from 296 public elementary schools [11]. A cluster sampling method was used, with the nine districts of Izmir City Center as the clusters. Twenty-two elementary schools chosen randomly from the sample were represented in proportion to their size. Taking into consideration the 9.7% prevalence rate detected by Aydın et al. [10] in 2008 with ± 1 standard deviation and 99% confidence interval, we planned to include 5340 students in the study. Taking into account the proportion of questionnaires expected to have missing responses and those that would not be returned, we distributed a total of 5501 questionnaires. After receiving Dokuz Eylül University Ethics Committee Approval for the study, written permission was obtained from the Provincial Education Administration and Governor of Izmir City prior to commencement of the study. Together with the questionnaire, a consent/approval form was sent to the families of the children in the study population.

We planned to collect data for our study via the questionnaire, which was distributed to the parents of grades 1 and 2 students in the school year 2015–2016. The survey, which consisted of 30 questions, was prepared according to the Guidelines for Epidemiologic Studies on Epilepsy proposed by the Commission on Epidemiology and Prognosis, International League Against Epilepsy in 1993 [1], and also according to the current literature about epilepsy. To minimize recall difficulties, we planned to conduct the surveys among the parents of grade 1 and 2 students aged 6 and 7, and added the option "I don't remember" to the survey, with these responses accepted as missing data. Teachers sent questionnaires to the parents, who were asked to return them within 5 days via the children. The response rate was 69.2%; 3806 of 5501 questionnaires sent were returned.

The questionnaire had two parts. The first part consisted of questions about families' socioeconomic and demographic features. The second part dealt with the history of any seizure episode(s). The highest body temperature measured during the seizure was determined from the family (via the questionnaire) and noted as peak fever. The main independent variables of the study were age, gender, and perinatal history of the child, educational status and occupation of parents, family income, and seizure history among family members. Family economic status was categorized as "lower income than expenses," "income equal to expenses," or "higher income than expenses." We planned to categorize the parental occupations as "blue collar" and "white collar" similar to the recent literature. However, as the incomes of these two groups are similar in our country, this variable was divided into occupations providing "regular" or "irregular" income. Parents' educational status was divided into four subgroups: "illiterate," "elementary school graduate," "high school graduate," and "university graduate." After preparation, the questionnaire was first piloted with a small group to determine whether the questions could be understood. The questions that could not be understood or answered by the survey population were rephrased.

Febrile seizures were defined as seizures occurring in infants and children between 6 months and 6 years old, accompanied by a fever of at least 38 °C before seizure onset [2]. FS were described to the parents as unconsciousness, fainting, unconscious movements or spasms of the extremities seen in children with fever higher than 38 °C. Children diagnosed with meningitis, encephalitis, or drug intoxication, children with gross structural abnormalities of the brain, and children with a history of afebrile seizures were excluded from the study. As it would be difficult to differentiate FS from fever-provoked seizures by a questionnaire, patients whose first episode of FS occurred at later than 72 months of age were excluded from the study. Recurrent FS was defined as the occurrence of more than one seizure during different febrile illnesses. We did not differentiate between FS types in the questionnaire, so the findings reflect the results of all FS types.

Data were analyzed using SPSS version 21.0 for Windows software (SPSS, Inc., Chicago, IL). The results are reported as means ± SD or n (%) where appropriate. In all analyses, $p < 0.05$ was taken to indicate statistical significance. The normality of the data distribution was checked using the Kolmogorov–Smirnov test for the whole group and for each subgroup. Statistical analyses were performed using the *t*-test for continuous variables and the χ^2 test for categorical variables. Logistic regression was performed to explain the variables affecting FS. Sociodemographic variables found to be significant on univariate analysis ($p \leq 0.25$) were included in the logistic regression models.

