Public Health Nutrition: 14(7), 1148–1156 doi:10.1017/S1368980011000103

Prevalence of overweight and obesity among migrants in Switzerland: association with country of origin

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Submitted 12 October 2010: Accepted 9 January 2011: First published online 22 February 2011

Abstract

Objective: Migrants tend to present higher overweight and obesity levels, but whether this relationship applies to all nationalities has seldom been studied. The present study aimed to assess the prevalence of overweight and obesity according to nationality in adults.
Design: Cross-sectional population-based samples.
Setting: Five-year nationwide interview surveys (Swiss Health Surveys – SHS) from 1992 to 2007 (*n* 63 766) and a local examination survey (CoLaus Study in Lausanne 2004–2006, *n* 6743).
Subjects: Participants were separated into Swiss, French, German, Italian, Portuguese, Spanish nationals, those from the former Republic of Yugoslavia and from other European and other countries.
Results: Compared with Swiss nationals, German and French nationals presented a lower prevalence of overweight and obesity, whereas nationals from Italy, Spain, Portugal and the former Republic of Yugoslavia presented higher levels. Adjusting the SHS data for age, gender, education, smoking, leisure-time physical activity and survey year, a lower risk for overweight and obesity was found for German (OR = 0·80, 95 % CI 0·70, 0·92) and French (OR = 0·74, 95 % CI 0·61, 0·89) nationals, whereas higher risks were found for participants from Italy (OR = 1·45, 95 % CI 1·33, 1·58), Spain (OR = 1·36, 95 % CI 1·15, 1·61), Portugal (OR = 1·25, 95 % CI 1·06, 1·47) and the former Republic of Yugoslavia (OR = 1·98, 95 % CI 1·69, 2·32). Similar findings were observed in the CoLaus Study for Italian (OR = 1·63, 95 % CI 1·29, 2·06), Spanish (OR = 1·54, 95 % CI 1·17, 2·04) and Portuguese (OR = 1·49, 95 % CI 1·16, 1·91) participants and for those from the former Republic of Yugoslavia (OR = 5·34, 95 % CI 3·00, 9·50).
Conclusions: Overweight and obesity are unevenly distributed among migrants in Switzerland. Migrants from Southern Europe and from the former Republic of Yugoslavia present higher prevalence rates. This suggests that preventive messages should be tailored to these specific populations.

Keywords
Length of residence
Migrants
Obesity
Overweight
Switzerland

Obesity has reached pandemic proportions. In Europe it is estimated that 30–80 % of adults are overweight or obese, with approximately 150 million individuals being obese[1]. Several studies have shown that migrants present a higher prevalence of overweight and obesity than nationals[2–4], although this finding has not been found in other studies[5,6]. Switzerland has a large migrant community of over 1·6 million, representing over one-fifth of the total population[7]. Nevertheless, the prevalence of overweight and obesity according to migrant status or nationality of adult migrants in Switzerland has seldom been studied[8].

Hence, we used the data from two large, population-based samples (Swiss Health Surveys (SHS) and CoLaus Study) to assess the prevalence of overweight and obesity according to nationality among adults in Switzerland.

Experimental methods

CoLaus Study

The CoLaus Study was approved by the Institutional Ethics Committee of the University of Lausanne. The CoLaus Study is cross-sectional in nature aimed at assessing the prevalence and deciphering the molecular determinants of cardiovascular risk factors in the Caucasian population of Lausanne, Switzerland, a town of 117 161 inhabitants, of whom 79 420 are of Swiss nationality.

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The sampling procedure of the CoLaus Study has been described previously[9]. Briefly, the complete list of Lausanne inhabitants aged 35–75 years (*n* 56 694) was provided by the population registry of the city. A simple, non-stratified random sample of 35 % of the overall population was drawn. The following inclusion criteria were applied: (i) written informed consent; (ii) 35–75 years of age; (iii) willingness to participate in the study and donate a blood sample; and (iv) Caucasian origin. Recruitment began in June 2003 and ended in May 2006. Participation rate was 41 %. For the present study, data from non-Caucasian participants (*n* 555), initially excluded from the main study but assessed the same way, were also included.

All participants presented to the outpatient clinic of the University Hospital of Lausanne in the morning after an overnight fast. Data were collected by trained field interviewers in a single visit lasting about 60 min.

Swiss Health Survey

Data from the four SHS were obtained from the Swiss Federal Statistical Office (www.bfs.admin.ch). The SHS is a cross-sectional, nationwide, population-based telephonic survey conducted every 5 years since 1992 by the Swiss Federal Statistical Office under a mandate of the Federal Government[10]. The SHS aims to track public health trends in a representative sample of the resident population of Switzerland aged ≥15 years[11]. To date, the survey has been carried out four times, in 1992–1993, 1997, 2002 and 2007.

