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Lost in translation: dietary management of cardiovascular risk factors is seldom implemented.

Running title: Dietary management of CVD risk factors

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All authors take responsibility for all aspects of the reliability and freedom from bias of the data presented and their discussed interpretation.

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Highlights

- Dietary management of cardiovascular risk factors is seldom implemented in Switzerland
- Dietary recommendations are provided mostly when drug treatment is initiated
- Joint prevalence of several cardiovascular risk factors does not seem to increase the likelihood of dietary recommendations.
- General practitioners should motivate their patients to adhere to a healthy diet rather than to avoid specific foods or nutrients

ABSTRACT

Objective: to **a**ssess dietary management of cardiovascular risk factors (CVRFs) in the general population.

Method: Cross-sectional study conducted between 2009 and 2012 on 4811 participants (2567 women, 58±11 years) living in Lausanne, Switzerland.

Results: Sixteen percent of participants diagnosed with overweight/obesity reported a slimming diet. Slimming diet was associated with diagnosis of hypertension: Odds ratio and (95% confidence interval): 0.61 (0.40-0.93); older age [0.84 (0.58-1.21), 0.79 (0.53-1.18) and 0.47 (0.27-0.81) for [50-60[, [60-70[and [70+ years, respectively]; female gender [1.84 (1.36-2.48)] and diagnosis of diabetes [2.16 (1.13-4.12)]. Only 8% of participants diagnosed with hypertension reported a low-salt diet. Low-salt diet was associated with antihypertensive drug treatment [2.17 (1.28-3.68)] and diagnosis of diabetes [2.72 (1.26-5.86)]. One-third of participants diagnosed with dyslipidemia reported a low-fat diet. Low-fat diet was associated with female gender [1.47 (1.17–1.86)]; older age [1.29 (0.89-1.87), 1.71 (1.18-2.48) and 2.01 (1.33-3.03) for [50-60[, [60-70[and [70+ years, respectively]; hypolipidemic drug treatment [OR=1.68 (1.29-2.18)]; current smoking [0.70 (0.51-0.96)] and obesity [0.67 (0.45-1.00)]. Approximately half of participants diagnosed with diabetes reported an antidiabetic diet. Antidiabetic diet was associated with current smoking [0.44 (0.22-0.88)] and antidiabetic drug treatment [OR=3.26 (1.81-5.86)].

Conclusion: Dietary management of CVRFs is seldom implemented in Switzerland.

Abstract word count: 199

INTRODUCTION

Cardiovascular diseases (CVD) are the leading cause of death worldwide (2011). Adequate lifestyle including a healthy diet, avoidance of smoking, healthy body weight and regular physical activity has been shown to prevent the majority of CVD (2011).

A healthy diet is paramount for the prevention and management of CVD (Hu and Willett, 2002). Several randomized controlled trials have shown that appropriate dietary modifications positively affect blood pressure, lipid levels and overall CVD risk (Champagne, 2006; Dickinson et al., 2006; Hooper et al., 2012; Swain et al., 2008), a finding also observed for specific dietary patterns in the general population (Estruch et al., 2013). Conversely, observational epidemiologic studies have shown that consumption of saturated and trans fatty acids is associated with higher CVD rates (Erkkila et al., 2008).

Even though accumulating evidence demonstrates the benefits of dietary management of cardiovascular risk factors (CVRF), little is known regarding if diagnosis of CVRFs is associated with healthy dietary implementation in Switzerland. Thus, our study aimed to assess the associations between diagnosis of CVRFs and presence of dietary intervention using self-reported as a proxy.

PARTICIPANTS AND METHODS

The Cohorte Lausannoise (CoLaus) study.

The CoLaus study is a population-based study assessing the clinical, biological and genetic determinants of CVD in the city of Lausanne, Switzerland (Firmann et al., 2008). The study was approved by the Institutional Ethics Committee of the University of Lausanne and all participants provided written informed consent. The initial recruitment took place between June 2003 and May 2006 and enrolled 6,733 participants (3,544 women) aged 35-75 years; participation rate was 41%.

Follow-up was conducted between April 2009 and September 2012 and included all participants willing to be re-contacted. At follow-up, participants attended a single visit, which

included an interview, a physical exam, and blood and urine collections in the fasting state. Average follow-up time was 5.5 years. In this study, only data from the follow-up examination was considered as no information regarding dietary intake was available at baseline.

Clinical and anthropometric data

Educational level was categorized as low (primary), middle (apprenticeship or secondary school) and high (university). Smoking status was defined as never, former and current. Body weight and height were measured using standard procedures (Firmann et al., 2008) in the baseline and follow-up examinations. Body mass index (BMI) was defined as weight (kg)/height(m)^2. Overweight was defined as 25≤BMI<30 kg/m^2 and obesity as BMI≥30 kg/m^2. Physical activity was assessed with a validated, self-administered quantitative physical activity frequency questionnaire developed in the Geneva general adult population (Bernstein et al., 1998). Sedentarity was defined as a total energy expenditure <10% in activities exceeding four times the basal metabolic rate. Information on sedentarity was missing for 17.5% of the sample. No data on income, stage of change or bariatric surgery was available.

Awareness of overweight-obesity / hypertension / dyslipidemia or diabetes was considered if the participant responded positively to the questions “did a doctor tell you that you had excess weight / were hypertensive / had high cholesterol levels / were diabetic?” respectively. Participants were asked to bring all drugs (prescribed and over the counter) to the examination and drug treatment of hypertension, dyslipidemia or diabetes was assessed by identifying each individual drug.

