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Tooth brushing and social characteristics of families in 32 countries

Lea Maes, Carine Vereecken and Jacques Vanobbergen
Ghent, Belgium
Sisko Honkala
Jyväskylä, Finland

Objectives: To compare the reported tooth brushing behaviour among adolescents in relation to age, gender and parental occupation, family affluence, single parent family and at least one parent not working but staying at home. **Methods**: Representative samples of 11-, 13- and 15 year old pupils in 32 countries completed an anonymous standardised questionnaire during school hours. **Results**: Large differences in prevalences of reported tooth brushing were found between countries for both genders: from 16-80 % for boys and 26-89% for girls. In some countries the prevalence of more-than-once-a-day tooth brushing increased by increasing age, whereas in others it declined. High occupational status and family affluence were clearly related to a high prevalence of more-than-once-a-day tooth brushing. Children living in two parent families had higher prevalences of recommended tooth brushing in only a few countries. **Conclusions**: Within the European continent and in North America, gender, family affluence and parental occupation were significantly associated with reported tooth brushing frequency among adolescents. The association between family characteristics, such as absence of one of the parents and the supervisory role of the parents, and brushing behaviour of the children appeared to be rather weak and inconsistent.

Key words: Tooth brushing, adolescents, socio-economical status, family structure, gender

Emphasis on health promotion research should be changed from studies on the association between diseases and their risk factors to the association between the determinants of diseases and their risk factors[1]. The two main dental diseases, caries and periodontal disease, can be considered as behavioural diseases, because they can be prevented simply by good oral hygiene and by restricting the frequency of sugar consumption[2]. Tooth brushing is the most effective method of oral hygiene and the universally recommended frequency has been twice a day[3,4].

Although the prevalence of tooth brushing twice a day is high in some countries, large geographical and gender differences exist in European and North American countries[5,6]. Gender differences in brushing in adolescents have been reported often, with girls brushing more frequently than boys[5-9]. Some authors have explained these gender behaviour differences according to social and psychological impacts of oral health, finding that women perceived oral health as having a greater impact than men on their quality of life in general[10].

The association between socio-demographic factors and oral health, including oral health behaviour has been investigated in many studies. Dental health behaviour in children and young adolescents was related to ethnicity and social class, such as maternal education and parental occupation status[11-13]. Tooth brushing habits of adolescents have been shown to reflect their future education level as adults, even after controlling for school achievement and socio-demographic background[14]. Tooth brushing habits most probably reflect the broader context of the life-style of adolescents rather than only dental behaviour.

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Tooth brushing habits are initiated at early ages in the family context, with mothers having a key role in their adoption[15,16], but a strong association has also been shown during adolescence between parents' and adolescents' tooth brushing[17,18]. Parents are responsible for promoting children's wellness, ameliorating their illness and providing the context within which they develop patterns of health behaviour[19,20]. A variety of parental factors have been identified as affecting this, including socio-demographic factors (e.g. social class, ethnicity), structural factors (e.g. family size, parents' employment, ordinal position) and system characteristics (e.g. mother child interaction patterns). Adolescence is an important period for learning and maintaining health-related behaviours that then continue into adulthood[21].

The effects of family characteristics, such as one parent families and families where both parents are working outside the home, have not been studied in relation to oral health behaviour. However, one of the most significant social changes that has occurred in many countries over the last few decades is the increase in numbers of children living in single parent families or stepfamilies[22]. Sweeting *et al.*[23], in their review of the literature, showed that adolescents from non-intact families were at greater risk of poor educational progress such as higher rates of truancy and leaving school at an early age, "deviant" or problem behaviour such as criminal activity and running away from home, as well as higher rates of risk behaviours. While several studies have investigated the relationship between family structure and health related behaviours, it is not clear in many of these studies to what extend such outcomes may be a direct result of family structure or processes rather than the poorer socio-economic circumstances of one parent families and stepfamilies compared to intact two-parents families[24]. If both parents of the child are working, this has an influence on available (free) time that can be spent with the child, however, the impact on health behaviour and oral health behaviour in particular has not been investigated in depth. In an adolescent population, family characteristics were observed to be important for adolescent's perceived oral health[25]. Children who lived with a single mother or with neither parent perceived their oral health to be poorer and reported higher frequencies of gingival bleeding significantly more often than those who lived with both parents. Associations between parental employment and self-perceived oral health were weak.