The study population was chosen by stratified random sampling of a database of all private Swiss households with fixed line telephones. The first sampling stratum consisted of the seven main regions: West 'Leman', West–Central 'Mittelland', Northwest, Zurich, North–East, Centre and South. The second stratum consisted of the cantons, and the number of households drawn was proportional to the population of the canton. In some cantons, households were oversampled to obtain accurate cantonal estimates. The third stratum consisted of households. One member of the household was randomly selected in advance from all members aged ≥15 years. A letter inviting this selected household member to participate in the survey was sent to each sampled individual, who was then contacted thereafter by phone and interviewed using a computer-assisted telephone interview software to manage dialling and data collection. Face-to-face interviews were organized for participants older than 75 years. In the case of long-term absence of a sampled individual, a proxy interviewee was requested to provide answers on behalf of the predefined sampled person (it is estimated that this substitution occurred in approximately 3 % of households). The interviews were carried out in German, French or Italian, as appropriate. People who did not speak any of these three languages were excluded from the survey. Other criteria for exclusion were: asylum seeker status; households without a fixed line telephone; very poor health status; and living in a nursing home[12]. Participation rate was 71 % in 1992–1993, 85 % in 1997, 64 % in 2002 and 66 % in 2007. It is estimated that <2 % of households were excluded because of these exclusion criteria. More details are available at http://www.bfs.admin.ch/bfs/portal/fr/index/infothek/erhebungen__quellen/blank/blank/ess/01.html.

Data collected

The following nationalities were considered: Swiss, former Yugoslavian, French, German, Italian, Portuguese and Spanish. Owing to the small number of participants, the other nationalities were grouped as follows: other European nations and the rest of the world. The choice was based on a previous study[8], although we did not consider Turkish migrants because of small sample sizes. When a participant had dual nationality, the Swiss or the first given nationality (if not Swiss) was considered. For the CoLaus Study, the country of birth was considered as the nationality, whereas for the SHS the participants were directly asked about their nationality. The length of residence in Switzerland was assessed for all participants in the CoLaus Study, whereas only the SHS for 2007 collected such information.

In the CoLaus Study, body weight and height were measured with participants standing without shoes in light indoor clothes. Body weight was measured in kilograms to the nearest 100 g using a Seca® scale (Seca Schweiz, Reinach, Switzerland), which was calibrated regularly. Height was measured to the nearest 5 mm using a Seca® height gauge (Seca Schweiz). In the SHS, the participants were asked about their current body weight and height. BMI was calculated as weight in kilograms divided by the square of height in metres (kg/m^2). Participants were considered to be normal weight, overweight or obese if their BMI was <25·0, ≥25·0 and <30·0 or ≥30·0 kg/m^2, respectively.

Waist was measured with a non-stretchable tape over the unclothed abdomen at the narrowest point between the lowest rib and the iliac crest[13]. Two measurements were recorded and the mean (expressed in centimetres) was used for analyses. Abdominal obesity was defined as waist circumference ≥102 cm for men and ≥88 cm for women[13].

Three age categories were considered: 18–34, 35–64 and ≥65 years. Education was categorized as follows: (i) no education completed/primary school (referred to as 'basic'); (ii) apprenticeship/secondary level (referred to as 'secondary'); and (iii) tertiary level, which included university and other forms of education after the secondary level (referred to as 'university'). Leisure-time physical activity was considered when the participant reported exercising at least once per week; no answer was considered as a negative answer. Smoking status was divided into current, former (irrespective of the delay) and never.

Statistical analysis

Statistical analysis was conducted using the SAS statistical software package version 9·2 (SAS Institute, Cary, NC, USA). For the SHS, a first analysis was conducted using the original data. A second analysis was conducted after weighting each participant. Weights were computed taking into account the percentage of non-responders by raking ratio estimation[14]. Weighting partly allows the correction for bias, i.e. participants with given characteristics who are under-represented in the original sample are attributed a higher weight.

Quantitative variables were expressed as mean and SD and qualitative variables as number of participants and percentage. Continuous and categorical data were analysed using the *t* test and the χ^2 test, respectively. The relationships between length of residence and BMI were assessed by Pearson's correlation and multiple regression, adjusting for age; the results of the regression analysis were expressed as standardized coefficients. Standardized regression coefficients represent the change in the dependent variable, expressed as a fraction of the SD per SD change in the independent variable, and can be considered as adjusted correlation coefficients. In the SHS, the time trends (1992–2007) in BMI were also assessed separately for each nationality by multiple regression adjusting for age and sex, and the results were expressed as standardized coefficients. As the number of participants with obesity according to nationality and survey year was relatively small, the combined prevalence of overweight and obesity was used, and its time trend was assessed separately for each nationality using the Cochran–Armitage test.