Dietary management of CVRF

Participants were asked if they were currently on a diet, with five possible non-exclusive answers: to lose weight (slimming diet); low fat/against cholesterol; low sugar/against diabetes; low salt/against hypertension; other (with description). For analysis, each type of diet was considered as a yes/no variable. As dietary management of CVRFs can only be performed upon

diagnosis, analysis was restricted to participants who reported a previous diagnosis of overweight/obesity, hypertension, dyslipidemia or diabetes. No further information on the exact characteristics of the diet where asked; namely, no information was available whether the diet was self-prescribed or doctor-prescribed.

Statistical analysis

Statistical analyses were performed using Stata version 13.0 for windows (Stata Corp, College Station, TX, USA). Descriptive results were expressed as number of participants (percentage) or as average ± standard deviation. Bivariate analyses were performed using chi-square test for qualitative variables and Student's t-test for quantitative variables. Multivariate analysis of the factors associated with the presence of a self-reported diet aimed at managing the condition (i.e. slimming, low salt or antidiabetic, respectively) was performed using logistic regression and the results were expressed as Odds ratio (OR) and 95% confidence interval (CI). Model goodness-of-fit, area under the receiver operating curve and the percentage of outcomes explained by the model were also provided. Sensitivity analyses were conducted with a further adjustment on sedentary status and after excluding participants aged over 70. Statistical significance was assessed for $p<0.05$.

RESULTS

Characteristics of the participants

Of the initial 5064 participants, 138 (5%) were excluded because of missing data for any variable (except sedentary status) used in the analysis. The main characteristics of the remaining 4811 participants overall and by gender are summarized in **supplementary table 1**. Men were younger, with higher levels of formal education, lived more frequently in couple, a higher prevalence of history of CVD, were more frequently overweight, obese and smokers and less frequently sedentary than women. Diagnosis of overweight/obesity, hypertension, dyslipidemia and diabetes was also higher among men (**table 1**). There were 70 (1.5%) underweight (BMI<18.5 kg/m^2) participants (61 women, 9 men); none reported being on a slimming diet.

Dietary management of CVRF

Only one sixth (16%) of participants diagnosed with overweight/obesity reported a slimming diet. On bivariate analysis, women, younger age and diagnosis of hypertension were positively associated with reporting a slimming diet (**table 1**). On multivariate analysis, women and diagnosis of overweight/obesity were positively associated, while older age or diagnosis of hypertension were negatively associated with reporting a slimming diet (**table 2**).

Less than one tenth (8%) of participants with diagnosed hypertension reported a low salt diet. On bivariate analysis, personal history of CVD, diagnosis of diabetes and antihypertensive drug treatment were positively associated with reporting a salt diet (**table 1**). On multivariate analysis, personal history of CVD, diagnosis of hypertension or antihypertensive drug treatment were positively associated with reporting a low salt diet (**table 2**).

One third (32%) of participants with diagnosed dyslipidemia reported a low fat diet, and less than half (47%) of participants with diagnosed diabetes reported an antidiabetic diet. On bivariate analysis, women, older age, lower education, personal history of CVD, and antihypertensive drug treatment were positively associated while smoking status was negatively associated with reporting a low fat diet (**table 1**). On multivariate analysis, women, older age, lower education, diagnosis of dyslipidemia or hypolipidemic drug treatment were positively associated with reporting a low fat diet (**table 2**).

Less than half (47%) of participants with diagnosed diabetes reported an antidiabetic diet. On bivariate analysis, diagnosis of overweight/obesity, antihypertensive, hypolipidemic or antidiabetic drug treatment were positively associated while smoking status was negatively associated with reporting an antidiabetic diet (**table 1**). On multivariate analysis, older age, diagnosis of overweight/obesity, diagnosis of diabetes or antidiabetic drug treatment were associated with a higher likelihood of reporting an antidiabetic diet (**Table 2**).

Table 1. Bivariate analysis of clinical and socio-demographic factors associated with reported diet among participants diagnosed with obesity, hypertension, dyslipidemia and diabetes.