The aim of this study was to compare the reported tooth brushing behaviour among adolescents in European and North American countries in relation to age and gender to several social characteristics of the families: parental occupation, family affluence, single-parent family and at least one parent not working but staying at home.

Material and methods

Study design

This study is based on the Health Behaviour in School-aged Children study (HBSC), which was started in 1983/84 in Austria, Finland, Norway, and England[26]. Since then, surveys have been conducted at four-yearly intervals. The HBSC study is a WHO collaborative cross-national survey, conducted in an increasing number of European countries, the US, Canada and Israel. The overall goal of the study is to gain new insights into, and to increase understanding of, health behaviour, lifestyles and their context in young people. The survey instrument is an international standard questionnaire. The questionnaire consists of a number of core questions, which are similar in all participating countries, and focus questions which allow those countries to include additional questions of national interest. Information in relation to tooth brushing, socio-demographics and family structure are collected as part of the core questions. The uniform measures, sampling and implementation procedures of the HBSC study, designed to be consistent across the participating countries, provide the unique opportunity to allow between country comparisons of the prevalence of these behaviours and the relationships between these variables.

Data collection and subjects

The present data were obtained from 32 countries or regions participating in the HBSC 2001/2002 survey. In each country, cluster sampling was used where the cluster was the school class. Schools and classes within schools were selected to be representative for 11-, 13- and 15-year-old schoolchildren. The recommended minimum sample size for each country was 1,536 students per age group, to assure a 95% confidence interval of +/- 3% for prevalence estimates. The sample size included a design factor of 1.2 because of the cluster sampling based on the design factor of 1.2 used on analyses of the 1993-1994 and 1997-1998 survey. The data were collected by means of standardised questionnaires, administered in school classrooms according to the international protocol[27]. The school response rates of the countries ranged from 36% to 100%.

Tooth brushing

Tooth brushing habit was measured by the following question: How often do you brush your teeth? Answer options were: more than once a day; once a day; at least once a week but not daily; less than once a week; never. As it is advised to brush your teeth twice a day, response options were dichotomised into 'more than once a day' and 'once a day or less often'.

Family structure

A considerable number of children live in complex families (e.g. when parents are divorced). The question about family structure was subdivided in two columns. In the first column, the child had to indicate on a checklist with which parent he/she lived in his/her main home. If a child also had a second home, he/she had to indicate in the second column the people with whom he/she lived in that home. The checklist included father, mother, stepfather, stepmother, siblings and extended family or other adults as well as an option of living in a foster home or children's home. The family structure variables were then recoded into two categories: single parent or two parents living in the main home. No distinction was made between natural or stepparents as in all countries but five, tooth brushing frequencies did not differ between children from step families and natural families. Children living with grandparents, in a children's home etc. were excluded from the current analyses.

Parental occupation

Parental occupation was recorded from questions asking students about their parents' jobs. Countries were required to classify the answers into six categories labelled from 1 (high occupational status) to 5 (low occupational status) and 6 (not working). For the analyses, responses were classified on the basis of the occupation of the 'head of the household' and the original six categories were recoded into three categories: high (1-2), middle (3), and low (4-6). The head of the household was defined as the person who had the dominant occupational position.

Housewife (husband)

This variable was derived from the parental occupation question and 'housewife/husband' was made operational as a deliberate choice of one of the parents to stay at home. All parents that were marked by the children as 'he/she takes care of others or is full time at home' were included in the 'housewife/husband' category. This category also included single parents staying at home.

