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Changes in the prevalence of overweight and obesity: some evidence from the Swiss Health Surveys 1992/93 and 2002

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Background: This study examines changes in the prevalence of overweight and obesity in the Swiss general population from 1992/93 to 2002 and their relationship with changes in the distribution and effect of socioeconomic and health behavioural risk factors. **Methods:** Cross-sectional data from telephone interviews of the non-institutionalized Swiss population aged 19 years and more were obtained from the Swiss Health Study 1992/93 ($n = 13798$) and 2002 ($n = 17677$). Binary logistic regression was used to address changes in overweight and obesity, defined as body mass index 25.0 kg/m^2 or more. The expected prevalence of overweight and obesity under adjusted models was computed to demonstrate the influence of changes in risk factors. **Results:** The prevalence of overweight and obesity rose from 22.8% in 1992/93 to 30.9% in 2002 among women and from 41.1% to 48.1% among men. In international comparison, the increase in the overall prevalence of overweight and obesity in Switzerland was lower. Contrary to similar studies from other countries, the increase in prevalence was lower among men than that among women, possibly because of an increased protective effect of the observed health behavioural factors among men and unobserved behavioural factors among middle-aged men. **Conclusion:** Public health action should consider the potential of changing health behavioural factors in subgroups with a higher prevalence of overweight and obesity. Measures that stimulate, for instance, light physical activity or healthy diet, to be supported by changes in the obesogenic environment, should be encouraged. More evidence is needed for gender-specific approaches.

Keywords: overweight, obesity, risk factors, Switzerland.

Introduction

Overweight and obesity have become a major issue on the public health agenda because of the dramatic increase of their prevalence—also referred to as a global epidemic.[1] The major consequences of overweight and obesity are morbidity, mortality, and economic and social burden of disease.[1–4] In particular, the association of overweight and obesity with cardiovascular diseases, diabetes, cancers and psychosocial consequences is well established (for instance [4–8]). The costs for overweight and obesity in Switzerland were estimated at CHF 2700 millions in 2001[9] and 6% of the total DALYs (disability-adjusted life years) were imputed to overweight and obesity.[10]

According to recent data (1999–2003), the prevalence of overweight and obesity was 47.9% in the average of 29 OECD countries, while it was lowest in Switzerland at 37.1%[10] (for data from the mid-80s, see [11]). The difference in the prevalence of overweight and obesity between Switzerland and other OECD countries has been accentuated in recent years. Between 1992 and 2002, there was a noticeably lower increase in the prevalence of overweight and obesity in Switzerland (from 30.3% to 37.1%) than in 15 OECD countries with available data (from 35.2% to 46.7%). More surprisingly, there was no comprehensive public-health strategy to prevent overweight and obesity at the national level in Switzerland during the period under consideration.[10] The comparatively moderate increase in Switzerland is therefore likely to be due to environmental and personal conditions rather than to institutional measures affecting individual behaviour.

While studies have been conducted in several countries to address nationwide changes in the prevalence of overweight and obesity (for instance [12–16]), research in Switzerland concentrated mainly on descriptive findings by year (for recent research, see [17–21]). To our knowledge, no research pooling data from different years is available for the Swiss general population. Thus, the present article aims to provide insight into individual determinants of overweight and obesity and their changes between 1992/93 and 2002 in the Swiss general population in order to document risk factors and especially protective factors that may be associated with the rather low increase in prevalence in Switzerland.

The relationship between a risk factor and the prevalence of overweight and obesity depends upon both quantitative and qualitative considerations, that is (i) upon the prevalence of the risk factor in the population and (ii) upon the correlation between the risk factor and overweight and obesity. In a dynamic perspective, this implies that changes in the prevalence of overweight and obesity can be due to (i) changes in the distribution of a risk factor (i.e. an overall increase in the education level with higher education having a stronger protective effect than lower education) as well as to (ii) changes in the effect of a risk factor (i.e. an erosion of the protective effect of higher education). Previous research, however, mainly concentrated on distributional changes in risk factors.[12] To address qualitative changes as well, the present study relates changes in the prevalence of overweight and obesity to both (i) quantitative changes in the distribution of risk factors and (ii) qualitative changes in the effect of risk factors.