	Obesity (N=1510)		**Hypertension (N=1657)**		**Dyslipidemia (N=1568)**		**Diabetes (N=379)**	
	Slimming diet		**Low salt diet**		**Low fat diet**		**Antidiabetic diet**	
	No (N=1264)	**Yes (N=246)**	**No (N=1531)**	**Yes (N=126)**	**No (N=1062)**	**Yes (N=506)**	**No (N=202)**	**Yes (N=177)**
Gender								
Woman	604 (47.8)	154 (62.6)	697 (45.5)	59 (46.8)	449 (42.3)	273 (54.0)	67 (33.2)	55 (31.1)
Man	660 (52.2)	92 (37.4)	834 (54.5)	67 (53.2)	613 (57.7)	233 (46.0)	135 (66.8)	122 (68.9)
p-value	<0.001		0.78		<0.001		0.66	
Age group (years)								
[40-50[	309 (24.5)	73 (29.7)	220 (14.4)	12 (9.5)	220 (20.7)	57 (11.3)	18 (8.9)	18 (10.2)
[50-60[	389 (30.8)	78 (31.7)	414 (27.0)	27 (21.4)	330 (31.1)	124 (24.5)	49 (24.3)	39 (22.0)
[60-70[	367 (29.0)	72 (29.3)	536 (35.0)	51 (40.5)	324 (30.5)	190 (37.6)	81 (40.1)	70 (39.6)
[70+[	199 (15.7)	23 (9.4)	361 (23.6)	36 (28.6)	188 (17.7)	135 (26.7)	54 (26.7)	50 (28.3)
p-value	<0.05		0.14		<0.001		0.93	
Marital status								
Single	547 (43.3)	117 (47.6)	640 (41.8)	58 (46.0)	439 (41.3)	199 (39.3)	79 (39.1)	71 (40.1)
Couple	717 (56.7)	129 (52.4)	891 (58.2)	68 (54.0)	623 (58.7)	307 (60.7)	123 (60.9)	106 (59.9)
p-value	0.22		0.36		0.45		0.84	
Education								
High	223 (17.6)	45 (18.3)	246 (16.1)	21 (16.7)	221 (20.8)	77 (15.2)	30 (14.9)	18 (10.2)
Middle	305 (24.1)	67 (27.2)	356 (23.3)	33 (26.2)	235 (22.1)	123 (24.3)	46 (22.8)	38 (21.5)
Low	736 (58.2)	134 (54.5)	929 (60.7)	72 (57.1)	606 (57.1)	306 (60.5)	126 (62.4)	121 (68.4)
p-value	0.51		0.71		0.03		0.33	
History of CVD	1162 (91.9)	233 (94.7)	166 (10.8)	22 (17.5)	109 (10.3)	73 (14.4)	26 (12.9)	33 (18.6)
p-value	0.13		0.03		0.02		0.12	
BMI categories								
Normal	89 (7.0)	17 (6.9)	406 (26.5)	35 (27.8)	352 (33.2)	176 (34.8)	37 (18.3)	26 (14.7)
Overweight	572 (45.3)	110 (44.7)	679 (44.4)	51 (40.5)	468 (44.1)	218 (43.1)	82 (40.6)	72 (40.7)
Obese	603 (47.7)	119 (48.4)	446 (29.1)	40 (31.8)	242 (22.8)	112 (22.1)	83 (41.1)	79 (44.6)

p-value	0.98		0.69		0.81		0.60	
Smoking categories								
Former	544 (43.0)	114 (46.3)	677 (44.2)	61 (48.4)	429 (40.4)	214 (42.3)	85 (42.1)	104 (58.8)
Never	482 (38.1)	97 (39.4)	584 (38.2)	49 (38.9)	392 (36.9)	208 (41.1)	67 (33.2)	54 (30.5)
Smoker	238 (18.8)	35 (14.2)	270 (17.6)	16 (12.7)	241 (22.7)	84 (16.6)	50 (24.8)	19 (10.7)
p-value	0.22		0.35		0.02		<0.001	
Sedentarity								
No	345 (33.7)	70 (34)	438 (34.6)	46 (43)	333 (38.1)	168 (39)	36 (26.3)	36 (25.7)
Yes	680 (66.3)	136 (66)	828 (65.4)	61 (57)	541 (61.9)	263 (61)	101 (73.7)	104 (74.3)
p-value	0.93		0.08		0.76		0.92	
Diagnosed overweight/obesity	-	-	719 (47.0)	60 (47.6)	438 (41.2)	215 (42.5)	120 (59.4)	124 (70.1)
p-value	NA		0.89		0.64		0.03	
Diagnosed hypertension	671 (53.1)	108 (43.9)	-	-	489 (46.1)	253 (50.0)	121 (59.9)	119 (67.2)
p-value	0.008		NA		0.14		0.14	
Diagnosed dyslipidemia	560 (44.3)	93 (37.8)	684 (44.7)	58 (46.0)	-	-	118 (58.4)	116 (65.5)
p-value	0.06		0.77		NA		0.16	
Diagnosed diabetes	207 (16.4)	37 (15.0)	214 (14.0)	26 (20.6)	158 (14.9)	76 (15.0)	-	-
p-value	0.60		0.04		0.94		NA	
Treated hypertension	541 (42.8)	95 (38.6)	1068 (69.8)	106 (84.1)	411 (38.7)	231 (45.7)	116 (57.4)	119 (67.2)
p-value	0.22		0.001		0.009		0.05	
Treated dyslipidemia	372 (29.4)	64 (26.0)	510 (33.3)	47 (37.3)	498 (46.9)	312 (61.7)	90 (44.6)	109 (61.6)
p-value	0.28		0.36		<0.001		0.001	
Treated diabetes	169 (13.4)	23 (9.4)	170 (11.1)	17 (13.5)	118 (11.1)	56 (11.1)	122 (60.4)	149 (84.2)
p-value	0.08		0.42		0.98		<0.001	
Personal physician	1184 (93.7)	232 (94.3)	1469 (96.0)	122 (96.8)	1010 (95.1)	490 (96.8)	193 (95.5)	169 (95.5)
p-value	0.71		0.63		0.12		0.98	

Results are expressed as number of participants and (column percentage). BMI, body mass index; CVD, cardiovascular disease; NA, not assessable. Between-group comparisons performed using chi-square.