Family affluence

A measure of family wealth, the Family Affluence Scale (FAS) was developed for earlier HBSC-studies[28,29] and expanded with an item on computer ownership in the 2001/02 survey. The FAS is conceptually related to indices of material deprivation. The following items are included: family car ownership (no=0; yes, one=1; yes, two or more=2), bedroom occupancy (no own bedroom=0; yes=1), family holidays (no family holidays in last 12 months=0; one=1; two or more=2), family computers (none=0; one=1; two or more=2). For these analyses a three point ordinal scale was computed, where FAS 1 (scores = 0 to 3) indicated a low affluence; FAS 2 (scores = 4, 5) indicated middle affluence; and FAS 3 (scores = 6, 7) indicated high affluence.

Statistics

The dataset was analysed using SPSS version 11.0. The analyses were accomplished for each country separately. Respondents who did not answer one or more questions were excluded from analyses. Two countries with more than 50% non-responded questions on the parental occupation questions were excluded from the analyses as well as one country with a very low number of respondents in the housewife (husband) variable. Due to missing data on several variables in a few countries the sample used in this analysis was about 75% of the original sample. An analysis of the missing data revealed a slightly lower tooth brushing frequency in a few countries for these respondents.

Univariate analysis was performed between more-than-once-a-day tooth brushing and age, family structure, housewife/husband, parental occupation, and FAS. The same explanatory variables were used in multiple logistic regression analysis and associations were expressed as odds ratios (OR). Multiple logistic regression analysis was used to analyse the simultaneous associations of age, gender, family wealth, parental occupation, family structure and housewife/husband with tooth brushing. All independent variables were entered in the multiple logistic regression models as categorical variables. All tests were two-sided and statistical significance was assumed when $p<0.05$.

Results

Tooth brushing by age and gender

The results from the univariate analyses of more-than-once-a-day tooth brushing frequencies by gender and age for each country are presented in *Table 1*. Countries were grouped by geographical region.

Prevalence for tooth brushing more than once a day for adolescents aged 11- to 15-year-olds was highest in Switzerland (80% for boys and 89% for girls). High prevalence of tooth brushing was also observed in the Northern European countries, in Germany, and in the Netherlands. The overall lowest prevalence of more-than-once-a-day tooth brushing was found in Malta (16% for boys and 26% for girls). Prevalence was also very low in the Eastern and Southern European countries. There were large prevalence differences between the countries in each region. In all countries tooth brushing prevalence was higher among girls than among boys. The countries with the largest gender differences (≥ 20%) were Finland, Poland, Estonia,

Table 1 Tooth brushing more than once a day by age and gender in different countries/regions in the HBSC study 2001/02