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Methods

Sample

Cross-sectional data were obtained from the Swiss Health Surveys (SHS) conducted in 1992/93 and 2002 (for methodological details, see [22,23]). In both surveys, a stratified two-stage random sample of non-institutionalized Swiss residents aged 15 years or more living in a household with a telephone connection was drawn. For each stratum, a sample of households was selected and a target person within each household was determined. The data used in the present study were obtained by computer-assisted telephone interviewing. The 1992/93 SHS was conducted from May 1992 to April 1993 and the 2002 SHS throughout the year. The sample size was 15 288 and 19 706, respectively. A response rate of 70.8% and 63.9%, respectively, was achieved. The final sample comprised 31 475 individuals aged 19 years and over with complete data for the variables under study, that is, 89.9% of the total of the two initial samples. A weighting scheme combining design-based and post-stratification weights was used to account for unequal inclusion probabilities and to achieve a sample distribution for gender, age, nationality and strata close to the distribution of the population.

Measures

To assess overweight and obesity, Quetelet's body mass index (BMI) was calculated as the weight (kg) divided by the square of the height (m). The related questions were *Could you tell me how tall you are (without shoes on)?* and *And how much do you weigh (without clothes on)?* Overweight and obesity were defined as BMI $\geq$25 kg/m^2.[24] Socioeconomic factors included gender, age (19–34 years, 35–49 years, 50–64 years, 65 years and more), education (up to 9 years of education, 10–12 years, more than 12 years), occupation (managers, employees and small business owners, workers, others), nationality (non-Swiss, Swiss) and the following contextual factors: linguistic region (German-speaking, French-speaking or Italian-speaking), type of household (living alone, not living alone) and type of locality (urban: at least 10 000 habitants or locality in an urbanized area with at least 20 000 habitants, non-urban). Health behavioural factors were physical activity (three times or more a week, once or twice a week, less than once a week); nutrition: eating meat (6 or 7 days a week, 3–5 days a week, 2 days or less a week), eating salad and vegetables (6 or 7 days a week, 5 days or less a week) and eating fruit (6 or 7 days a week, 5 days or less a week); alcohol use (at least once a week, less than once a week) and tobacco use (current smoker, former smoker, non-smoker).

Statistical analysis

Analyses with Stata Version 7.0 were carried out separately for women and men.[25] To obtain correct standard errors, sample weighting and stratification were accounted for.[26] Descriptive findings provided sample characteristics for overweight and obesity, and their potential determinants in 1992/93 and 2002. Logistic regression models were used to examine the effect of risk factors and the changes in risk factors between 1992/93 and 2002 on the prevalence of overweight and obesity. Dummy-coded variables were used. The reference category is the last category presented in the *measures* section, except for occupation (managers). For the time period, the reference category is 1992/93. Quantitative changes in the distribution of risk factors were modelled as main effects, while qualitative changes in the effect of risk factors were included as interaction effects. Main effects apply to the influence of risk factors in 1992/93. An interaction effect accounts for the difference between the influence of a risk factor in 2002 and its influence in 1992/93, i.e. the main effect of the risk factor. In the absence of an interaction effect, the main effect is the same as in 1992/93 and 2002.

Several gender-specific binary regression models were computed.[27] Model 0 is a crude model that includes a sole predictor for the time period; model 1 comprises all the main effects and represents changes in the distribution of risk factors; in addition to the main effects, the final model 2 incorporates interaction effects selected by a stepwise procedure to address changes in the effect of risk factors. In models 1 and 2, the odds ratios (ORs) of overweight and obesity for the time period are adjusted for the remaining predictors in the model, while no adjustment is made in model 0. As socio-economic predictors may reflect the influence of health behavioural factors—i.e. the more proximal behavioural factors exert their influence via factors that are *per se* little or not amenable to change such as education or age—a submodel 2a containing the same predictors as model 2 but without the health behavioural predictors was calculated. The comparison of the OR for a socioeconomic predictor in the two models allows the determination of the extent to which this predictor is related to the included health behavioural factors.

First, changes in overweight and obesity were examined considering the risk factors in model 2, including a comparison with submodel 2a. Secondly, based on the adjusted OR of overweight and obesity for the time period in models 1 and 2, the prevalence of overweight and obesity, which would have been expected in 2002 if there had been no changes in the distribution (model 1) or in both the distribution and effect (model 2) of the 1992/93 risk factors, was calculated (see [12] for a similar application to changes in the distribution of risk factors).

