

Prevalence and socioeconomic determinants of dental sealant use among schoolchildren in Saudi Arabia

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معدل انتشار استخدام الختّامات السنّية ومحدّداتها الاجتماعية لدى أطفال المدارس في المملكة العربية السعودية دانية إبراهيم العقيلي، هاني أحمد نيازي، ميري آن باس

الخلاصة: لا تتوافر تقارير منشورة عن بحوث أجريت حول معدّل انتشار ختّامات الأسنان لدى الأطفال في المملكة العربية السعودية. وتتعرف هذه الدراسة على معدّل انتشار استخدام الختّامات السنّية في الرّحى الدائمة، والمؤشّرات الاقتصادية والاجتماعية له، باستخدام عينة عشوائية طبّاقية من أطفال المدارس في جدة. وقد استخدم الباحثون نتائج مسح للتحرّي الأساسي الفموي بين الأطفال، قام به أطباء الأسنان، مع استخدام استبيان يُدار ذاتياً ويستكمّله الوالدان. واتضح أن معدّل انتشار ختّامات الأسنان لدى 1668 من طلاب السنوات الثالثة والثامنة يبلغ 9.0%، وأن الأطفال الذين يداومون في مدارس القطاع العام والذين ليس لأبائهم مستوى تعليمي يزيد عن الثانوية لديهم احتمال أقل بأن تجرى لهم ختّامات سنّية، وقد أظهر نموذج لوجستي تدرّجي أن الوضع الاقتصادي والاجتماعي للمنطقة التي توجد فيها المدرسة، والدخل الشهري للأسرة، ونمط منزل الأسرة، والتمتّع بضمان طبي، وتلقّي الدعم المالي من الحكومة، كلها عوامل ذات ترابط يُعتدُّ به إحصائياً مع استخدام الختّامات. ويبدو أن من الواجب تعزيز الجهود لزيادة استخدام الختّامات السنّية وإنقاص الفوارق الاجتماعية والاقتصادية، وذلك في ضوء المعدلات المرتفعة لأمراض الأسنان.

ABSTRACT There are no published research reports on the prevalence of dental sealant use in children in Saudi Arabia. This study determined the prevalence and socioeconomic indicators of dental sealant use on the permanent molars of a stratified random sample of schoolchildren in Jeddah. A basic oral screening survey of students was conducted by dentists and a self-administered questionnaire was completed by parents. The prevalence of dental sealant use among 1668 3rd and 8th grade students was 9.0%. Students who attended public schools and those who had fathers with lower than high-school education were less likely to have sealants. A stepwise logistic regression model showed that socioeconomic status of school district, family's monthly income, family's type of home, having medical insurance and receiving government financial support were significantly associated with sealant use. Efforts to increase sealant use and to reduce socioeconomic disparities appear warranted in the light of high rates of dental disease.

Prévalence et déterminants socioéconomiques de l'utilisation de la résine de scellement chez des élèves en Arabie saoudite

RÉSUMÉ Aucun rapport de recherche n'a été publié sur la prévalence de l'utilisation de la résine de scellement chez les enfants en Arabie saoudite. L'étude a déterminé la prévalence et les indicateurs socioéconomiques de l'utilisation de la résine de scellement sur les molaires permanentes d'un échantillon randomisé et stratifié d'élèves à Djeddah. Une enquête de dépistage de base de la santé bucco-dentaire des élèves a été menée par des dentistes et un auto-questionnaire a été rempli par les parents. La prévalence de l'utilisation de la résine de scellement chez 1668 élèves de 3e et de 8e années à l'école était de 9,0 %. Les élèves des établissements publics et ceux dont les pères n'étaient pas allés au lycée étaient moins susceptibles de porter des résines de scellement. Un modèle logistique par étapes a révélé que le statut socioéconomique du district de l'école, le revenu mensuel et le type de logement de la famille, le fait d'avoir une assurance médicale et de bénéficier d'une aide financière du gouvernement étaient des facteurs fortement associés à l'utilisation de la résine de scellement. Des efforts pour augmenter l'utilisation de la résine de scellement et pour réduire les disparités socioéconomiques semblent justifiés à la lumière des taux élevés des maladies dentaires.