3. Results

Of the 5501 questionnaires initially sent out, parents of 3806 children completed the survey (69.2%). Of these 3806 cases, 30 were excluded from the study due to a diagnosis of intoxication, encephalitis, meningitis, or history of afebrile seizures. Finally, 3776 cases were included in the analysis. Of these, 49.3% were male, and the mean age of participants was 6.5 years (median age = 7 years). Of the 3776 children included in the investigation, 181 were reported to have experienced at least one FS (4.8%). Although FS prevalence was higher in boys (5.3%, n = 98) than in girls (4.3%, n = 83), the difference was not statistically significant (p = 0.105). There was no significant difference between age-specific prevalence rates of FS [4.1% (6 years) and 5.3% (7 years), p = 0.103]. A total of 76 children (41.9%) had a family history of FS, including 52 (28.7%) in their parents and 24 (13.2%) in their siblings.

Some sociodemographic variables of the study population are shown in Table 1. According to univariate analyses, the prevalence of FS was significantly associated with consanguineous marriage (OR: 1.54, 95% CI: 1.004–2.371, p = 0.046), developmental delay of the child (OR: 2.05, 95%CI: 1.277–3.302, p = 0.002), chronic illnesses requiring continuous medication (OR: 2.58, 95% CI: 1.596–4.167, p < 0.001), history of neonatal intensive care unit (NICU) admission (OR: 1.96, 95% CI: 1.252–3.065, p = 0.003), and maternal history of gestational hypertension (OR: 2.14, 95% CI: 1.326–3.443, p = 0.001). In addition, the prevalence of FS increased with decreasing parental education level (p < 0.001). There was no significant relationship between health insurance status and the prevalence of FS (p = 0.455).

Some characteristics of the seizures are shown in Table 2. Most occurred before 18 months of age and were associated with body temperature above 39 °C A total of 59 (32.9%) children had a history of recurrent FS. Among these, 39 children had two episodes, and 20 children had three or more episodes of FS (Table 2). Recurrence after the first FS was reported within the first 3 months in 20 (33.9%) children, after 3–6 months in 21 (35.6%) children, after 6–12 months in 10 (16.9%) children, after 12–24 months in five (8.5%) children, and after more than 24 months in three (5.1%) children. Among children with recurrent FS, 15.8% had developmental delay (p = 0.323), and 37.3% had their first FS episode before 18 months of age (p = 0.327).

The relationships between positive history of FS and study variables were analyzed by logistic regression. We eliminated similar variables from the analysis to obtain more reliable results. For example, because NICU history, intrauterine fetal growth retardation, type of delivery, and gestational age were related, NICU history was chosen for the analysis. Thus, gender, consanguinity, chronic illnesses requiring continuous medication, developmental delay, NICU history, maternal education level, paternal occupation, and history of gestational hypertension were included in the model. Chronic illness requiring continuous medication, developmental delay, NICU history, history of maternal gestational hypertension, and lower maternal education level (elementary school) were found to be significantly associated with the

Table 1
Some sociodemographic and clinical variables of the study population.