Results

Table 1 summarizes descriptive findings about changes in the distribution of risk factors and the prevalence of overweight and obesity in the study sample. Among women, the prevalence of overweight and obesity rose from 22.8% in 1992/93 to 30.9% in 2002 and among men from 41.1% to 48.1%. Mean BMI (kg/m^2) increased from 22.82 to 23.67 among women and from 24.75 to 25.22 among men (not shown in Table 1). The increase in prevalence was widely similar across the categories of most of the risk factors. Stronger variations in the increase were associated with occupation and physical activity. Gender-specific variations were related to education among women and to age, nationality, alcohol use and tobacco use among men. Changes in the distribution of risk factors were predominantly related to age (ageing of the population), education and occupation (upward shifts in the educational and occupational structures), alcohol consumption (reduction in the frequency of drinking) and nutrition (reduction in the proportion of frequent meat, salad, vegetables and fruit eaters).

Model 2 presented in Table 2 emphasizes the gender-specific changes in overweight and obesity related to interaction effects, while main effects were mostly similar among women and men. The most influential factors were age, education and some health behavioural factors (nutrition, alcohol use among women and tobacco use among men). With regard to interaction effects among women, the protective effect of education (10–12 years) diminished between 1992/93 and 2002. Among men, there was an increased protective effect associated with age 35–49 years, age 50–64 years and health

Table 1 Distribution of socioeconomic and health behavioural factors and prevalence of overweight and obesity (BMI ≥25 kg/m^2) with 95% CI by subgroups (SHS 1992/93 and 2002).