	Gender				Age							
	Boy	Girl			11	13	15	13		15		
Country	%	%	OR	p	%	%	%	OR	p	OR	p	N
Israel	57	72	1.93	+++	67	64	60	0.87		0.74	---	4727
North America												
USA	65	79	2.08	+++	72	72	74	1.02		1.13		4009
Canada	63	78	2.06	+++	70	69	72	0.97		1.14		3551
Central and Eastern Europe												
Croatia	42	62	2.29	+++	54	50	52	0.85	-	0.96		4146
Czech Republic	56	75	2.35	+++	68	62	65	0.77	---	0.88		4723
Estonia	48	69	2.33	+++	56	56	63	0.99		1.33	+++	3834
Hungary	54	68	1.82	+++	58	61	63	1.10		1.27	++	3729
Latvia	40	59	2.23	+++	50	45	54	0.80	-	1.19		2889
Lithuania	32	48	2.00	+++	38	40	42	1.08		1.18	+	4366
Macedonia	50	65	1.91	+++	64	54	54	0.65	---	0.66	---	3224
Poland	53	75	2.75	+++	61	64	67	1.14		1.35	+++	5814
Russia	52	71	2.33	+++	58	62	64	1.21	++	1.34	+++	6933
Slovenia	49	67	2.13	+++	59	59	56	0.97		0.87		3520
Ukraine	41	55	1.80	+++	49	46	48	0.90		0.94		3623
Northern Europe												
Denmark	74	84	1.89	+++	77	79	80	1.12		1.19		3449
Finland	31	53	2.51	+++	40	41	45	1.04		1.25	++	4511
Norway	75	85	1.98	+++	78	81	81	1.22	+	1.23	+	4203
Sweden	77	85	1.71	+++	80	80	83	1.03		1.26	+	3234
Southern Europe												
Greece	41	56	1.82	+++	52	46	47	0.78	--	0.80	--	3617
Italy	54	74	2.42	+++	57	65	70	1.42	+++	1.84	+++	4106
Malta	16	26	1.83	+++	26	19	18	0.70	-	0.62	--	1723
Portugal	47	68	2.34	+++	53	57	62	1.16		1.49	+++	2499
Spain	43	60	1.97	+++	56	49	49	0.74	---	0.75	---	5514
Western Europe												
Belgium Fl	39	56	1.96	+++	47	47	49	1.01		1.13		5665
Belgium Fr	45	58	1.71	+++	48	51	55	1.15		1.34	++	3180
France	56	71	1.96	+++	58	64	68	1.29	+++	1.55	+++	7447
Germany*	71	84	2.07	+++	79	77	76	0.91		0.85	-	4967
Ireland	50	68	2.10	+++	57	60	59	1.17		1.17		2652
Netherlands	73	80	1.43	+++	79	77	73	0.87		0.73	--	3035
Scotland	61	77	2.04	+++	67	70	71	1.14		1.20		3488
Switzerland	80	89	2.02	+++	85	86	83	1.13		0.89		3985
Wales	60	78	2.37	+++	67	69	70	1.12		1.18		3092

* regional sample
+/-:p<0.05, ++/--p<0.01, +++/---p<0.001

Portugal, Croatia and Italy. The smallest gender differences (≤ 10%) were found in the Netherlands, Sweden, Switzerland, and Malta.

The prevalence of more-than-once-a-day tooth brushing according to age seemed to be inconsistent. An increasing trend according to increasing age was consistent and clear in Italy, France, Russia, and Norway. In addition, the 15-year-olds had the highest prevalence in Portugal, Poland, Belgium Fr., Estonia, Hungary, Sweden, Finland, and Lithuania. A declining trend according to increasing age was found in Macedonia, Greece, Spain, Israel, Malta, Germany, and the Netherlands.

Tooth brushing by family characteristics

Children living in a family with two parents had a higher prevalence of more-than-once-a-day tooth brushing in nine countries (Switzerland, Ireland, Sweden, the Neth-

erlands, Norway, Canada, France, Scotland, and Russia) (*Table 2*). No countries appeared to have significantly higher prevalence in tooth brushing frequency among the children living in a single-parent family than in families with two parents. The presence at home of a non-working parent seemed to be associated with lower tooth brushing prevalence in 14 countries Slovenia, Denmark, Portugal, Norway, Israel, Croatia, Lithuania, Estonia, the Netherlands, Malta, Hungary, Germany, Poland, Spain; (OR 0.44-0.86). Only in the USA was it associated with a higher prevalence of brushing. In all countries, there was a positive relationship between high parental occupation and more-than-once-a-day tooth brushing, except in France. This association was strongest in Poland, Slovenia, Hungary, Scotland, Malta, Portugal, Croatia, Czech Republic, Lithuania, and Germany (OR >1.60). Also with family wealth (FAS) a consistent positive relationship was found in all countries except Finland and Norway. The strongest association with FAS (OR ≥ 2.00) was found for Macedonia, Portugal, Poland, Hungary, Lithuania, Malta, Slovenia, Ukraine, Russia, Croatia, and Sweden.

Multivariate analysis

The multivariate analyses tested the independent effect of age, gender and each of the family characteristics (*Table 3*). The strong relationship between gender and tooth brushing was confirmed for all countries: girls brush their teeth more frequently than boys (OR from 1.46 to 3.02). The largest gender difference was found in Poland, Portugal, Finland, Czech Republic, Italy, Croatia, Russia, and Estonia (OR > 2.40). The countries with the smallest gender difference were the Netherlands, Sweden and Belgium Fr. (OR < 1.90).