The impact of nationality on the risk of presenting with overweight and/or obesity was assessed by multivariate logistic regression analysis adjusting for age, gender, educational level, smoking status and physical activity. For the SHS, a further adjustment on survey year was applied. The results were expressed as OR and 95% CI. Statistical significance was considered for $P < 0{\cdot}05$.

Results

Sample characteristics

Overall, 63 766 participants from the SHS and 6743 participants from the CoLaus Study (6188 from the main study and 555 non-Caucasians) were included in the analyses. Their demographic and anthropometric characteristics according to nationality are summarized in Table 1. In both samples, participants from Southern Europe and from the former Republic of Yugoslavia were younger, had a lower educational level, practised leisure-time physical activity less frequently, smoked more and were living in Switzerland for a shorter time. The proportions of women were also lower among German, Italian and Spanish citizens.

Overweight and obesity levels

Differing prevalence of overweight and obesity was found according to nationality (Table 1). Compared with Swiss nationals, German and French nationals presented lower levels of overweight and obesity, whereas Southern European nationals and citizens from the former Republic of Yugoslavia presented higher levels. Similar findings were obtained for waist and abdominal obesity (Table 1). On multivariate analysis adjusting for age, gender, education, smoking, leisure-time physical activity and survey year (for the SHS only), German and French nationals tended to have a lower risk, whereas participants from Southern European countries (Italy, Spain, Portugal) and from the former Republic of Yugoslavia had a higher risk of presenting with overweight or obesity (Table 2).

The length of residence of non-Swiss nationals was positively related with BMI (Pearson $r = 0{\cdot}203$, n 1853 and $r = 0{\cdot}089$, n 2640, for the SHS and the CoLaus Study, respectively, both with $P < 0{\cdot}001$). Findings were similar for waist circumference (Pearson $r = 0{\cdot}126$, $P < 0{\cdot}001$) in the CoLaus Study. These significant positive relationships remained after adjusting for age in SHS 2007 (standardized regression coefficient = 0·11, $P < 0{\cdot}001$), but not in the CoLaus Study (standardized regression coefficient = $-0{\cdot}03$, $P = 0{\cdot}31$ and $-0{\cdot}02$, $P = 0{\cdot}38$, respectively). Splitting the length of residence into 10-year categories (<10, 10–19, 20–29 and ≥30 years) showed no significant relationship with obesity and overweight/obesity after adjusting for age, gender, smoking, leisure-time physical activity and nationality in the CoLaus Study, and no clear trend was identified in the SHS 2007 (Table 3). As for BMI-derived obesity, no relationship between length of residence and abdominal obesity was found, and no differences were found regarding nationality; for French and Portuguese nationals, OR = 0·74 (95% CI 0·44, 1·25) and 0·80 (95% CI 0·45, 1·43), respectively (P = NS).

After adjusting for age and sex, positive increases in BMI with time were found for German (standardized regression coefficient = 0·065, $P < 0{\cdot}02$), Italian (standardized regression coefficient = 0·057, $P < 0{\cdot}004$), French (standardized regression coefficient = 0·095, $P < 0{\cdot}01$), Portuguese (standardized regression coefficient = 0·113, $P < 0{\cdot}002$), other European (standardized regression coefficient = 0·090, $P < 0{\cdot}001$) and other world (standardized regression coefficient = 0·100, $P < 0{\cdot}004$) nationals, whereas no significant trends were found for Spanish (standardized regression coefficient = 0·058, $P = 0{\cdot}14$) nationals and for those from the former Republic of Yugoslavia (standardized regression coefficient = 0·065, $P = 0{\cdot}06$). The corresponding value for Swiss nationals was 0·048 ($P < 0{\cdot}001$). Similarly, the combined prevalence of overweight and obesity increased with time in most migrant groups, with the exception of Spain and the former Republic of Yugoslavia (Table 4).