	Women 1992/93			Women 2002			Men 1992/93			Men 2002		
	RF	BMI ≥25 kg/m^2		RF	BMI ≥25 kg/m^2		RF	BMI ≥25 kg/m^2		RF	BMI ≥25 kg/m^2	
	%	%	(95% CI)	%	%	(95% CI)	%	%	(95% CI)	%	%	(95% CI)
Age												
19–34 years	31.8	10.8	(9.3–12.2)	25.2	17.4	(15.3–19.5)	33.3	24.9	(22.8–27.0)	27.2	31.9	(29.1–34.7)
35–49 years	29.2	19.4	(17.4–21.4)	29.1	25.1	(23.0–27.2)	29.4	43.3	(40.7–45.9)	33.1	48.5	(46.0–50.9)
50–64 years	21.2	32.6	(30.0–35.3)	23.7	38.3	(36.0–40.7)	20.7	56.6	(53.4–59.8)	23.9	58.8	(56.0–61.6)
≥ 65 years	17.8	38.0	(35.1–40.9)	21.9	45.9	(43.4–48.5)	16.6	50.3	(46.5–54.0)	15.8	59.1	(56.1–62.0)
Education												
≤9 years	26.4	36.3	(33.9–38.8)	22.4	44.8	(42.1–47.5)	14.6	48.1	(44.1–52.1)	12.6	54.9	(50.4–59.4)
10–12 years	66.7	18.5	(17.3–19.8)	68.7	28.0	(26.7–29.4)	68.7	41.0	(39.3–42.7)	65.5	48.7	(47.0–50.4)
>12 years	7.0	12.0	(9.0–15.1)	8.9	17.5	(14.5–20.5)	16.7	35.3	(31.9–38.7)	21.8	42.4	(39.6–45.3)
Occupation												
Managers	26.5	16.2	(14.4–18.0)	32.3	23.8	(22.0–25.6)	36.9	38.1	(35.9–40.4)	40.0	43.6	(41.5–45.7)
Employee, small business owners	39.6	21.3	(19.6–23.0)	41.9	30.5	(28.7–32.3)	22.5	43.1	(40.1–46.2)	23.7	50.5	(47.7–53.3)
Workers	30.4	29.8	(27.6–32.0)	19.4	41.6	(38.7–44.6)	38.3	42.6	(40.2–44.9)	33.9	53.5	(51.0–56.0)
Others	3.5	28.5	(22.0–35.1)	6.3	36.4	(31.5–41.3)	2.2	44.1	(34.3–53.8)	2.4	24.5	(15.6–33.3)
Nationality												
Swiss	85.9	22.5	(21.3–23.6)	83.4	30.2	(29.0–31.3)	81.6	41.2	(39.7–42.8)	80.2	47.0	(45.5–48.4)
Non-Swiss	14.1	24.6	(21.3–27.9)	16.6	34.3	(30.6–38.0)	18.4	40.4	(36.8–44.0)	19.8	52.8	(48.9–56.7)
Linguistic region												
German	72.1	23.7	(22.4–25.1)	70.9	31.5	(30.1–32.9)	73.4	41.0	(39.3–42.7)	73.4	48.3	(46.6–50.0)
French/Italian	27.9	20.3	(18.4–22.1)	29.1	29.3	(27.4–31.3)	26.6	41.3	(38.7–43.9)	26.6	47.7	(45.3–50.2)
Type of household												
Living alone	20.6	25.5	(23.7–27.4)	20.3	34.4	(32.5–36.3)	15.2	35.7	(33.3–38.1)	13.6	43.9	(41.4–46.5)
Not living alone	79.4	22.1	(20.8–23.4)	79.7	30.0	(28.6–31.3)	84.8	42.1	(40.4–43.7)	86.4	48.8	(47.2–50.4)
Type of locality												
Urban	70.8	22.2	(20.9–23.5)	74.7	29.7	(28.4–31.1)	70.6	39.9	(38.2–41.6)	72.5	46.9	(45.3–48.6)
Non-urban	29.2	24.2	(22.2–26.3)	25.3	34.2	(31.8–36.5)	29.4	43.9	(41.3–46.5)	27.5	51.2	(48.6–53.8)
Physical activity												
<once a week	39.9	27.0	(25.2–28.9)	42.1	36.2	(34.4–38.1)	32.9	45.9	(43.4–48.4)	33.9	53.5	(51.1–55.9)
Once or twice a week	38.6	18.9	(17.2–20.5)	34.8	27.2	(25.3–29.1)	37.5	40.1	(37.7–42.4)	37.5	50.0	(47.7–52.3)
≥three times a week	21.4	21.8	(19.4–24.2)	23.1	26.6	(24.3–28.9)	29.7	37.1	(34.5–39.7)	28.7	39.3	(36.8–41.9)
Eating meat												
0–2 days a week	28.7	18.5	(16.6–20.3)	34.6	25.8	(23.9–27.6)	17.3	35.7	(32.3–39.0)	20.7	43.6	(40.5–46.8)
3–5 days a week	45.8	22.5	(20.9–24.1)	48.6	32.1	(30.4–33.7)	42.5	40.5	(38.3–42.7)	46.3	48.1	(46.0–50.2)
6–7 days a week	25.4	28.0	(25.6–30.5)	16.8	37.9	(34.9–40.9)	40.2	44.1	(41.8–46.4)	33.0	51.0	(48.5–53.4)
Eating salad/vegetables												
0–5 days a week	8.0	20.5	(16.9–24.0)	10.4	30.9	(27.2–34.7)	13.1	39.6	(35.8–43.4)	18.7	48.2	(44.9–51.5)
6–7 days a week	92.0	23.0	(21.8–24.1)	89.6	30.8	(29.6–32.1)	86.9	41.3	(39.8–42.9)	81.3	48.1	(46.5–49.7)
Eating fruit												
0–5 days a week	16.9	17.4	(15.2–19.7)	21.9	25.5	(23.2–27.8)	33.9	37.8	(35.4–40.2)	41.6	46.5	(44.4–48.7)
6–7 days a week	83.1	23.8	(22.6–25.1)	78.1	32.4	(31.0–33.7)	66.1	42.8	(41.0–44.6)	58.4	49.3	(47.4–51.1)
Alcohol use												
<once a week	54.1	27.0	(25.5–28.6)	54.6	35.8	(34.1–37.4)	23.3	38.2	(35.3–41.1)	28.3	49.5	(46.8–52.2)
≥once a week	45.9	17.7	(16.3–19.2)	45.4	24.9	(23.3–26.5)	76.7	42.0	(40.3–43.6)	71.7	47.6	(45.9–49.2)
Tobacco use												
Current smoker	25.1	17.9	(15.9–19.8)	25.3	25.2	(23.1–27.4)	37.2	39.9	(37.6–42.2)	36.2	43.9	(41.5–46.2)
Former smoker	17.3	23.6	(21.0–26.3)	17.4	31.4	(28.7–34.1)	27.3	51.4	(48.6–54.2)	25.5	58.7	(56.1–61.4)
Non-smoker	57.6	24.6	(23.2–26.2)	57.4	33.2	(31.6–34.7)	35.5	34.5	(32.1–36.9)	38.3	45.1	(42.8–47.4)
Total	100.0	22.8	(21.7–23.9)	100.0	30.9	(29.7–32.0)	100.0	41.1	(39.7–42.5)	100.0	48.1	(46.7–49.5)