Consistent, significant positive associations between prevalence of tooth brushing and age was found only in Italy, France, and Russia (OR > 1.20). The 15-year-olds had a higher prevalence of more-than-once-a-day tooth brushing than 11-year-olds in Portugal, Poland, Belgium Fr., Estonia, Hungary, and Finland. However, lower prevalence among 15-year-olds compared to 11-year-olds was found in Macedonia, Greece, Spain, Israel, Malta, Germany, and the Netherlands (OR < 0.80).

Children living in a family with two parents had a higher prevalence of recommended tooth brushing in Switzerland, Norway, and France. Only in Lithuania did the children in a single-parent family have a higher prevalence of recommended tooth brushing frequency. The presence of one parent at home was significantly inversely associated with recommended tooth brushing in nine countries (Denmark, Slovenia, Norway, Estonia, Portugal, the Netherlands, Croatia, Israel, Lithuania; (OR < 0.85). Only in the US was the housewife/husband variable (at least one parent staying at home) associated with a higher prevalence of more-than-once-day tooth brushing. The highest parental occupation status was significantly associated with a high prevalence of tooth brushing in all countries except in France, Estonia, Wales, and Israel. High family wealth (FAS) was associated with the highest prevalence of tooth brushing in all countries except in Finland, Norway, and Latvia.

Discussion

The results of the present Health Behaviour in School-Aged Children survey, using reported data, confirmed the existence of large differences in tooth brushing behaviour of schoolchildren in 32 different countries or regions. The prevalence of more-than-once-a-day tooth brushing frequency seemed to be the highest in Switzerland, Sweden, Norway, Denmark, Germany, the Netherlands, the USA, and Canada. Malta had the lowest prevalence among both genders. There is still much work to be done to reach the guideline of at least twice-a-day tooth brushing for all adolescents in all countries.

In all 32 countries, more girls than boys reported brushing their teeth as recommended. Gender differences in health behaviour have been reported previously in several countries[5,7,9,30-33]. The evidence of this association was strengthened by adjusting for differences in family wealth characteristics and parental occupational status. The use of a validated compound score as a measure of family wealth at individual levels contributes to this.

In most of the countries, the prevalence of recommended tooth brushing seemed to increase according to increasing age, indicating an improvement in adopting the twice-a-day tooth brushing habit when adolescents were approaching adulthood. However, it is difficult to explain why the 15-year-olds in some Southern European countries and in Germany had lower prevalence than 11-year-olds. Earlier studies have shown quite consistent patterns of tooth brushing after adoption of the recommended habit[7,33-35].

Family characteristics were studied by family structure, the presence of one parent at home, parental occupation, and family wealth variables. High occupational status and affluence were clearly related with a high prevalence of tooth brushing. Family characteristics were expected to be strongly related to tooth brushing, because the parents, especially mothers, have been shown to have a strong influence on their children's tooth brushing during childhood[15,16]. During adolescence the role of both parents has been shown to be important[17,18] Occupational and educational status of the parents have also been shown to be related to tooth brushing habits of the children in several studies[5,7,14,30]. This study confirmed the strong association between recommended tooth brushing and occupational status and affluence in all countries studied.

Gender, the family affluence scale and the parental occupational status were the factors associated with more-than-once-a-day prevalence of tooth brushing in

Table 2 *Tooth brushing more than once a day by family characteristics in different countries/regions in the HBSC study 2001/02*