Table 1 Characteristics of the participants according to nationality: SHS 1992–2007 and the CoLaus Study

Characteristic	Swiss		French		German		Italian		Portuguese		Spanish		Former Republic of Yugoslavia		Other European		Other	
	n or Mean	% or SD	*n* or Mean	% or SD	*n* or Mean	% or SD	*n* or Mean	% or SD	*n* or Mean	% or SD	*n* or Mean	% or SD	*n* or Mean	% or SD	*n* or Mean	% or SD	*n* or Mean	% or SD
SHS																		
Sample size	(*n* 55 238)		(*n* 646)		(*n* 1131)		(*n* 2533)		(*n* 691)		(*n* 616)		(*n* 687)		(*n* 1433)		(*n* 791)	
Age (years)	49·2	17·7	44·7	15·3	47·1	15·5	45·7	16·1	35·5	9·4	40·2	13·4	37·5	10·8	43·1	15·6	37·4	11·7
Length of residence (years)*	–	–	16·6	14·7	14·9	15·5	35·3	15·2	17·0	7·6	27·7	11·8	18·0	8·1	19·3	14·9	11·0	9·0
Women (%)	30 812	55·8	346	53·6	576	50·9	1150	45·4	365	52·8	292	47·4	340	49·5	753	52·6	448	56·6
Educational level (%)																		
Basic	9162	16·6	90	13·9	68	6·0	1085	42·8	475	68·8	277	45·0	233	34·0	325	22·7	214	27·1
Secondary	34 528	62·5	321	49·7	566	50·0	1216	48·0	200	28·9	283	45·9	385	56·0	637	44·5	338	42·7
University	11 548	20·9	235	36·4	497	44·0	232	9·2	16	2·3	56	9·1	69	10·0	471	32·8	239	30·2
Smoking status (%)																		
Never	26 702	48·4	231	35·8	509	45·0	1103	43·6	313	45·3	244	39·6	258	37·6	648	45·2	448	56·6
Former	12 004	21·7	169	26·2	266	23·5	538	21·3	137	19·8	121	19·6	104	15·1	300	20·9	116	14·7
Current	16 511	29·9	246	38·1	356	31·5	891	35·2	241	34·9	251	40·8	325	47·3	485	33·9	227	28·7
Leisure-time PA (%)	27 264	49·4	273	42·3	657	58·1	824	32·5	178	25·8	189	30·7	214	31·2	592	41·3	276	34·9
BMI (kg/m^2)	24·1	4·0	23·4	3·7	23·7	3·6	25·1	4·1	24·3	3·6	24·6	3·7	25·0	3·9	24·1	4·0	23·4	4·2
BMI class (%)																		
Normal	35 381	64·0	471	72·9	799	70·6	1355	53·5	423	61·2	362	58·8	364	53·0	904	63·1	566	71·6
Overweight	15 670	28·4	140	21·7	277	24·5	907	35·8	228	33·0	214	34·7	247	36·0	421	29·4	183	23·1
Obese	4187	7·6	35	5·4	55	4·9	271	10·7	40	5·8	40	6·5	76	11·0	108	7·5	42	5·3
The CoLaus Study																		
Sample size	(*n* 4046)		(*n* 439)		(*n* 92)		(*n* 404)		(*n* 391)		(*n* 262)		(*n* 87)		(*n* 543)		(*n* 479)	
Age (years)	54·0	10·9	51·8	10·6	55·6	11·1	56·2	10·6	44·5	6·1	51·0	8·7	45·9	7·3	50·8	10·1	48·1	8·9
Length of residence (years)	–	–	27·0	15·6	33·1	12·2	36·8	11·7	19·0	7·4	29·4	10·6	19·4	9·8	23·9	13·5	21·0	12·3
Women (%)	2157	53·3	240	54·7	69	75·0	165	40·8	176	45·0	128	48·9	39	44·8	304	56·0	266	55·5
Educational level (%)																		
Basic	526	13·0	53	12·1	9	9·8	183	45·3	303	77·5	135	51·5	34	39·1	89	16·4	86	18·0
Secondary	2781	68·7	264	60·1	58	63·0	188	46·5	80	20·5	108	41·2	44	50·6	242	44·6	240	50·1
University	739	18·3	122	27·8	25	27·2	33	8·2	8	2·1	19	7·3	9	10·3	212	39·0	153	31·9
Smoking status (%)																		
Never	1589	39·3	166	37·8	35	38·0	149	36·9	177	45·3	118	45·0	36	41·4	280	51·6	196	40·9
Former	1366	33·8	140	31·9	37	40·2	145	35·9	104	26·6	81	30·9	26	29·9	137	25·2	149	31·1
Current	1091	27·0	133	30·3	20	21·7	110	27·2	110	28·1	63	24·1	25	28·7	126	23·2	134	28·0
Leisure-time PA (%)	2771	68·5	283	64·5	68	73·9	189	46·8	162	41·4	141	53·8	40	46·0	308	56·7	200	41·8
BMI (kg/m^2)	25·6	4·6	24·8	4·1	24·9	4·6	27·4	4·7	26·7	4	26·9	4·3	28·5	4·4	25·3	4·6	25·8	4·3
BMI class (%)																		
Normal	2045	50·5	248	56·5	49	53·3	124	30·7	149	38·1	96	36·6	15	17·2	302	55·6	218	45·5
Overweight	1401	34·6	148	33·7	32	34·8	194	48·0	168	43·0	112	42·8	46	52·9	171	31·5	191	39·9
Obese	600	14·8	43	9·8	11	12·0	86	21·3	74	18·9	54	20·6	26	29·9	70	12·9	70	14·6
Waist circumference (cm)	89·4	13·7	86·4	13·0	93·0	13·2	86·5	12·5	89·8	12·4	88·9	11·4	92·9	11·5	87·0	13·1	87·3	12·2
Abdominal obesity (%)	1145	28·3	29	31·5	135	33·4	91	20·7	68	26·0	82	21·0	27	31·0	126	23·2	106	22·1