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Introduction

Dental caries is the most common preventable chronic disease of childhood [1]. The prevalence of dental caries in children has declined in many developed countries yet remains high in most developing countries [2]. In Saudi Arabia, less than 10% of children are caries-free [3–8]. The decayed, missing and filled permanent teeth (DMFT) index values among 12-year-old children range from 3–5, indicating moderate to severe oral disease [8–10]. These values are still very far from the World Health Organization (WHO) 2000 global goals for oral health of no more than 3 DMFT in 12-year-old children and at least 50% of 6-year-olds caries-free [2].

Although fluoride use has been credited with much of the decline in dental caries worldwide throughout the past decades, it has limited effectiveness on the chewing surfaces (pits and fissures) of teeth [11]. Most of the untreated dental caries is found in the pits and fissures of molar teeth which represent only 12.5% of tooth surfaces [6,12]. Pit and fissure sealants are primary preventive measures for dental caries affecting molar teeth [13,14]. Scientific evidence shows that sealants are highly effective in preventing dental caries [15,16]. Reductions in dental caries range from 87% at 12 months to 60% at 48–54 months post-application [15].

Dental sealant use in children and adolescents varies worldwide. It is very high (50% or more) in northern European countries where comprehensive oral health care systems are available and services are offered free of charge to both children and adolescents [17–19]. In Greek children, only 8% of 12- and 15-year-olds had at least 1 sealed permanent molar. The educational level of parents and residence in urban areas were statistically significantly associated with a higher percentage of sealant use [20]. This can be compared with the United States (US), where 29% of 6–11-year-olds and 37% of 12–15-year-olds had

at least 1 sealed permanent tooth [21]. Moreover, dental sealant use is lower in non-white and low-income American children [21]. These rates are still well below the US Healthy People 2010 objective of 50% [22].

There are no published research reports on the prevalence of sealant use in children in Saudi Arabia, and strong, publicly supported dental sealant programmes are lacking. The aims of this study were to determine the prevalence of pit and fissure sealant use in the permanent molars of children and adolescents in Jeddah, Saudi Arabia, and to determine the socioeconomic indicators of sealant use. This research will help identify and target communities in need of dental public health prevention programmes.

Methods

Study design and sampling method

The study design was cross-sectional. A stratified random sample of schools was selected. School selection was stratified by grade (3rd or 8th), type (public or private), and region (geographical location in the city) using the Jeddah city schools' list. The number of schools in each region of Jeddah was verified and the schools were selected according to their actual proportions in the city. All 3rd and 8th male and female grade students in these schools were included.

Sample size

In 2008, there were 621 elementary and 400 middle schools, yielding a total of 38 951 3rd and 39 389 8th graders respectively. The schools in Saudi Arabia are segregated by sex. Using a 2:1 elementary to middle school ratio, 8 elementary schools from each sex (total 16) and 4 middle schools from each sex (total 8) were included in the study. Using the sample size calculator with a 95% confidence level and a confidence interval of 5, the minimum

recommended sample size was 380 3rd and 380 8th graders from each boys' and girls' school system. The sample was increased to 1600 (800 female and 800 male) students to account for non-responders. The final sample consisted of 1668 male and female students.

Procedure

The protocol of this study was approved by the ethics committee of the Deanship of Scientific Research in King Abdulaziz University, Jeddah, Saudi Arabia. Approval was also obtained from the director of the Department of Education prior to conducting the study. Next, the principals of selected schools were contacted in writing to explain the purpose of the study and to solicit their support and approval. Upon approval, a covering letter and a passive consent form were sent to parents. The parents were also asked to complete a questionnaire and to return it to school before or on the day of the dental screening.

Dental screening

The Basic Screening Survey (BSS) was chosen as a quick and easy method for conducting oral screenings among children [23]. A 2-hour didactic training session utilizing a Microsoft *PowerPoint* presentation and discussion was conducted to explain the criteria of the BSS to 4 dental examiners. This was followed by a 3-hour clinical training session with a master examiner to train those examiners on the BSS criteria and methods. Twenty (20) children from similar age groups as the study participants were screened in the dental clinic of the school of dentistry by the master examiner and the 4 dental examiners. Standardization and calibration of the examiners with the master examiner was performed. The inter-examiner and intra-examiner reliability were $\geq 90\%$ for detecting sealants and caries during this session prior to the start of the study.