	Family structure				Housewife/husband				Parental occupation							Family Affluence Scale						
	single	2 parents			no	yes			low	middle	high	middle		high		low	middle	high	middle		high	
Country	%	%	OR	p	%	%	OR	p	%	%	%	OR	p	OR	P	%	%	%	OR	p	OR	p
Israel	60	65	1.21		65	57	0.68	---	59	64	67	1.23	+	1.47	+++	55	66	68	1.61	+++	1.95	+++
North America																						
USA	70	73	1.19		72	78	1.36	+	69	72	75	1.18		1.34	+++	66	69	76	1.17		1.70	+++
Canada	66	71	1.28	+	71	70	0.96		66	69	73	1.20		1.50	+++	63	68	74	1.25		1.74	+++
Central and Eastern Europe																						
Croatia	47	52	1.24		55	47	0.69	---	47	54	60	1.34	+++	1.77	+++	46	55	60	1.56	+++	2.01	+++
Czech Republic	65	65	1.02		65	62	0.87		59	64	70	1.26	++	1.68	+++	60	68	71	1.53	+++	1.90	+++
Estonia	58	58	1.08		59	51	0.72	--	57	58	61	1.08		1.25	++	55	60	61	1.37	+++	1.52	+++
Hungary	62	61	0.95		62	55	0.77	--	51	58	70	1.34	++	2.35	+++	52	65	70	1.81	+++	2.50	+++
Latvia	47	50	1.16		49	49	0.93		46	50	53	1.18		1.33	++	48	51	51	1.29	++	1.41	++
Lithuania	43	40	0.89		41	35	0.71	---	36	41	48	1.23	+	1.70	+++	34	45	52	1.67	+++	2.50	+++
Macedonia	52	58	1.20		58	58	1.05		56	54	63	1.01		1.51	+++	51	59	72	1.55	+++	2.88	+++
Poland	66	64	0.95		65	62	0.85	-	57	68	76	1.68	+++	2.53	+++	57	68	73	1.74	+++	2.51	+++
Russia	59	62	1.15	+	61	63	1.09		59	62	64	1.15	+	1.31	+++	59	64	70	1.33	+++	2.02	+++
Slovenia	56	58	1.08		59	42	0.44	---	51	61	69	1.55	+++	2.22	+++	48	58	66	1.55	+++	2.32	+++
Ukraine	48	48	0.99		48	49	1.06		45	51	51	1.28	+	1.28	+++	45	53	60	1.48	+++	2.26	+++
Northern Europe																						
Denmark	78	79	1.07		79	67	0.56	-	76	81	82	1.29	+	1.54	+++	73	78	82	1.35	+	1.85	+++
Finland	43	42	0.95		42	42	0.99		38	43	45	1.23	++	1.31	+++	43	43	41	1.02		1.01	
Norway	76	81	1.30	++	81	73	0.66	--	77	80	84	1.20	+	1.54	+++	76	79	81	1.24		1.39	
Sweden	77	82	1.37	++	81	76	0.70		77	82	84	1.38	+	1.51	+++	72	80	83	1.60	++	2.01	+++
Southern Europe																						
Greece	43	49	1.26		49	47	0.94		45	48	54	1.15		1.49	+++	43	50	53	1.41	+++	1.66	+++
Italy	67	64	0.93		64	65	1.02		62	64	68	1.30	++	1.50	+++	59	65	69	1.34	+++	1.70	+++
Malta	21	21	1.07		22	19	0.76	-	17	20	27	1.22		1.99	+++	18	21	32	1.30	+	2.36	+++
Portugal	61	57	0.83		59	49	0.65	---	51	62	66	1.56	+++	1.84	+++	48	56	68	1.45	+++	2.62	+++
Spain	52	51	1.00		52	48	0.86	-	48	54	54	1.29	+++	1.33	+++	45	52	55	1.42	+++	1.65	+++
Western Europe																						
Belgium Fl	46	48	1.09		48	47	0.99		45	46	52	1.03		1.33	+++	42	46	52	1.20	+	1.54	+++
Belgium Fr	50	52	1.05		52	50	0.93		47	48	56	1.09		1.51	+++	49	47	58	0.95		1.55	+++
France	59	64	1.28	++	64	63	0.98		63	64	65	1.07		1.12		54	64	67	1.53	+++	1.83	+++
Germany	80	77	0.84		78	74	0.81	--	72	81	80	1.64	+++	1.66	+++	72	76	81	1.34	++	1.78	+++
Ireland	50	60	1.50	++	59	60	1.06		52	58	61	1.30		1.45	++	51	58	65	1.37	++	1.90	+++
Netherlands	71	77	1.34	+	77	71	0.76	-	75	76	81	1.09		1.46	++	68	76	79	1.44	+	1.73	+++
Scotland	66	70	1.22	+	69	67	0.85		62	72	74	1.69	+++	1.83	+++	63	69	73	1.35	++	1.78	+++
Switzerland	79	86	1.60	+++	85	86	1.11		83	86	87	1.34	++	1.45	++	80	85	86	1.51	++	1.79	+++
Wales	66	69	1.16		69	65	0.83		66	72	70	1.28	+	1.22	+	65	68	71	1.25		1.54	+++