Table 2 ORs and 95% CIs of overweight and obesity (BMI ≥25 kg/m^2) from model 2 (SHS 1992/93 and 2002)

	Women		Men	
	OR	**(95% CI)**	**OR**	**(95% CI)**
Time period (1992/93)				
2002	1.59	(1.21–2.09)	1.98	(1.58–2.47)
Age (≥65 years)				
19–34 years	0.27	(0.23–0.31)	0.35	(0.30–0.40)
35–49 years	0.52	(0.43–0.63)	0.80	(0.68–0.95)
50–64 years	0.89	(0.75–1.06)	1.32	(1.10–1.59)
Education (>12 years)				
≤9 years	2.21	(1.80–2.71)	1.44	(1.21–1.70)
10–12 years	1.25	(1.01–1.55)	1.21	(1.05–1.40)
Occupation (managers)				
Employees, small business owners	1.15	(1.03–1.28)	1.13	(1.01–1.27)
Workers	1.36	(1.20–1.54)	1.30	(1.17–1.45)
Others	1.12	(0.90–1.38)	0.81	(0.59–1.12)
Nationality (Swiss)				
Non-Swiss	1.25	(1.02–1.54)	1.03	(0.87–1.13)
Linguistic region (French/Italian)				
German	1.25	(1.14–1.38)	1.02	(0.93–1.12)
Type of household (not living alone)				
Living alone	0.99	(0.88–1.09)	0.85	(0.77–0.93)
Type of locality (non-urban)				
Urban	0.89	(0.80–0.98)	0.87	(0.79–0.96)
Physical activity (<once a week)				
Once or twice a week	0.85	(0.77–0.94)	0.99	(0.89–1.09)
≥three times a week	0.92	(0.78–1.09)	0.89	(0.77–1.04)
Eating meat (0–2 days a week)				
3–5 days a week	1.39	(1.25–1.54)	1.28	(1.14–1.44)
6–7 days a week	1.72	(1.51–1.95)	1.47	(1.30–1.67)
Eating salad/vegetables (0–5 days a week)				
6–7 days a week	0.92	(0.78–1.08)	0.93	(0.82–1.04)
Eating fruit (0–5 days a week)				
6–7 days a week	1.22	(1.01–1.48)	1.11	(0.97–1.27)
Alcohol use (< once a week)				
≥once a week	0.62	(0.57–0.68)	0.96	(0.87–1.06)
Tobacco use (non-smoker)				
Current smoker	0.92	(0.78–1.09)	1.17	(1.02–1.35)
Former smoker	1.14	(1.01–1.28)	1.42	(1.28–1.59)
Interaction effects with time period 2002				
Age 35–49 years	0.85	(0.68–1.06)	0.82	(0.86–1.00)
Age 50–64 years	0.94	(0.77–1.16)	0.74	(0.59–0.92)
Education 10–12 years	1.26	(1.06–1.51)	1.02	(0.86–1.20)
Swiss nationality	1.13	(0.86–1.48)	1.30	(1.01–1.66)
Current smoker	0.98	(0.79–1.21)	0.75	(0.63–0.90)
Physical activity ≥three times a week	0.86	(0.70–1.07)	0.73	(0.61–0.89)
Eating fruit 6–7 days a week	0.93	(0.73–1.18)	0.82	(0.68–0.98)

Reference categories in parentheses.