Table 2: multivariate analysis of the clinical and socio-demographic factors associated with reported diet, among participants diagnosed with obesity, hypertension, dyslipidemia or diabetes

	Obesity (slimming diet)	**Hypertension (low salt diet)**	**Dyslipidemia (low fat diet)**	**Diabetes (antidiabetic diet)**
Gender (woman vs. man)	1.84 (1.36 - 2.48)	1.09 (0.73 - 1.61)	1.47 (1.17 - 1.86)	1.06 (0.65 - 1.74)
Age group				
[40-50[	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
[50-60[	0.84 (0.58 - 1.21)	1.03 (0.50 - 2.10)	1.29 (0.89 - 1.87)	0.67 (0.27 - 1.62)
[60-70[	0.79 (0.53 - 1.18)	1.27 (0.64 - 2.51)	1.71 (1.18 - 2.48)	0.48 (0.20 - 1.14)
[70+[	0.47 (0.27 - 0.81)	1.23 (0.59 - 2.53)	2.01 (1.33 - 3.03)	0.42 (0.17 - 1.07)
p-value for trend	0.008	0.47	<0.001	0.05
Education				
High	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Middle	1.08 (0.71 - 1.66)	1.00 (0.56 - 1.79)	1.41 (0.99 - 2.00)	1.29 (0.59 - 2.84)
Low	0.87 (0.59 - 1.28)	0.77 (0.45 - 1.30)	1.27 (0.93 - 1.74)	1.47 (0.73 - 2.97)
p-value for trend	0.49	0.33	0.13	0.28
History of CVD (Yes vs. No)	0.78 (0.41 - 1.49)	1.59 (0.93 - 2.75)	1.23 (0.86 - 1.75)	1.27 (0.67 - 2.40)
BMI categories (%)				
Normal	-	1 (ref.)	1 (ref.)	1 (ref.)
Overweight	-	0.82 (0.50 - 1.35)	0.81 (0.61 - 1.08)	0.79 (0.39 - 1.61)
Obese	-	0.90 (0.47 - 1.73)	0.67 (0.45 - 1.00)	0.63 (0.27 - 1.45)
p-value for trend	-	0.75	0.05	0.28

Smoking categories (%)				
Never	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Former	1.20 (0.88 - 1.63)	1.00 (0.67 - 1.51)	0.94 (0.73 - 1.20)	1.43 (0.87 - 2.35)
Smoker	0.73 (0.48 - 1.12)	0.70 (0.39 - 1.27)	0.70 (0.51 - 0.96)	0.44 (0.22 - 0.88)
p-value for trend	0.15	0.24	0.03	0.02
Diagnosed overweight/obesity (Yes vs. No)	-	0.99 (0.60 - 1.63)	1.26 (0.94 - 1.68)	1.38 (0.75 - 2.51)
Diagnosed hypertension (Yes vs. No)	0.61 (0.40 - 0.93)	-	0.94 (0.69 - 1.29)	1.18 (0.61 - 2.29)
Diagnosed dyslipidemia (Yes vs. No)	0.79 (0.54 - 1.14)	0.93 (0.56 - 1.54)	-	1.01 (0.56 - 1.81)
Diagnosed diabetes (Yes vs. No)	2.16 (1.13 - 4.12)	2.72 (1.26 - 5.86)	1.13 (0.65 - 1.98)	-
Treated hypertension (Yes vs. No)	1.46 (0.93 - 2.29)	2.17 (1.28 - 3.68)	0.96 (0.68 - 1.36)	0.84 (0.41 - 1.72)
Treated dyslipidemia (Yes vs. No)	1.31 (0.84 - 2.05)	0.93 (0.53 - 1.63)	1.68 (1.29 - 2.18)	1.43 (0.78 - 2.64)
Treated diabetes (Yes vs. No)	0.39 (0.18 - 0.85)	0.42 (0.17 - 1.03)	0.69 (0.36 - 1.30)	3.26 (1.81 - 5.86)
Physician (Yes vs. No)	1.19 (0.65 - 2.18)	1.00 (0.35 - 2.85)	1.13 (0.62 - 2.04)	0.89 (0.29 - 2.73)
Model characteristics				
Goodness-of-fit (p-value)	0.42	0.007	0.44	0.25
Area under the ROC curve	0.640	0.633	0.640	0.701
Proportion of outcomes explained (%)	83.7	92.4	67.6	63.9

Results are expressed as Odds-ratio and (95% confidence interval). BMI, body mass index; CVD, cardiovascular disease. Analysis by logistic regression adjusting for all variables included in the model. Goodness-of-fit was assessed by Hosmer-Lemeshow test and results are provided as p-value; a p-value >0.05 indicates adequate fit.

Similar findings were obtained after further adjusting for sedentary status (**supplementary table 2**) or after excluding participants aged over 70 (**supplementary table 2**).

DISCUSSION

To our knowledge, this is the first study to assess adherence to dietary recommendation for CVRFs in Switzerland. Our results indicate that, in this Swiss population-based study, diagnosis of CVRFs is seldom associated with dietary measures.

Over three-quarters of all CVD mortality could be prevented by lifestyle-induced reduction of CVRFs (2011), and European guidelines state that dietary modifications should form the basis for CVD prevention (Perk et al., 2012). Still, in this study, a low prevalence of dietary management of CVRFs was noted. Likely explanations include the lack of 1) nutritional knowledge of Swiss doctors, as it has been reported in the UK (Barratt, 2001); 2) adherence to dietary recommendations of patients (Vernay et al., 2012), or 3) reimbursement of dietician's consultations . Thus, efforts should be made to implement dietary management in patients with CVRFs, either by increasing dietary knowledge of doctors, by increasing patients' adherence or by facilitating access to dieticians or nutritionists.