+/-p<0.05, ++:--p<0.01, +++/---p<0.001

Table 3 Odds ratios (OR) and significance levels for socio-demographic and family characteristics of the multiple logistic regression analyses with as dependent variable tooth brushing more than once a day in the different countries/regions in the HBSC study 2001/02

	Gender		Age				Family structure		Housewife		Parental occupation				Family Affluence Scale			
Country	Girl	p	13		15		2-parents		yes		middle		High		middle		high	
Israel	2.05	+++	0.88		0.77	--	1.13		0.80	-	1.03		1.13		1.52	+++	1.78	+++
North America																		
USA	2.09	+++	1.02		1.12		1.03		1.39	+	1.13		1.22	+	1.13		1.56	+++
Canada	2.12	+++	0.96		1.16		1.15		1.00		1.16		1.36	++	1.17		1.55	++
Central and Eastern Europe																		
Croatia	2.45	+++	0.84	-	0.96		1.20		0.80	--	1.14		1.42	+++	1.44	+++	1.73	+++
Czech Republic	2.50	+++	0.77	---	0.88		0.95		0.94		1.19	+	1.49	+++	1.44	+++	1.72	+++
Estonia	2.43	+++	0.98		1.34	+++	1.00		0.73	--	0.99		1.11		1.34	+++	1.46	+++
Hungary	1.98	+++	1.03		1.30	++	0.86		0.93		1.18		1.79	+++	1.61	+++	2.04	+++
Latvia	2.32	+++	0.80	-	1.17		1.11		0.93		1.15		1.25	+	1.23	+	1.30	
Lithuania	2.17	+++	1.09		1.19	+	0.79	-	0.84	-	1.12		1.34	+++	1.57	+++	2.16	+++
Macedonia	2.15	+++	0.67	---	0.67	---	1.13		1.07		0.96		1.28	++	1.49	+++	2.64	+++
Poland	3.02	+++	1.14		1.38	+++	0.87		1.05		1.51	+++	2.06	+++	1.51	+++	1.90	+++
Russia	2.44	+++	1.21	++	1.36	+++	1.07		1.05		1.12		1.18	+	1.30	+++	1.93	+++
Slovenia	2.29	+++	0.98		0.87		1.01		0.58	---	1.34	+++	1.83	+++	1.35	++	1.78	+++
Ukraine	1.92	+++	0.88		0.95		0.92		1.10		1.24		1.20	+	1.44	+++	2.14	+++
Northern Europe																		
Denmark	1.95	+++	1.09		1.15		0.98		0.57	-	1.21		1.39	++	1.30	+	1.70	+++
Finland	2.51	+++	1.04		1.25	++	0.94		1.08		1.25	++	1.34	+++	1.00		0.97	
Norway	2.00	+++	1.20		1.19		1.27	+	0.70	--	1.13		1.44	++	1.09		1.15	
Sweden	1.75	+++	1.01		1.24		1.25		0.78		1.28		1.40	+++	1.44	+	1.71	+++
Southern Europe																		
Greece	1.89	+++	0.77	--	0.79	--	1.23		0.99		1.08		1.32	++	1.32	+++	1.48	+++
Italy	2.50	+++	1.33	+++	1.87	+++	0.88		1.08		1.26	+	1.33	+	1.31	+++	1.63	+++
Malta	1.92	+++	0.69	-	0.59	---	1.17		0.82		1.16		1.71	+++	1.16		1.95	+++
Portugal	2.57	+++	1.11		1.41	++	0.80		0.75	--	1.38	++	1.33	+	1.37	++	2.31	+++
Spain	2.04	+++	0.74	---	0.77	---	1.00		0.90		1.18	+	1.18	+	1.36	+++	1.52	+++
Western Europe																		
Belgium Fl	1.98	+++	1.01		1.13		1.00		1.04		0.99		1.21	+	1.17		1.45	+++
Belgium Fr	1.81	+++	1.17		1.36	+++	1.03		1.02		1.04		1.34	++	0.89		1.35	++
France	2.01	+++	1.30	+++	1.58	+++	1.17	+	1.02		0.98		0.99		1.52	+++	1.81	+++
Germany*	2.14	+++	0.89		0.83	-	0.83		0.88		1.49	+++	1.43	+++	1.21		1.49	+++
Ireland	2.16	+++	1.15		1.18		1.30		1.12		1.23		1.30	+	1.29	+	1.76	+++
Netherlands	1.46	+++	0.87		0.75	--	1.28		0.79	-	1.06		1.34	+	1.33		1.51	++
Scotland	2.16	+++	1.08		1.14		1.08		1.01		1.61	+++	1.66	+++	1.19		1.44	++
Switzerland	2.11	+++	1.14		0.91		1.56	+++	1.11		1.31	++	1.37	+	1.39	+	1.53	++
Wales	2.43	+++	1.12		1.19		1.10		0.90		1.22		1.11		1.20		1.45	++