SHS, Swiss Health Survey; PA, physical activity.
Results are expressed as number of participants and percentage, or mean and standard deviation.
Statistical analysis was carried out using the χ^2 test or ANOVA; all comparisons are significant at $P < 0{\cdot}001$.
*For 2007 only.

Table 2 Multivariate analysis of the factors associated with overweight and obesity: SHS 1992–2007 and the CoLaus Study

	Obesity				Overweight and obesity			
	SHS (*n* 63 766)		CoLaus (*n* 6188)		SHS (*n* 63 766)		CoLaus (*n* 6188)	
Characteristic	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI
Age (years)	1·02	1·01, 1·03	1·03	1·02, 1·04	1·03	1·02, 1·04	1·03	1·02, 1·04
Study year								
1992	1·00	Ref.	–	–	1·00	Ref.	–	–
1997	1·05	0·94, 1·16	–	–	1·11	1·04, 1·17	–	–
2002	1·44	1·32, 1·58	–	–	1·33	1·27, 1·40	–	–
2007	1·62	1·48, 1·77	–	–	1·41	1·34, 1·48	–	–
Gender								
Woman	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.
Man	1·28	1·20, 1·36	1·35	1·17, 1·56	2·50	2·41, 2·60	2·56	2·30, 2·84
Educational level								
Basic	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.
Secondary	0·66	0·62, 0·71	0·64	0·54, 0·77	0·70	0·67, 0·73	0·74	0·64, 0·85
University	0·41	0·37, 0·46	0·33	0·26, 0·43	0·54	0·51, 0·58	0·47	0·39, 0·56
Smoking								
Never	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.
Former	1·34	1·25, 1·44	1·01	0·86, 1·18	1·21	1·16, 1·27	1·06	0·94, 1·20
Current	0·94	0·88, 1·02	0·62	0·52, 0·75	0·90	0·87, 0·94	0·67	0·59, 0·76
Leisure-time PA								
No	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.
Yes	0·73	0·68, 0·78	0·57	0·49, 0·65	0·90	0·86, 0·93	0·63	0·56, 0·70
Nationality								
Swiss	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.
German	0·75	0·57, 0·98	0·86	0·45, 1·64	0·80	0·70, 0·92	1·08	0·70, 1·67
Italian	1·28	1·12, 1·47	1·03	0·79, 1·35	1·45	1·33, 1·58	1·63	1·29, 2·06
French	0·79	0·56, 1·12	0·69	0·49, 0·96	0·74	0·61, 0·89	0·87	0·71, 1·07
Spanish	0·83	0·60, 1·15	1·17	0·84, 1·62	1·36	1·15, 1·61	1·54	1·17, 2·04
Portuguese	0·68	0·49, 0·95	1·01	0·74, 1·37	1·25	1·06, 1·47	1·49	1·16, 1·91
Former Yugoslavian	1·65	1·29, 2·11	2·31	1·41, 3·77	1·98	1·69, 2·32	5·34	3·00, 9·50
Other European	1·09	0·89, 1·33	0·98	0·74, 1·29	1·19	1·06, 1·33	0·96	0·79, 1·17
Other world	0·82	0·60, 1·12	1·05	0·79, 1·40	0·93	0·79, 1·09	1·44	1·17, 1·77

SHS, Swiss Health Survey; PA, physical activity; Ref., reference category.
Statistical analysis was carried out using multivariate logistic regression.

Discussion

To our knowledge, the present study is the most comprehensive one assessing the prevalence of overweight and obesity according to nationality among migrants living in Switzerland. Our data indicate that overweight and obesity are unevenly distributed among migrants in Switzerland, some groups showing higher overweight and obesity levels independently of education, smoking, physical activity or length of residence. Our findings are partly in agreement with those of a previous study[8], which failed to find any relationship between nationality and obesity status, probably because of the smaller sample size.