Obesity

Obesity is associated with an increased mortality from CVD (Lavie et al., 2009). Weight reduction leads to a decrease in hypertension (Siebenhofer et al., 2011) and diabetes (Lindstrom et al., 2013). In this study, only one sixth of the participants diagnosed with overweight/obesity reported being on a slimming diet. This value is considerably lower than in the US (Post et al., 2011) but comparable to a Portuguese study (Marques-Vidal et al., 2011) and slightly better than a Spanish study (10%) (Rodriguez-Martin et al., 2009). Women and younger participants were more likely to be on a slimming diet, a finding also reported elsewhere (Rodriguez-Martin et al., 2009). Possible explanations include the social importance and the media pressure for an adequate body image among young people, namely women (Cuadrado et al., 2000) and the increasing presence of slimming advices in women's magazines (Barker et al., 2013). Treatment of diabetes was negatively

associated, while diagnosis of diabetes was positively associated with a slimming diet. One possible explanation is the belief by patients that antidiabetic treatment makes dietary management (including weight loss) unnecessary, as suggested by their higher ranking of medication relative to diet and exercise (Broadbent et al., 2011)

Hypertension

Dietary management is one of the main treatment strategies for hypertension (Mancia et al., 2014). Sodium reduction associated with other dietary recommendations has been shown to be effective in reducing blood pressure levels (Bray et al., 2004; He et al., 2013; Sacks et al., 2001), although no effect of sodium reduction on cardiovascular or overall mortality has been found (DiNicolantonio et al., 2013; Taylor et al., 2011). In this study, only a small number of participants diagnosed with hypertension reported being on a low salt diet, a value lower than reported in other studies (Hu et al., 2013; Warren-Findlow and Seymour, 2011). A possible explanation is the difficulty in implementing low salt diets (He and MacGregor, 2010). Finally, no sociodemographic or clinical variable was significantly associated with being on a low salt diet, most probably because of the small sample size, which would have reduced statistical power. Nevertheless, our results show that Swiss doctors should be sensitized regarding prescription of low salt diet to their hypertensive patients.

Lipids

Dietary factors have been shown to influence atherogenesis directly or through effects on lipid levels (Mancia et al., 2014), and guidelines regarding dietary management of dyslipidemia have been issued (European Association for Cardiovascular et al., 2011). In this study, one third of participants diagnosed with dyslipidemia reported being on a low-fat diet, a value higher than reported for Poland (20%) (Waskiewicz et al., 2008) or in the US, where only 11.7% of visits to primary care physicians included any type of counselling for diet or nutrition (Kulick et al., 2013). On multivariate analysis, women and elderly participants were more likely to report being on a low fat diet. Possible explanations include a better health management by women, although other

explanations such as a desire to lose weight (low fat diets are usually associated with slimming) cannot be ruled out. The higher adoption of a low fat diet by elderly people could also be due to the fact that they retained their dietary habits. As fat content of the Swiss diet increased from 33.5% in 1961 to 40.3% of total caloric intake in 2007 (Guerra et al., 2012), it is possible that older participants might have fewer difficulties in implementing low-fat diets.

Diabetes

Healthy dietary management (including weight loss) successfully prevents the development of diabetes (Lindstrom et al., 2013), and most guidelines emphasize dietary intervention for the management of diabetes (Authors/Task Force et al., 2013; Bantle et al., 2006). Still, only half of the participants diagnosed with diabetes reported being on an antidiabetic diet, a value also reported elsewhere (Davison et al., 2014; Munoz-Pareja et al., 2012; Peytremann-Bridevaux et al., 2013). Possible explanations include a lower adherence to diet because of reduction in the patient's quality of life (Puder et al., 2005), limited access to dieticians (Peytremann-Bridevaux et al., 2013) or a reduced knowledge of doctors regarding dietary management of diabetes. Still, our results question the current dietary management of diabetes in the Swiss population.

Implication for clinical practice

Our results strongly suggest that dietary management of CVRFs is neglected in the general population. Further, presence of other CVRFs (with the exception of diabetes) did not increase the likelihood of reporting a diet, also suggesting that diet implementation is directed towards a single CVRF. Still, dietary management of CVRFs should promote an overall healthy diet rather than focusing on single CVRFs. Indeed, the joint effects of energy and nutrient changes provide more health benefits than intervention on an individual dietary component (Champagne, 2006; Riegel et al., 2012). Thus, general practitioners should motivate their patients to adhere to a healthy diet rather than to avoid specific foods or nutrients.