Table 3 Crude and adjusted ORs of overweight and obesity (BMI $\geq$25 kg/m^2) for the time period with 95% CI and expected prevalence of overweight and obesity in 2002 (SHS 1992/93 and 2002)

	OR	(95% CI)	Expected prevalence 2002 (%)
Women			
Crude model (0)	1.51	(1.39–1.64)	30.9
Main effect model (1)	1.61	(1.47–1.76)	32.2
Final model (2)	1.59	(1.21–2.09)	31.9
Men			
Crude model (0)	1.33	(1.23–1.44)	48.1
Main effect model (1)	1.34	(1.23–1.46)	48.3
Final model (2)	1.98	(1.58–2.47)	58.0

behavioural factors (nutrition, tobacco use and physical activity), but an augmented risk for non-Swiss residents.

The ORs of socioeconomic factors in model 2 were most similar to the corresponding ORs in submodel 2a (results not shown), except for education among women [9 years or less: OR = 2.42, 95% CI = (1.98–2.95); 10–12 years: OR = 1.32, 95% CI = (1.07–1.64); more than 12 years: reference category].

Table 3 presents the expected prevalence of overweight and obesity based on the crude (model 0) and adjusted ORs for the time period (models 1 and 2). In the crude model 0 without adjustment for risk factors, the ORs for the time period were 1.51 among women and 1.33 among men and the expected prevalence of overweight in 2002 were similar to those observed (Table 1). The adjustment for risk factors in models 1 and 2 differed markedly between women and men. Among women, the expected prevalence of overweight and obesity was slightly higher than the observed prevalence when adjusted for main effects (model 1). Subsequent adjustment for interaction effects did not basically change the expected prevalence (model 2). Among men, adjustment for the main effects did not alter the expected prevalence of overweight and obesity (model 1), but the expected prevalence increased substantially when adjusted for interaction effects (model 2).

The expected prevalence of overweight and obesity when adjusting only for socioeconomic factors was 29.2% among women and 50.0% among men (submodel 2a), while adjustment for the sole health behavioural factors included in model 2 yielded an expected prevalence of 33.1% among women and 55.5% among men (results not shown).

Discussion

This study aimed to investigate changes in the prevalence of overweight and obesity in Switzerland between 1992/93 and 2002 and to relate these changes to both quantitative changes in the distribution of risk factors and qualitative changes in the effect of risk factors. During this period, the prevalence of overweight and obesity rose by 8.1% (from 22.8% to 30.9%) among women and by 7.0% (from 41.1% to 48.1%) among men. Higher increase among women than among men is consistent with changes in mean BMI (women +0.85, men +0.47 kg/m^2). Thus, the comparatively lower increase in the prevalence of overweight and obesity among men does not seem to be artefactual because of the threshold set for overweight and obesity (but see [28,29]).

With regard to quantitative changes, the main findings confirmed a strong association of the prevalence of overweight and obesity with age and, especially among women, with education (for instance [12–14,16]). Occupation, health behavioural and contextual factors showed a comparatively lower association, which was mostly similar among men and women. Qualitative changes, however, were clearly gender-specific. Changes in the effect of risk factors benefited men and resulted in an overall increase in the protective effect. Among women, only the effect of education changed and its protective effect diminished over time.

Furthermore, changes in the risk factors under analysis may have contributed to attenuate the increase in the overall prevalence of overweight and obesity. Contrary to previous research by Rodriguez Artalejo *et al.*[12] that emphasized changes in the distribution of risk factors, attenuation was mainly related to changes in the effect of risk factors. As qualitative changes depended on gender, the observed prevalence of overweight and obesity in 2002 among men (48.1%) was lower than the expected prevalence under the hypothesis that the distribution and effect of the risk factors are the same as in 1992/93 (58.0%). Among women, no similar benefit was found. Changes in the distribution of risk factors only slightly attenuated the increase in observed prevalence (30.9%) compared with the expected prevalence (31.9%). The findings of the present study seem compatible with the Spanish study of Rodriguez Artalejo *et al.*[12] with data from 1987 and 1995/97, although it only considered changes in the distribution of risk factors. In the Spanish study, the increase in the prevalence of overweight and obesity was strongly attenuated due to extending higher education and more frequent physical activity, especially among women. In Switzerland, more recent data showed only a slight educational shift among women. Findings from both studies appear thus to be consistent with educational expansion in the second half of the 20th century in Europe.