The highest prevalence of overweight and obesity was found for migrants from the former Republic of Yugoslavia, a finding already reported for adolescents[15]. The reasons for such an increase cannot be attributed solely to differences in age, socio-economic status or physical activity, as this increased prevalence remained after multivariate adjustment. It is possible that some migrants associate a fat body to increased wealth[16], but this statement has been challenged[17,18]. Hence, other factors such as diet and eventually a differing genetic background await further investigation.

Some discrepancies were found regarding the factors associated with BMI and waist-derived obesity. No associations were found between most nationalities and abdominal obesity, whereas significant associations were found using BMI. Further, Portuguese migrants had a higher OR for overweight and obesity (BMI-derived) and a lower OR for abdominal obesity, although no significant association was found after adjusting for length of residence. Overall, our findings suggest that the relationship between migrant status or nationality and abdominal obesity might be different from that regarding BMI-derived obesity, but the reasons for such a discrepancy await further investigation.

Compared with data from their country of origin[1], differing patterns were found: migrants from France, Germany and Spain presented lower levels of overweight and obesity, whereas migrants from Portugal presented higher levels (Fig. 1). A possible explanation might be the socio-economic status of migrants. Indeed, and as reported in Table 1, the Portuguese had a much lower educational level than the Swiss, whereas the French and Germans had a higher level. Nevertheless, the Spanish also had a lower educational level than the Swiss, but their obesity levels were actually lower than those

Table 3 Multivariate analysis of the effect of duration on overweight and obesity (migrants only): SHS 2007 and the CoLaus Study

	Obesity				Overweight and obesity			
	SHS 2007 (*n* 1832)		CoLaus (*n* 2639)		SHS 2007 (*n* 1832)		CoLaus (*n* 2639)	
	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI
Age (years)	1·01	1·00, 1·03	1·03	1·02, 1·04	1·02	1·01, 1·03	1·04	1·03, 1·06
Duration of stay (years)								
<10	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.
10–19	1·30	0·75, 2·26	0·91	0·59, 1·42	1·06	0·79, 1·41	0·95	0·70, 1·29
20–29	2·06	1·16, 3·65	0·96	0·61, 1·50	1·20	0·86, 1·67	0·86	0·62, 1·18
≥30	1·84	0·95, 3·59	1·02	0·63, 1·65	1·28	0·87, 1·88	0·72	0·51, 1·01
Gender								
Woman	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.
Man	1·18	0·84, 1·65	1·11	0·89, 1·39	2·66	2·16, 3·28	2·64	2·22, 3·14
Educational level								
Basic	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.
Secondary	0·63	0·43, 0·93	0·62	0·48, 0·81	0·54	0·41, 0·70	0·71	0·57, 0·88
University	0·46	0·28, 0·78	0·38	0·26, 0·55	0·40	0·29, 0·56	0·50	0·38, 0·66
Smoking								
Never	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.
Former	1·36	0·93, 2·01	0·97	0·76, 1·26	1·03	0·79, 1·33	1·11	0·91, 1·37
Current	0·67	0·44, 1·02	0·58	0·43, 0·77	0·72	0·56, 0·91	0·61	0·50, 0·75
Leisure-time PA								
No	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.
Yes	0·64	0·46, 0·90	0·66	0·53, 0·83	0·87	0·70, 1·07	0·71	0·59, 0·84
Nationality								
German	1·00	Ref.	1·00	Ref.	1·00	Ref.	1·00	Ref.
Italian	1·32	0·72, 2·44	1·35	0·67, 2·73	1·33	0·92, 1·93	1·63	0·99, 2·67
French	0·59	0·25, 1·39	0·88	0·43, 1·81	0·98	0·66, 1·47	0·79	0·49, 1·28
Spanish	1·01	0·39, 2·63	1·57	0·76, 3·25	1·30	0·73, 2·34	1·51	0·90, 2·53
Portuguese	1·11	0·53, 2·36	1·50	0·71, 3·15	1·16	0·74, 1·81	1·35	0·80, 2·27
Former Republic of Yugoslavia	2·31	1·12, 4·77	3·51	1·54, 8·00	2·05	1·29, 3·28	5·66	2·66, 12·1
Other European	1·20	0·66, 2·16	1·28	0·63, 2·57	1·17	0·84, 1·62	0·86	0·54, 1·38
Other world	1·08	0·52, 2·26	1·47	0·72, 2·98	1·07	0·72, 1·59	1·30	0·81, 2·11

SHS, Swiss Health Survey; PA, physical activity; Ref., reference category.
Statistical analysis was carried out using multivariate logistic regression.