Study limitations

This study has several limitations worth acknowledging for. Firstly, no information was available whether the diet was self-prescribed or doctor-prescribed. This self-prescription applies mostly to slimming diets, although other types of diet can also be impacted. Hence, it is likely that the actual prescription rates of dietary management by Swiss doctors are lower than reported. Secondly, it was not possible to confirm (i.e. via a 24h urine collection) if participants reporting a low salt diet were actually compliant with the dietary recommendations. Still, this would decrease even further the very low prevalence of hypertensive participants on a low salt diet, as it has been demonstrated that only a limited number of patients succeed in reducing their salt consumption to the desired levels (Korhonen et al., 1999). Thirdly, it is possible that participants who did not report being on a modified diet already had a healthy dietary intake, so no specific changes were deemed necessary. The assessment of energy and nutrient intake will provide more information on the adequacy of diets consumed by participants with CVRFs. Fourthly, the cross-sectional design of the study is a limitation because it is not possible to know if it is the diagnosis that makes the participants modify their diet or if they do it by themselves. The ongoing collection of new data in the same cohort will allow such a study in the forthcoming years. Finally, no information was collected regarding previous adherence to dietary recommendations. Hence, it is possible that a sizable number of participants diagnosed with CVRFs actually received dietary recommendations but failed to implement them. Still, as dietary management of CVRFs should be a lifelong process, or results suggest that implementation of a healthy diet among participants with CVRFs should be improved.

Conclusion

Diagnosis of CVRF is seldom associated with self-reported diet. Dietary prevention of CVRFs appears to complement drug treatment rather than to be an essential part of CVRF management.

AUTHORS CONTRIBUTIONS

MG made part of the statistical analyses and wrote most of the article; PMV collected data, made part of the statistical analysis and wrote part of the article; ALM wrote part of the article; IG, PV and GW revised the article for important intellectual content. PMV had full access to the data and is the guarantor of the study.

CONFLICT OF INTEREST

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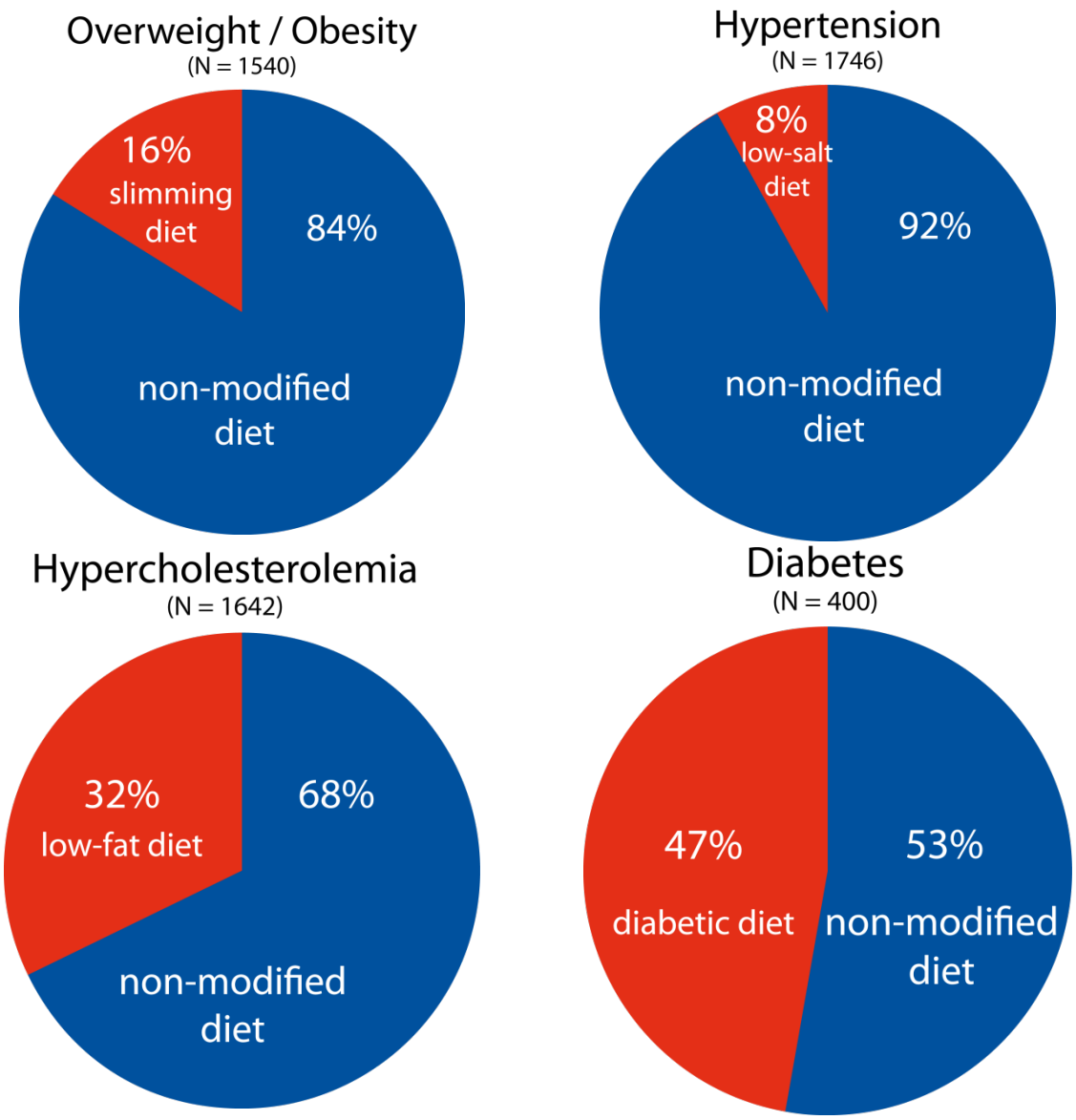
Figure 1


Overweight / Obesity
(N = 1540)
16%
slimming diet
84%
non-modified diet
Hypertension
(N = 1746)
8%
low-salt diet
92%
non-modified diet
Hypercholesterolemia
(N = 1642)
32%
low-fat diet
68%
non-modified diet
Diabetes
(N = 400)
47%
diabetic diet
53%
non-modified diet

Supplementary table 1: Clinical and socio-demographic factors associated with reported diet among participants diagnosed with obesity, hypertension, dyslipidemia and diabetes.