On the actual visits, the dental screening was performed in a classroom with the student seated on a chair under

artificial illumination with a headlamp. A visual and tactile examination with the aid of a disposable mouth mirror and toothpick was performed. Using the BSS criteria each tooth was assessed for caries experience, untreated dental caries and dental sealants. Caries experience was determined by the presence of an untreated cavity, a filling or a permanent molar tooth that was missing because it was extracted as a result of caries. Untreated caries was marked as present or absent in primary and permanent teeth (present = 1, absent = 0). Sealants were marked as present if at least 1 permanent molar was sealed (present = 1, absent = 0).

Students' age, sex, grade and nationality were obtained during the dental screening sessions. In addition, the schools' type, district and region were recorded.

The schools were revisited twice to complete the dental screenings for students who were absent the day of the first visit and to collect any returned questionnaires. Written reminder notes and text messages were sent to parents who did not return their questionnaires after each visit to the school. On completion of the dental screenings, parents who did not return their questionnaires or those who had missed key questions in their questionnaires were contacted by phone by the same dental examiners to complete the questionnaires.

Parent questionnaire

A self-administered questionnaire was sent home with the students to their parents. The questionnaire was mainly developed from the BSS manual questions. Other questions were added. The questionnaire was translated into Arabic and then back to English to make sure the meaning of the questions were not altered. Questions about selected socioeconomic status (SES) indicators (family income, educational attainment of both parents, type of home and receipt of government financial support), medical insurance, dental

insurance, parents' perception of child's oral health, and child's utilization of dental services were included.

Monthly family income in Saudi riyals (SR) was categorized as: < SR 3000, SR 3000–7000, SR 7001–10 000, SR 10 001–15 000, SR 15 001–20 000 and > SR 20 000. Parental education was determined by taking the highest educational attainment achieved by each parent and was categorized as: illiterate, elementary school graduate, middle-school graduate, less than high school, high-school graduate, some college, college graduate, and higher than a college degree. Type of home was classified into low-cost housing (basic building materials, not reinforced with concrete); traditional apartment; and traditional house. Boys' and girls' schools were grouped into 4 regions according to their geographical location within the city: south, east, central and north for boys' schools and southeast, southwest, central, and north for the girls' schools. The schools' districts were classified into 5 SES levels (low, lower-middle, middle, upper-middle and high) based on the income of residents of these districts. The districts in the south area of Jeddah are the poorest, with about 70% of the government financial beneficiaries residing in the southern region of the city [personal communication, Saeed Al-Malki, Center for Statistics and Information, Jeddah, June 2010].

Data entry and statistical analysis

The data were entered into a Microsoft Access database from paper collection forms. After the data were checked for accuracy, they were imported into SAS, version 9.2 for statistical analysis. For analysis, family monthly income levels were consolidated into 3 levels: low (\leq 7000), middle (SR 7001–15 000) and high ($>$ SR 15 000). Parental education attainment was consolidated into 3 categories: less than high-school attainment, high-school graduate and greater

than high-school attainment. Finally, the SES levels of schools' districts were combined into 3 categories: low, medium and high. The prevalence of sealant use was calculated. The frequencies of children demographic factors, parents' SES indicators and school factors were calculated and their chi-squared statistics for sealant use were computed. Logistic regression models for dental sealant use and children's demographic and socioeconomic determinants were computed.

Results

Almost all the study students (1666/1668) were examined between March and June 2009 and 92% of parents of selected students completed and returned their questionnaires. The mean age of the sample was 12.1 [standard deviation (SD) 2.7] years: 9.1 (SD 0.7) years for 3rd grade students and 14.2 (SD 0.9) for 8th grade students. About 54% of the sample were 3rd graders and 60% were males. The characteristics of the study group and the study schools are shown in Table 1.

The overall caries experience was 83.1%: 91.6% in 3rd graders and 73.4% in 8th graders. The proportion of untreated dental caries in primary and permanent teeth of all students were 63.0% and 56.7% respectively. Overall, 9.0% had at least 1 sealed permanent molar (6.7% in 3rd graders and 11.4% in 8th graders) (Table 1). The students who had not received sealants were more likely to experience untreated caries than those who had received sealants. In 3rd graders the odds of caries in permanent teeth were 3 times higher among those who did not receive sealants compared with those who had received sealants (OR = 0.32, 95% CI: 0.17–0.56). In 8th graders these odds were 5 times higher among those who did not receive sealants as compared with those who did (OR 0.20; 95% CI: 0.12–0.33) (Table 2).