Table 4 Trends in the prevalence of overweight and obesity according to survey year (migrants): SHS 1992–2007

	1992		1997		2002		2007			
	%	SD	%	SD	%	SD	%	SD	Test for trend	*P* value
Germany	22·7	2·7	25·3	3·2	33·9	2·7	32·0	2·4	2·89	<0·005
Italy	39·2	1·9	47·4	1·9	48·5	1·9	52·4	2·3	4·42	<0·001
France	17·0	2·9	27·1	4·0	29·5	3·7	33·8	3·3	3·62	<0·001
Spain	33·7	3·5	44·1	4·0	47·1	3·8	40·8	4·8	1·78	0·08
Portugal	32·1	4·1	29·4	3·3	48·5	3·9	43·9	3·4	3·24	<0·002
Former Republic of Yugoslavia	42·8	4·2	44·7	3·7	48·8	3·5	50·9	3·9	1·61	0·11
Other European	32·4	2·7	30·2	2·8	40·9	2·5	40·2	2·2	2·91	<0·005
Other world	19·1	3·2	28·9	3·4	29·4	3·3	32·4	2·8	2·66	<0·01

SHS, Swiss Health Survey.
Test for trend was performed separately for each nationality using the Cochran–Armitage test.

reported for Spain. Although socio-economic status might partly explain the differences in overweight and obesity prevalence between migrants, other factors such as diet should also be considered[19]. For instance, and as reported for Greek migrants in Australia[20], Portuguese migrants might adopt a less healthy diet than in their original countries, whereas maintaining a more traditional lifestyle would protect them against obesity[21]. Overall, our data indicate that the prevalence of overweight and obesity among migrants in Switzerland depends on their nationality, and does not obligatorily replicate the obesity pattern of the original country. Further, these differences in the prevalence of overweight and obesity cannot only be ascribed to differences in age, socio-economic status or leisure-time physical activity, and other factors such as diet and eventually a differing genetic background should be assessed.

It has been shown that increased length of residence can be associated with the risk of overweight and obesity[5,22,23], although this statement has been challenged[24]. The present analysis shows ambiguous results. The small but significant relationships between length of