*regional sample

+/-p<0.05, ++/--p<0.01, +++/---p<0.001

almost all countries. Multivariate analysis allowed the study of simultaneous associations of several explaining variables. It can be hypothesised that the presence of a parent being permanently at home influences the health behaviour of young children and adolescents, especially those behaviours that are learned in the family, such as tooth brushing. However, family structure and the permanent presence of one parent at home had only minor associations in only in a few countries, especially after adjusting for the other variables. This study could not confirm the findings of Simons *et al.*[36], that in relation to tooth brushing divorced/single parents are less likely to monitor and discipline their children than those in intact families. Also, possible differences in family processes between single parent families and two parent families seemed not to have an impact on the tooth brushing habits of the adolescents. However, in our study we could not control for educational level of the parents. It can be hypothesised that in families where one of the parents stays at home the educational level is lower and this could possibly explain the lack of association between the presence of a supervisor at home and tooth brushing behaviour as reported by the children.

This study suggests that in all countries interventions to enhance tooth brushing behaviour are still needed. On the individual level research and interventions should focus on the gender differences in tooth brushing behaviour. Additionally there should be attention to the structural influences of parental occupation and family wealth on tooth brushing behaviour.

There are several limitations in this cross-country epidemiological study. As self reports are used, recall bias can play a role. The answers might give a too positive picture of tooth brushing, because they are biased towards the expected behaviour. However, the validity and reliability of the tooth brushing question has been tested in several earlier studies and it has been shown to be good[11,37,38]. Because of the different culture, language and traditions in different countries, the questions could be understood differently, although the questionnaires were strictly structured and standardised, as well as translated into different languages from English. Nevertheless, questioning by a questionnaire or by an interview is the only possible data collection method for this kind of vast survey.

Conclusions

The main findings of this study were that within the European continent and in North America, gender, family affluence and parental occupation were significantly associated with tooth brushing frequency as reported by adolescents. The association between family characteristics, such as the absence of one of the parents and the supervisory role of the parents, and brushing behaviour of the children appeared to be rather weak and inconsistent.

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Correspondence to: Dr Lea Maes, Department of Public Health, University Hospital, Blok A, De Pintelaan 185, B-9000 Ghent, Belgium. Email: Lea.maes@ugent.be