Table 1 Characteristics of the study group of school students and prevalence of dental sealant use

Variable	No. of students	%	Prevalence of sealant use %	χ^2 -value	<i>P</i> -value
<i>Student's age (years)</i>				11.5	< 0.001
< 12	885	53.1	6.7		
≥ 12	783	46.9	11.4		
<i>Student's sex</i>				11.6	< 0.001
Male	998	59.9	10.8		
Female	669	40.1	6.0		
<i>Student's grade</i>				12.0	< 0.001
3rd grade	891	53.4	6.6		
8th grade	777	46.6	11.5		
<i>Student's nationality</i>				19.0	< 0.001
Saudi	1153	69.4	11.0		
Non-Saudi	508	30.6	4.3		
<i>Student's receipt of school aid</i>				4.2	< 0.05
Yes	42	2.5	0.0		
No	1626	97.5	9.1		
<i>Mother's education</i>				68.7	< 0.001
Illiterate	171	10.9	2.9		
Below high school	572	36.7	4.0		
High school	397	25.5	6.6		
Above high school	419	26.9	17.5		
<i>Father's education</i>				50.2	< 0.001
Illiterate	67	4.3	1.5		
Below high school	502	32.5	3.4		
High school	409	26.5	6.6		
Above high school	568	36.7	14.5		
<i>Family income (SR)</i>				89.6	< 0.001
< 7000	940	62.7	3.7		
7001–15 000	397	26.5	10.8		
> 15 000	163	10.9	24.5		
<i>Home type</i>				73.7	< 0.001
Low-cost housing	348	22.1	0.9		
Apartment	935	59.4	7.7		
House	292	18.5	19.6		
<i>Family's receipt of government support</i>				0.22	
Yes	63	4.1	6.4		
No	1446	94.9	8.0		
<i>School type</i>				117.2	< 0.001
Public	1378	82.7	5.4		
Private	289	17.3	25.4		
<i>Boys' school region</i>				144.6	
South	187	18.7	2.1		
East	463	46.4	4.5		
Centre	178	17.8	12.4		
North	170	17.0	35.9		

Table 1 Characteristics of the study group of school students and prevalence of dental sealant use (concluded)

Variable	No. of students	%	Prevalence of sealant use %	χ^2 -value	P-value
Girls' school region				21.5	< 0.001
Southwest	261	39.0	2.3		
Southeast	130	19.4	1.4		
Centre	148	22.1	4.6		
North	130	19.4	11.2		
School district SES				36.8	< 0.001
Low	644	38.6	6.1		
Medium	446	26.7	21.6		
High	578	34.7	72.3		

Note: totals do not add up to 1666 because of missing data.
SES = socioeconomic status; SR = Saudi riyals.

The prevalence of sealant use varied significantly by student's sociodemographic factors, parent's educational attainment and by type, location and SES of the school (Table 1). The prevalence of dental sealants was significantly higher among male students, all students aged 12+ years, 8th graders and students attending private schools. The likelihood of having a child with at least 1 sealed permanent molar rose significantly with higher educational level of both mothers (χ^2 for trend = 9.3, $P < 0.05$) and fathers (χ^2 for trend = 6.8, $P < 0.05$). Similarly, families with a high income were significantly more likely to have a child with sealed teeth compared with medium- and low-income families.

Boys' schools located in the north area of Jeddah had the highest rate of students with dental sealants (35.9%) ($P < 0.05$), followed by central Jeddah (12.3%). East and south areas had the lowest rates (3.7% and 2.1% respectively). Girls' schools located in the north and central regions of Jeddah had significantly more students with sealants (11.15% and 4.6% respectively) compared with the southwest and southeast of Jeddah (2.3% and 1.4% respectively).