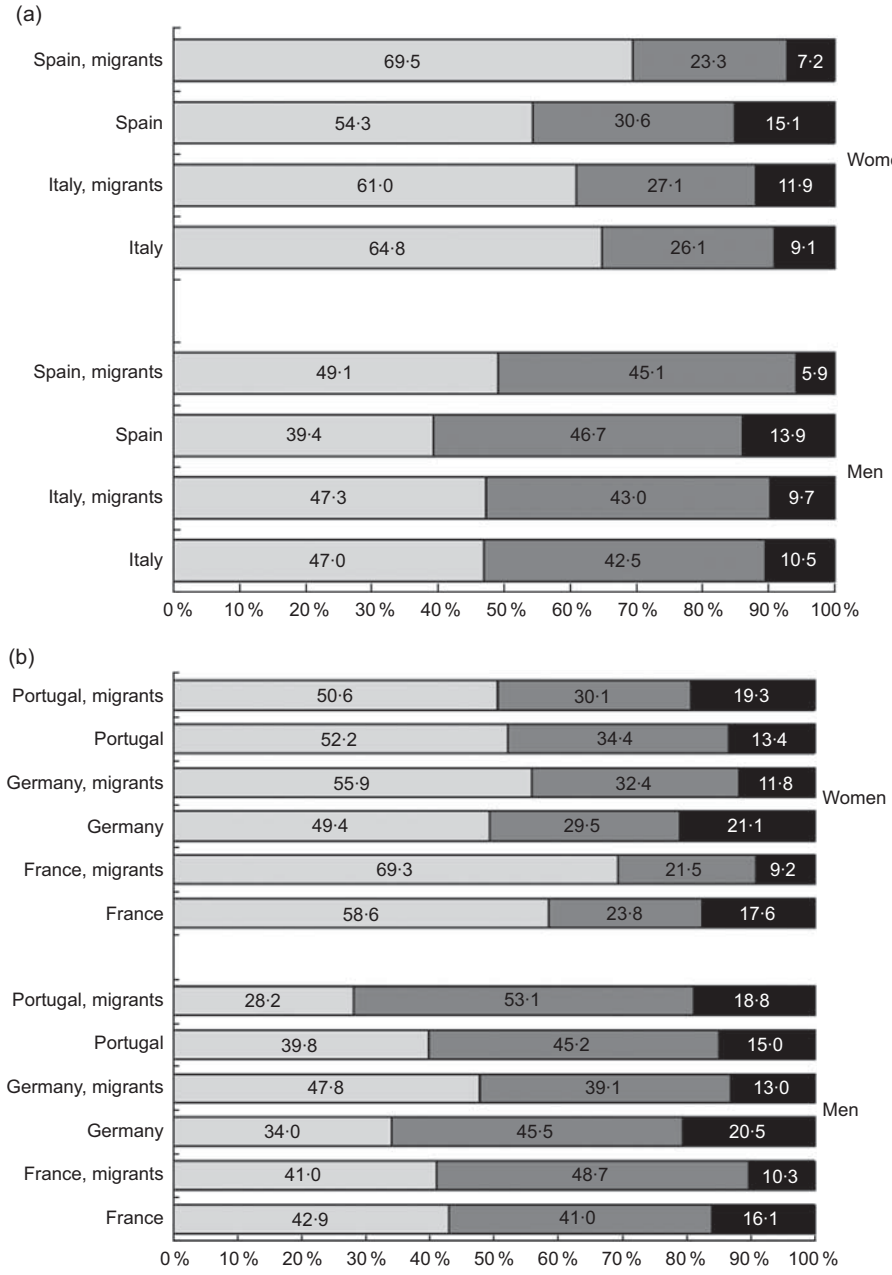

Fig. 1 Comparison of the prevalence of overweight and obesity between migrants and their country of origin: (a) self-reported data and (b) measured data (□, normal; ■, overweight; ■, obese)

residence and BMI were no longer significant after multivariate adjustment. Indeed, with increasing length of residence, the obesity rates in migrants tend to increase until they equal or even surpass the host country's rates[25,26]. Hence, the risk of becoming obese is likely to depend on the actual prevalence of obesity in the host country; migrants in a country with a high obesity prevalence such as the USA might have a higher risk[5,22] than migrants in a country with a low obesity prevalence such as Sweden[24]. Compared with other European countries[1], the prevalence of overweight and obesity in Switzerland is rather low; hence, it is possible that migrants coming to Switzerland may have a lower risk of developing overweight or obesity than migrants going to other countries. Overall, our data indicate that the length of residence does not seem to exert a significant effect on overweight or obesity levels among migrants in Switzerland, possibly because of a less 'obesogenic' environment.

An increase in BMI with time was found for most migrant groups, and this increase tended to be higher than the increase observed for Swiss nationals. However, some increases did not reach statistical significance (i.e. for Spanish and formerly Yugoslavian nationals); the most likely explanation is the relatively small sample sizes, and

thus limited statistical power. Interestingly, most increases were stronger than those observed for Swiss nationals. A possible explanation is the fact that in some countries the prevalence of overweight and obesity has increased steeper than in Switzerland and that, therefore, migrants who arrived more recently might be more overweight or obese than those who came several years ago.

The present study has several limitations worth pointing out. The participation rate in the CoLaus Study was low (41 %), which might limit the generalization of the findings; however, this participation rate is similar to that of other epidemiological studies[27]. In addition, in the SHS, height and weight were self-reported, leading to a probable underestimation of the prevalence of overweight and obesity. Nevertheless, if we assume a non-differential bias, i.e. that the magnitude of height and weight underestimation does not change according to nationality, the relationship between overweight/obesity and nationality should not change. Finally, specific BMI and waist thresholds were used to define obesity, and it has been suggested that other thresholds should be used for non-Caucasians[28]. Nevertheless, as it was not possible to precisely assess the ethnicity of all CoLaus and SHS participants, the use of specific thresholds was justified. The major strength of our study is that we used two population-based samples representative of the Swiss population and that the results obtained were quite similar.

In summary, our results indicate that overweight and obesity are unevenly distributed among migrants in Switzerland. Migrants from Southern Europe and from the former Republic of Yugoslavia present higher prevalence rates. These differences suggest that preventive interventions should be tailored to the needs of specific populations[29].

Acknowledgements

The CoLaus Study was supported by research grants from GlaxoSmithKline, the Faculty of Biology and Medicine of Lausanne, Switzerland, and the Swiss National Science Foundation (Grant no.: 33CSCO-122661). P.V. and G.W. received an unrestricted grant for GSK to conduct the CoLaus Study. The authors report no conflict of interest. P.M.-V. analysed the data and drafted the manuscript; F.P., G.W. and P.V. conceived and designed the study and revised the manuscript critically for important intellectual content. All authors gave their final approval of the version published. The authors express their gratitude to the participants in the Lausanne CoLaus Study and to the investigators who have contributed to the recruitment, in particular Yolande Barreau, Anne-Lise Bastian, Binasa Ramic, Martine Moranville, Martine Baumer, Marcy Sagette, Jeanne Ecoffey and Sylvie Mermoud for data collection.

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