	Obesity (N=1510)		**Hypertension (N=1657)**		**Dyslipidemia (N=1568)**		**Diabetes (N=379)**	
	Slimming diet		**Low salt diet**		**Low fat diet**		**Antidiabetic diet**	
	No	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**
	(N=1264)	**(N=246)**	**(N=1531)**	**(N=126)**	**(N=1062)**	**(N=506)**	**(N=202)**	**(N=177)**
Gender								
Woman	604 (47.8)	154 (62.6)	697 (45.5)	59 (46.8)	449 (42.3)	273 (54.0)	67 (33.2)	55 (31.1)
Man	660 (52.2)	92 (37.4)	834 (54.5)	67 (53.2)	613 (57.7)	233 (46.0)	135 (66.8)	122 (68.9)
p-value	<0.001		0.78		<0.001		0.66	
Age group (years)								
[40-50[	309 (24.5)	73 (29.7)	220 (14.4)	12 (9.5)	220 (20.7)	57 (11.3)	18 (8.9)	18 (10.2)
[50-60[	389 (30.8)	78 (31.7)	414 (27.0)	27 (21.4)	330 (31.1)	124 (24.5)	49 (24.3)	39 (22.0)
[60-70[	367 (29.0)	72 (29.3)	536 (35.0)	51 (40.5)	324 (30.5)	190 (37.6)	81 (40.1)	70 (39.6)
[70+[	199 (15.7)	23 (9.4)	361 (23.6)	36 (28.6)	188 (17.7)	135 (26.7)	54 (26.7)	50 (28.3)
p-value	<0.05		0.14		<0.001		0.93	
Marital status								
Single	547 (43.3)	117 (47.6)	640 (41.8)	58 (46.0)	439 (41.3)	199 (39.3)	79 (39.1)	71 (40.1)
Couple	717 (56.7)	129 (52.4)	891 (58.2)	68 (54.0)	623 (58.7)	307 (60.7)	123 (60.9)	106 (59.9)
p-value	0.22		0.36		0.45		0.84	
Education								
High	223 (17.6)	45 (18.3)	246 (16.1)	21 (16.7)	221 (20.8)	77 (15.2)	30 (14.9)	18 (10.2)
Middle	305 (24.1)	67 (27.2)	356 (23.3)	33 (26.2)	235 (22.1)	123 (24.3)	46 (22.8)	38 (21.5)
Low	736 (58.2)	134 (54.5)	929 (60.7)	72 (57.1)	606 (57.1)	306 (60.5)	126 (62.4)	121 (68.4)

p-value	0.51		0.71		0.03		0.33	
History of CVD	1162 (91.9)	233 (94.7)	166 (10.8)	22 (17.5)	109 (10.3)	73 (14.4)	26 (12.9)	33 (18.6)
p-value	0.13		0.03		0.02		0.12	
BMI categories								
Normal	89 (7.0)	17 (6.9)	406 (26.5)	35 (27.8)	352 (33.2)	176 (34.8)	37 (18.3)	26 (14.7)
Overweight	572 (45.3)	110 (44.7)	679 (44.4)	51 (40.5)	468 (44.1)	218 (43.1)	82 (40.6)	72 (40.7)
Obese	603 (47.7)	119 (48.4)	446 (29.1)	40 (31.8)	242 (22.8)	112 (22.1)	83 (41.1)	79 (44.6)
p-value	0.98		0.69		0.81		0.60	
Smoking categories								
Former	544 (43.0)	114 (46.3)	677 (44.2)	61 (48.4)	429 (40.4)	214 (42.3)	85 (42.1)	104 (58.8)
Never	482 (38.1)	97 (39.4)	584 (38.2)	49 (38.9)	392 (36.9)	208 (41.1)	67 (33.2)	54 (30.5)
Smoker	238 (18.8)	35 (14.2)	270 (17.6)	16 (12.7)	241 (22.7)	84 (16.6)	50 (24.8)	19 (10.7)
p-value	0.22		0.35		0.02		<0.001	
Diagnosed overweight/obesity	-	-	719 (47.0)	60 (47.6)	438 (41.2)	215 (42.5)	120 (59.4)	124 (70.1)
p-value	NA		0.89		0.64		0.03	
Diagnosed hypertension	671 (53.1)	108 (43.9)	-	-	489 (46.1)	253 (50.0)	121 (59.9)	119 (67.2)
p-value	0.008		NA		0.14		0.14	
Diagnosed dyslipidemia	560 (44.3)	93 (37.8)	684 (44.7)	58 (46.0)	-	-	118 (58.4)	116 (65.5)
p-value	0.06		0.77		NA		0.16	
Diagnosed diabetes	207 (16.4)	37 (15.0)	214 (14.0)	26 (20.6)	158 (14.9)	76 (15.0)	-	-
p-value	0.60		0.04		0.94		NA	
Treated hypertension	541 (42.8)	95 (38.6)	1068 (69.8)	106 (84.1)	411 (38.7)	231 (45.7)	116 (57.4)	119 (67.2)
p-value	0.22		0.001		0.009		0.05	
Treated dyslipidemia	372 (29.4)	64 (26.0)	510 (33.3)	47 (37.3)	498 (46.9)	312 (61.7)	90 (44.6)	109 (61.6)
p-value	0.28		0.36		<0.001		0.001	