Of the responding parents 22.2% reported that their child received dental care from public dental clinics, 71.7% from private dental clinics and 6.1% from King Abdulaziz University School of Dentistry dental clinic. The prevalence of sealant use among these groups

was 6.2%, 10.4% and 16.4% respectively ($\chi^2 = 7.21$, $P < 0.05$). In addition, nearly two-thirds (65.1%) of responding parents reported that their child had been to the dentist before for different reasons. Among the children who had been to a dentist, only 13.3% received dental sealants ($P < 0.001$). The reasons reported by parents for taking their child to a dentist included: check-up or cleaning (32.2%), toothache or cavities (63.1%) and for treatment (4.7%). Only 14.8% of children who had check-ups or cleaning, 6.1% of those who went for cavities or toothache and 14.0% of those who went for treatment had sealants placed on at least 1 permanent molar ($P < 0.001$). Only 4.8% of students who had caries in their primary teeth had

Table 2 Sealant use by presence of untreated dental caries in 3rd and 8th graders

Untreated dental caries	Sealant use				χ^2 -value	OR (95% CI)
	No		Yes			
	No.	%	No.	%		
Primary teeth of 3rd graders (n = 880)						
Present	680	82.7	35	60.3	17.8	0.32 (0.18-0.56)
Absent	142	17.3	23	39.7		
Permanent teeth of 3rd graders (n = 890)						
Present	467	56.2	17	28.8	16.7	0.32 (0.17-0.56)
Absent	364	43.8	42	71.2		
Permanent teeth of 8th graders (n = 775)						
Present	437	63.7	23	25.8	46.8	0.20 (0.12-0.33)
Absent	249	36.3	66	74.2		

OR = odds ratio; CI = confidence interval.

Table 3 Logistic regression analysis of the association between child and family characteristics and dental sealant use

Variable	OR (95% Wald CI)
School type	
Public	0.41 (0.26–0.66)
Private	ref
School grade	
3rd	0.74 (0.50–1.09)
8th	ref
Sex	
Male	1.66 (1.07–2.57)
Female	ref
Nationality	
Saudi	1.31 (0.78–2.22)
Non-Saudi	ref
Mother's education	
Below high school	0.71 (0.39–1.29)
High school	ref
Above high school	1.62 (0.97–2.72)
High school	ref
Father's education	
Below high school	0.51 (0.27–0.98)
High school	ref
Above high school	1.21 (0.72–2.04)
High school	ref

Wald $\chi^2 = 98.2$, $P < 0.001$.

Ref = Reference group; OR = odds ratio; CI = confidence interval.

sealed permanent molars compared with 11.9% of students who did not have caries in their primary teeth ($\chi^2 = 19.9$, $P < 0.001$). The comparative figures for sealant use among students with and without caries in their permanent teeth were 4.3% and 14.9%, respectively ($\chi^2 = 57.2$, $P < 0.001$).

A multivariate logistic regression model of sealant use is shown in Table 3. The odds of having sealants on permanent molars were significantly higher in children attending private schools compared with students in public schools (OR = 0.41, 95% CI: 0.26–0.66). In addition, fathers with less than high-school education were significantly more likely to have a child without sealants compared with fathers with high-school diplomas.

Pearson correlation coefficients were calculated for all socioeconomic

variables. Medical and dental insurance ($r = 0.7$, $P < 0.001$) and mother's and father's educational attainment ($r = 0.6$, $P < 0.001$) were significantly associated with each other. Dental insurance and father's education attainment were therefore dropped from the logistic model of socioeconomic predictors of sealant use.

A stepwise logistic regression selection procedure was used to identify the most significant socioeconomic variables that determined sealant use among children. The following variables were entered: mother's education attainment, family's income, family's receipt of government financial support, student's receipt of school financial aid, medical insurance, school type and SES of school district. Five predictors met the 0.05 significance level for entry into the model (Table 4). These were: SES

of school district, family's monthly income, family's type of home, medical insurance and government financial support.

Discussion

This study assessed the prevalence of sealant use in the permanent molars of 3rd and 8th grade schoolchildren and determined the socioeconomic determinants of sealant use in this group. Overall 9.0% of children had at least 1 sealed permanent molar and the use of sealants was much lower among children from lower socioeconomic backgrounds. Specifically, disparities in dental sealant use were noted in children of low-income families, children whose parents have low education attainment levels, children who live in low-cost housing and those who attend public schools located in low SES districts.