Gender-specific differences in qualitative changes in risk factors may partially explain the more modest increase in the prevalence of overweight and obesity in Switzerland in international comparison.[10] Research from other countries showed a higher increase in the prevalence of overweight and obesity among men than among women (for instance [12–14,16]). In the present study, however, the prevalence of overweight and obesity increased more among women than among men. According to the models presented, qualitative changes among men showed an increased protective effect (i) of observed health behavioural factors and also (ii) in the age group 35–64 years, which is likely to be related to changes in unobserved behavioural factors specific to middle-aged men. Adjusting for the protective effect consistently resulted in a higher increase in the prevalence of overweight and obesity among men than that among women.

In line with theories on the diffusion of innovations[30] (men invent new patterns, women imitate them) or emancipation hypotheses[31] (women integrate patterns of men), the gender-specific increase in the prevalence of overweight and obesity could be indicative of women adopting behavioural patterns of men. Among men, qualitative and quantitative changes in health behaviour were not consistent: while qualitative changes revealed a stronger protective effect of physical activity and fruit consumption in 2002 than that in 1992/93, the proportion of men who frequently ate salad, vegetables and fruit diminished (see also [32]). Although the increased protective effect concentrated on qualitative changes, it should be asked whether women and men respond differently to possible prevention efforts. For instance, as men are more likely to idealize physical strength or competition compared to women,[33] measures promoting physical activity could be more or less attractive if they incorporate gender-specific aspects (for evidence in children and youth, see [34,35]).

The present study has some limitations. First, self-reported data were used, which may induce measurement biases. Compared with clinical measures, self-reports tend to overestimate height and underestimate weight.[36,37] As a consequence, the prevalence of overweight and obesity may be underestimated in the present research. Although measurement biases are often viewed as being of minor importance with regard to changes,[12,38] the observed increase in the prevalence of overweight and obesity may underestimate the true change, as underestimation is more likely to happen among overweight and obese individuals.[39] Second, as in most studies on nationwide changes in the prevalence of overweight and obesity, the data used were cross-sectional and changes could not be examined at an individual level. However, cross-sectional data were suitable for the present study as the main interest lay in the influence of risk factors rather than in individual or subgroup trajectories. Third, although the predictors used addressed socioeconomic and health behavioural factors, the adjusted models are contingent upon these predictors. Some predictors were also rather rudimental. For instance, nutrition was only measured with respect to frequency and not quantity, which only roughly reflects the eating behaviour, and tobacco use was confined to the smoker status. Thus, the qualitative changes measured may be associated with unobserved dimensions of the predictors (i.e. quantity). Also, the more proximal behavioural factors under study explained only to a very limited extent the influence of socioeconomic factors. Thus, behavioural factors associated with an increased protective effect (qualitative changes) among middle-aged men could not be identified. However, taking these restrictions into account, the gender-specific differences should be reliable as the same models were used for women and men.

Public health measures to stem increasing overweight and obesity that address health behaviour directly are all the more important since the education level is high in Switzerland. A large proportion of individuals already benefit from the indirect protective effect of education on overweight and obesity. At the same time, insufficient physical activity and inadequate diet are common or are even becoming more frequent despite the presumed increased protective effect of education.[32] Hence, because they are amenable to intervention, health behavioural factors should deserve special attention. Even small changes in health behaviour may contribute to the attenuation of overweight and obesity at the population level.[29] During the period examined, no comprehensive public-health strategy against overweight and obesity existed in Switzerland, but there were several local actions to promote physical activity and healthy diet in daily life, often supported by changes in the obesogenic environment, such as healthy catering in educational and work settings, walking incentives or developing bicycle infrastructure.[40] However, little is known about the effectiveness of such measures.[1] Further research should especially investigate the effectiveness of (i) sustainable changes in daily activities to promote light physical activities and reduce over-consumption and (ii) their support by environmental and political incentives in the long run.

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Key points

- Gender is a central dimension of changes in overweight and obesity.
- Public health strategies should consider the potential for prevention in population groups with a higher prevalence of overweight and obesity such as men.
- Health socialization is not an irreversible process, but health attitudes and behaviours are likely to change even in adult populations.
- Gender-specific patterns of overweight and obesity may be responsible for international differences in the prevalence of overweight and obesity.
- The effectiveness of changes in the obesogenic environment that support physical activity and healthy diet should be investigated further.

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