	Febrile seizure history				P
	Yes		No		
	N	%	N	%	
Gender					
Boy	98	5.3	1764	94.7	0.183
Girl	83	4.3	1831	95.7	
Consanguineous marriage					
Yes	26	6.9	352	93.1	**0.046**
No	155	4.6	3243	95.4	
Developmental delay					
Yes	21	8.9	216	91.1	**0.002**
No	160	4.5	3379	95.5	
Chronic illnesses that require continuous medication					
Yes	21	10.8	174	89.2	< **0.001**
No	160	4.5	3421	95.5	
Mother's occupation					
Housewife	125	5.2	2273	94.8	0.111
Employed	56	4.1	1322	95.9	
Father's occupation					
Regular	118	4.3	2632	95.7	0.118
Irregular	58	5.7	961	94.3	
Monthly income					
Lower income than expenses	51	5.5	883	94.5	
Income equals to expenses	109	4.5	2329	95.5	0.448
Higher income than expenses	21	5.2	383	94.8	
Mother's education					
Primary school	69	6.8	949	93.2	
High School	80	4.5	1712	95.5	**0.001**
University	32	3.3	934	96.7	
Father's education					
Primary school	66	7.2	850	92.8	
High School	74	4.1	1765	95.9	< **0.001**
University	41	4.0	980	96.0	
Kindergarten attendance					
Yes	95	4.3	2124	95.7	0.079
No	86	5.5	1471	94.5	
Type of delivery					
Vaginal	73	5.4	1282	94.6	0.203
Cesarian section	108	4.5	2313	95.5	
Gestational age					
Full-term	147	4.6	3061	95.4	0.254
Preterm	35	6.2	533	93.8	
Birth weight					
< 2500 g	26	6.5	371	93.5	
2500-3500 g	105	4.7	2143	95.3	0.335
> 3500 g	50	4.4	1081	95.6	
NICU history					
Yes	24	8.5	260	91.5	**0.003**
No	158	4.5	3334	95.5	
Intrauterine growth retardation history[a]					
Yes	9	11.7	68	88.3	**0.009**
No	164	4.5	3446	95.5	
Gestational hypertension history					
Yes	21	9.0	212	91.0	**0.001**
No	208	5.8	3335	94.2	
Gestational smoking history					
Yes	32	7.2	411	92.8	0.387
No	163	4.9	3170	95.1	

Bold values mean $p < 0.05$.
[a] As there are 89 missing data for the intrauterine growth retardation variable, the statistics were made by subtracting these cases. NICU: Neonatal intensive care unit.

prevalence of FS (Table 3).

Logistic regression analysis was performed to examine the combined effects of more than one variable on recurrence risk of FS (Table 4). There was no significant difference in FS recurrence rate between male and female children ($p = 0.284$), and the age at first FS was not significantly related to the risk of FS recurrence ($p = 0.077$). Among the clinical and sociodemographic variables, only the degree of fever was found to be an important risk factor for FS recurrence. The risk of FS recurrence was found to be approximately double in children who had FS at body temperature lower than 39 °C compared to those who had FS at temperatures higher than 39 °C. On the other hand, the duration of

Table 2
Some characteristics of febrile seizures.

	N	%
Age (first febrile seizure)		
< 18 m	58	32.4
18-35 m	51	28.5
3-4 yrs.	40	22.3
> 4 yrs.	30	16.8
Peak fever		
< 38 °C	29	16.0
38-39 °C	74	41.0
> 39 °C	78	43.0
Time between fever and seizure		
≤ 30 minutes	43	35.6
31-60 minutes	33	27.2
1-23 hours	37	30.6
≥ 24 hours	8	6.6
Recurrent febrile seizure		
No	120	67.1
Yes	59	32.9
Recurrent febrile seizure episodes		
2 episodes	39	66.1
3 episodes	9	15.2
4 episodes	3	5.1
5 episodes	4	6.8
≥ 6 episodes	4	6.8

*As there are 2 missing data from the first febrile seizure age variable, 60 missing data from the time between fever and seizure, and 2 missing data from the recurrent febrile seizure variable; the statistics were made by subtracting these cases.

Table 3
Sociodemographic risk factors for febrile seizure (logistic regression model).

Variables	d.f.	p	OR	95% CI	
				Lower	Upper
Gender	1	0.248	1.204	0.879	1.650
Consanguinity	1	0.433	1.205	0.757	1.918
Chronic illnesses that require continuous medication	1	**0.001**	2.320	1.397	3.852
Developmental delay	1	**0.049**	1.671	1.003	2.783
NICU history	1	**0.019**	1.752	1.097	2.797
Fathers' occupation	1	0.356	1.173	0.836	1.644
Gestational hypertension history	1	**0.038**	1.724	1.032	2.881
Mothers' educational level (University)[a]	2	**0.006**			
Primary school		**0.004**	1.968	1.246	3.109
High school		0.336	1.238	0.802	1.911

Constant -3.695.
Bold values mean $p < 0.05$.
[a] Reference group.