Unfortunately, data on sealant use from countries located in the same region are missing. Our result is similar to that reported for adolescents in Greece, where only 8% had at least 1 sealed permanent molar. The comparative prevalence of dental sealants on permanent teeth of US children and adolescents was 32% in 1999–2002 [21]. In addition, the current percentage (9%) of sealed permanent teeth in Saudi children was even less than the percentage (22%) reported for US children and adolescents living below 100% federal poverty level [21].

Despite the safety and effectiveness of sealants, they are still underutilized in the prevention of dental caries in Saudi children [24]. Our findings indicate that more than 80% of 3rd and 8th grade children had dental caries and about 60% suffered from untreated dental decay. These findings provide evidence for the pressing need for comprehensive public oral health prevention programmes for children. Oral health education on its own may not

Table 4 Stepwise logistic model of the association between students' socioeconomic characteristics and dental sealant use

Variable	OR (95% Wald CI)
School SES district (high versus medium ^a)	1.65 (1.01-2.70)
School SES district (low versus medium ^a)	0.25 (0.10-0.60)
Family income (high versus middle ^a)	1.51 (0.87-2.61)
Family income (low versus middle ^a)	0.57 (0.35-0.99)
Housing (low-cost versus house ^a)	0.16 (0.03-0.74)
Housing (apartment versus house ^a)	0.78 (0.47-1.29)
Medical insurance (yes versus no ^a)	1.61 (1.04-2.50)
Government support (yes versus no ^a)	0.17 (0.05-0.61)

^aReference group.

SES = socioeconomic status; OR = odds ratio; CI = confidence interval.

be enough to bring these alarming rates down. A school preventive oral health programme can incorporate several elements, such as oral health education, dental screenings, referral for dental treatment, fluoride mouth-rinsing and sealant applications [25]. Immediate measures must be taken to reach out to these children, particularly those of lower SES. Targeting high-risk schools to reach high-risk children is a practical and effective approach for increasing sealant prevalence [26]. Collaboration among different government agencies and providers is critical for implementing and sustaining such programmes.

Our study also showed that sealants were underutilized by dentists. There may be many missed opportunities for placing dental sealants in children who attend dental visits, especially among those who attend for prevention rather than for emergency treatment. Farsi reported that one-third of private dentists in Jeddah did not use any sealants in their practice [24]. Reasons for underutilization of dental sealants reported by these dentists included patients' low valuation of sealants, patients' unwillingness to pay for sealants, short survival of sealants in the mouth, not treating enough children and reduced cost-effectiveness compared with amalgam restorations [24]. Therefore,

to increase sealant utilization at the public and individual levels, dentists need to be educated and motivated to use dental sealants on children's teeth. Sustained efforts, however, are needed to change their attitudes towards use of dental sealants [24]. Furthermore, community education on the values of dental sealants in the prevention of dental caries should be part of any oral health promotion programme.

The significant socioeconomic determinants of sealant use were SES of school district, family's monthly income, family's type of home, medical insurance and government financial support. These findings can help us to develop and implement cost-effective public oral health prevention programmes targeted at high-risk children. School-based or school-linked programmes that target low-income schools are one way of implementing such programmes [27]. Federally subsidized school lunch programmes in the US provide a successful means for identifying children from low SES communities in high need for both dental prevention and intervention [28,29]. Such children have consistently higher levels of oral disease and lower prevalence of sealant use compared with children from higher SES communities [28,29]. Similarly, ownership of a medical card by a child

in the UK is used to identify high-risk children who benefit most from these interventions [30].

The strengths of this study include its high response rate (92%) and the use of stratified and proportional random sampling, which rendered our findings representative of schoolchildren in Jeddah, Saudi Arabia. The fact that this was a cross-sectional study limited the ability to assess a cause-effect relationship between low sealant use and SES determinants. In addition, the temporal relationship between sealant use and caries was difficult to assess. Therefore, it is possible that these children received dental sealants because they had caries.

In conclusion, the prevalence of sealant use on permanent teeth of children and adolescents in Jeddah is low, and disparities in sealant use existed among children from different SES groups. Based on the findings of this study, schools located in lower SES districts in Jeddah with high numbers of children living in low-cost housing can be used to target effectively children in need of oral health intervention programmes. Implementing and sustaining these programmes could increase the prevalence of dental sealant use and eventually help reduce disparities in dental caries prevalence among children.

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