Treated diabetes	169 (13.4)	23 (9.4)	170 (11.1)	17 (13.5)	118 (11.1)	56 (11.1)	122 (60.4)	149 (84.2)
p-value	0.08		0.42		0.98		<0.001	
Personal physician	1184 (93.7)	232 (94.3)	1469 (96.0)	122 (96.8)	1010 (95.1)	490 (96.8)	193 (95.5)	169 (95.5)
p-value	0.71		0.63		0.12		0.98	

Results are expressed as number of participants and (column percentage). BMI, body mass index; CVD, cardiovascular disease; NA, not assessable. Between-group comparisons performed using chi-square.

Supplementary table 2: multivariate analysis of the clinical and socio-demographic factors associated with reported diet, among participants diagnosed with obesity, hypertension, dyslipidemia or diabetes

	Obesity (slimming diet)	**Hypertension (low salt diet)**	**Dyslipidemia (low fat diet)**	**Diabetes (antidiabetic diet)**
Gender (woman vs. man)	1.84 (1.36 - 2.48) ***	1.09 (0.73 - 1.61)	1.47 (1.17 - 1.86) ***	1.06 (0.65 - 1.74)
Age group				
[40-50[	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
[50-60[	0.84 (0.58 - 1.21)	1.03 (0.50 - 2.10)	1.29 (0.89 - 1.87)	0.67 (0.27 - 1.62)
[60-70[	0.79 (0.53 - 1.18)	1.27 (0.64 - 2.51)	1.71 (1.18 - 2.48) **	0.48 (0.20 - 1.14)
[70+[	0.47 (0.27 - 0.81) **	1.23 (0.59 - 2.53)	2.01 (1.33 - 3.03) ***	0.42 (0.17 - 1.07)
p-value for trend	0.008	0.47	<0.001	0.05
Education				
High	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Middle	1.08 (0.71 - 1.66)	1.00 (0.56 - 1.79)	1.41 (0.99 - 2.00)	1.29 (0.59 - 2.84)
Low	0.87 (0.59 - 1.28)	0.77 (0.45 - 1.30)	1.27 (0.93 - 1.74)	1.47 (0.73 - 2.97)
p-value for trend	0.49	0.33	0.13	0.28
History of CVD (Yes vs. No)	0.78 (0.41 - 1.49)	1.59 (0.93 - 2.75)	1.23 (0.86 - 1.75)	1.27 (0.67 - 2.40)
BMI categories (%)				
Normal	-	1 (ref.)	1 (ref.)	1 (ref.)
Overweight	-	0.82 (0.50 - 1.35)	0.81 (0.61 - 1.08)	0.79 (0.39 - 1.61)
Obese	-	0.90 (0.47 - 1.73)	0.67 (0.45 - 1.00) *	0.63 (0.27 - 1.45)
p-value for trend	-	0.75	0.05	0.28
Smoking categories (%)				

Never	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Former	1.20 (0.88 - 1.63)	1.00 (0.67 - 1.51)	0.94 (0.73 - 1.20)	1.43 (0.87 - 2.35)
Smoker	0.73 (0.48 - 1.12)	0.70 (0.39 - 1.27)	0.70 (0.51 - 0.96) *	0.44 (0.22 - 0.88) *
p-value for trend	0.15	0.24	0.03	0.02
Diagnosed overweight/obesity (Yes vs. No)	-	0.99 (0.60 - 1.63)	1.26 (0.94 - 1.68)	1.38 (0.75 - 2.51)
Diagnosed hypertension (Yes vs. No)	0.61 (0.40 - 0.93) *	-	0.94 (0.69 - 1.29)	1.18 (0.61 - 2.29)
Diagnosed dyslipidemia (Yes vs. No)	0.79 (0.54 - 1.14)	0.93 (0.56 - 1.54)	-	1.01 (0.56 - 1.81)
Diagnosed diabetes (Yes vs. No)	2.16 (1.13 - 4.12) *	2.72 (1.26 - 5.86) *	1.13 (0.65 - 1.98)	-
Treated hypertension (Yes vs. No)	1.46 (0.93 - 2.29)	2.17 (1.28 - 3.68) **	0.96 (0.68 - 1.36)	0.84 (0.41 - 1.72)
Treated dyslipidemia (Yes vs. No)	1.31 (0.84 - 2.05)	0.93 (0.53 - 1.63)	1.68 (1.29 - 2.18) ***	1.43 (0.78 - 2.64)
Treated diabetes (Yes vs. No)	0.39 (0.18 - 0.85) *	0.42 (0.17 - 1.03)	0.69 (0.36 - 1.30)	3.26 (1.81 - 5.86) ***
Physician (Yes vs. No)	1.19 (0.65 - 2.18)	1.00 (0.35 - 2.85)	1.13 (0.62 - 2.04)	0.89 (0.29 - 2.73)

Results are expressed as Odds-ratio and (95% confidence interval). BMI, body mass index; CVD, cardiovascular disease. Analysis by logistic regression adjusting for all variables included in the model: *, $p<0.05$; **, $p<0.01$; ***, $p<0.001$.