Table 4
Risk factors for recurrence of febrile seizures.

Variables	p	OR	95% CI	
			Lower	Upper
Gender	0.284	1.411	0.751	2.651
Fever (< 39 °C vs ≥ 39 °C)	**0.039**	1.985	1.301	3.821
First febrile seizure age (< 1 yr. vs ≥ 1 yr.)	0.077	0.397	0.158	0.996
Parental febrile seizure history	0.176	0.630	0.322	1.234
Sibling febrile seizure history	0.330	0.647	0.269	1.559
Consanguinity	0.246	1.767	0.669	4.666
Mothers' education (≤ 8 yrs. vs > 8 yrs.)	0.912	0.966	0.517	1.802
Kindergarten / day care history	0.746	0.902	0.483	1.685

Bold values mean $p < 0.05$.

the period between the fever and the FS episode was not a significant risk factor for FS recurrence (p = 0.860).

4. Discussion

The results of the present study indicated a prevalence rate of FS of 4.8% in children based on a school-based parent questionnaire conducted in Izmir, Turkey. As in most previous studies, there were no significant differences in prevalence rates of FS according to age or sex [2,9]. Elementary school education from 6 years of age has been obligatory in Turkey since 1997. To minimize recall difficulties, we conducted the surveys among students in grades 1 and 2. Our results were similar to those previously reported in the literature from Western countries [2,12–14]. In contrast, the prevalence rate determined here was lower than those reported previously in Asian and African countries [15–17]. Although the prevalence of FS in our country is uncertain, two previous studies reported prevalence rates of 4.5% and 3.5% [18,19]. However, in another study from Turkey, the FS prevalence rate in elementary school children was found to be 8.9% [20]. We found a lower prevalence rate compared to a previous study performed in the same geographical area by Aydın et al. (9.7% vs. 12.5%, respectively) [10,21]. These differences may have been due to methodological variations between studies. In addition, the reduction in prevalence of FS within similar populations may be partly due to improved education regarding parental behavior toward a child with a fever. Parental education level in this study was higher than that in the study by Aydın et al. [10]. Unfortunately, we did not have any information about parental attitudes toward fever in our study. Maternal and child health services in Turkey have improved in recent years [22]. Increased access to health services and improvement of the sociodemographic and economic conditions of families may also have contributed to our results.

We found that eight univariate sociodemographic risk factors were significantly associated with the occurrence of FS in children: chronic illnesses requiring continuous medication, history of developmental delay, consanguineous marriage, maternal education level, paternal education level, NICU history of children, history of intrauterine growth retardation, and history of gestational hypertension. In the multivariate analysis, chronic illnesses requiring continuous medication, history of developmental delay, NICU history of children, history of gestational hypertension, and maternal education level remained statistically significant.

Consanguineous marriage was a risk factor for FS in our study. It has been reported that FS shows a significant genetic predisposition. There is a tendency for familial aggregation of FS, and we speculated that the risk of FS may be increased by consanguineous marriage [23–25].

In the present study, chronic illnesses requiring continuous medication was associated with increased FS risk. Similar results have been reported in the recent literature [26–28]. For example, the prevalence of FS was significantly higher in children with comorbid atopic disorders than in other subgroups [29]. Recently, it was reported that iron deficiency anemia was associated with an increased risk of FS in children [30].

FS is known to occur during the period of neurodevelopmental maturation, and developmental delay is one of the risk factors of FS [31,32]. We found that children with developmental delay had 1.67 times higher FS risk than did children without such a delay in development. Gestational hypertension and intrauterine growth retardation were also found to significantly affect the prevalence of FS in the present study. All of these risk factors may prolong this maturation period and thus increase the risk of FS.

A history of NICU stay increased the risk of FS, similar to previous reports [8,27,31]. However, in contrast to previous studies, we did not detect a significant relationship between the duration of NICU stay and the prevalence of FS. This may have been caused by parents' inability to accurately recall the duration of NICU stay.

In contrast to a previous study by Aydın et al. [10], health insurance status, paternal occupation, and family income were not risk factors for FS in the present study. The General Health Insurance Law was enacted by the Grand National Assembly of Turkey in 2006, ensuring that all people under 18 years of age are included in the General Health Insurance system regardless of their parents' social security status [33,34]. These improvements have resulted in increased access to high-quality healthcare regardless of financial status, which may have reduced the prevalence rate of FS in the present study.

Similar to previous studies, we showed that maternal education level was significantly related to the prevalence of FS [10,35]. Logistic regression analysis showed that FS prevalence among children whose mothers graduated from elementary school was approximately double that of children whose mothers graduated from university. We speculated that mothers with higher education level would be much more conscious about their children's health and symptoms. They may also have appropriate knowledge of fever management, which would impede the development of FS.

In contrast to previous studies, we found that maternal occupation status did not affect the prevalence rate of FS [31,35]. Kindergarten attendance is a significant risk factor for FS, and it has been suggested that children whose mothers are working have a higher risk of FS because they attend kindergarten more often that those whose mothers stay at home [2,13,31,35]. A history of kindergarten attendance did not significantly affect the prevalence of FS in the present study, and maternal occupation status was not found to be a risk factor for FS. The kindergarten attendance rate was low, and grandparents seemed to be the most common caregivers of the children in our study population. These factors may also have contributed to our results.

Approximately one third of children with first FS will experience a recurrence [2,3,8,12]. Although there were some methodological difficulties in our study, FS was shown to recur in 32.9% of cases. The recurrence risk of FS was significantly increased only in children whose first FS occurred at a temperature below 39 °C. The duration between fever and FS was not shown to be a risk factor for recurrence, in contrast to previous studies [2,16,36,37]. Parents' recall may have played a role in these results.

Our study has several limitations. First, the questionnaire was designed in a retrospective manner, and recall bias may have interfered with the results. Second, the accuracy of the answers could not be confirmed by medical records. There was no clinical evaluation in the present study. On the other hand, the population-based questionnaire is the most practical method for assessing these parameters in large groups. To reduce recall bias, this study was performed in children 6–7 years old. As seizures are worrisome and frightening events for parents, it is unlikely that they would forget the details so quickly. Moreover, as it would be difficult to differentiate FS from fever-provoked generalized seizures by a questionnaire, subjects who had their first episode of FS later than 72 months of age were excluded from the study. Use of a school-based questionnaire survey enabled us to find cases in which no healthcare facility was contacted. Although bias cannot be excluded completely, the presence of a demographically similar control group should reduce the likelihood of systematic error, providing more realistic results. Third, due to methodological problems, we did not include some parameters, such as seizure duration or focal features of the seizure (type of FS).

5. Conclusion

In conclusion, within 10 years, the FS prevalence rate declined from 9.7% in an earlier study to 4.3% in our study population. However, it is still one of the most frequently encountered pediatric disorders. This cross-sectional study, among others, enabled us to identify sociodemographic risk factors of FS, but further and repeated studies are needed to confirm the effects of sociodemographic factors on FS prevalence.

Conflict of interest

The authors declare no financial or other conflicts of interest.

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Author contributions

Concept: Merve Ateşoğlu, Tolga İnce and Adem Aydın.
Design: Merve Ateşoğlu, Tolga İnce and Adem Aydın.
Data Collection or Processing: Merve Ateşoğlu, Duygu Lüleci, and Tolga İnce.
Analysis or Interpretation: Duygu Lüleci, Alp Ergör, Tolga İnce, and Adem Aydın.
Literature Search: Merve Ateşoğlu, Tolga İnce.
Writing: Merve Ateşoğlu, Tolga İnce.

Ethics committee approval

The study was approved by the Dokuz Eylül University Local Ethics Committee (approval number: 2015/28-15).

Informed consent

The patients provided written and verbal consent prior to the study.

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