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Title: **Relationship of behavioral risk factors for chronic diseases and preventive health services utilization among adults, aged 50+, from eleven European countries**

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Abstract

Aim: The current study aims to assess the relationship between behavioral risk factors (BRFs) for chronic diseases and preventive health services utilization among European adults.

Subjects and Methods: We used data from 16,125 adults, aged 50+ years, from eleven countries, participating in the Survey of Health, Ageing and Retirement in Europe (2004/05). Prevalence of BRFs (high body weight, smoking, physical inactivity and risky alcohol consumption) was examined in relation to preventive health services utilization, which was assessed via a twelve-component score (PHSUs) (scale: 0-100). Estimations were based on the complex study design.

Results: 90.7% of participants were seeing a general practitioner (GP) and 52.7% had 2+ BRFs. Adults with high body weight had lower odds of seeing a dentist (0.75, $p<0.05$) or having sigmoidoscopy/colonoscopy (0.70, $p<0.05$) and higher odds of receiving GP advice to exercise regularly (1.56, $p<0.05$). Smokers had lower odds of having mammograms (0.76, $p<0.05$), sigmoidoscopy/colonoscopy (0.72, $p<0.05$) and being tested for hidden blood in stool (0.63, $p<0.05$). Risky drinkers had lower odds of having mammograms (0.23, $p<0.05$). Lower mean PHSUs were found for adults with high body weight ($p=0.001$), smokers ($p=0.001$) and risky drinkers ($p=0.008$), while PHSUs did not differ by BRF clusters ($p=0.218$). In adults with 2+ BRFs, Greece was the country with the lowest mean PHSUs (28.0, $p<0.05$).

Conclusion: Adults with high body weight, those who smoked and were risky drinkers used fewer preventive health services. Primary prevention programmes should be developed to reduce BRF prevalence and promote preventive health services use in this population.

Word count: 250

Keywords: Preventive health services; Behavioral risk factors; Chronic disease; SHARE study

Introduction

Lifestyle habits such as smoking, physical inactivity, risky alcohol consumption and high body weight are associated with the occurrence of chronic, non-communicable diseases (NCDs). These habits, namely behavioral risk factors (BRFs), individually or cumulatively increase the risk of development of NCDs, such as cardiovascular disease, diabetes mellitus, chronic obstructive pulmonary disease, arthritis and/or some types of cancer (Fine et al. 2004; Klein-Geltink et al. 2006; Linardakis et al. 2013; World Health Organization 2010, 2011). **High body weight**, as a direct consequence of unhealthy dietary choices and physical inactivity, is globally responsible for 2.8 million deaths annually, while it is estimated that in 2030, mortality attributed to smoking will be doubled (from 3.4 to 6.8 million deaths) (World Health Organization 2010, 2011).

Several studies have revealed that increased morbidity and mortality attributed to BRFs are associated with the use of health services and increased healthcare costs (Anderson et al. 2005; Bertakis and Azari 2006; Hill et al. 2009; Sturm 2002; Vals et al. 2013). Hill and colleagues estimated that in the period 2004-06, the average medical annual costs were greater among Americans with one or more BRFs ($4,432), compared with those with no BRFs ($2,382), and increased with age (Hill et al. 2009). Preventive health services offer the possibility to prevent and/or treat chronic diseases by providing systematic information and advice, particularly regarding the non-adoption or reduction of harmful lifestyle habits, such as BRFs (Anderson et al. 2005; Bertakis and Azari 2006; Littman et al. 2011; Peytremann-Bridevaux and Santos-Eggimann 2007). In US adults, the presence of a behavioral risk factor e.g. obesity, appears to be combined with reduced use of specific preventive health services, such as cervical and breast cancer screening, and increased use of services related to immunizations, cholesterol and colon cancer screening (Littman et al. 2011). In contrast, the presence of **high body weight** in European adults does not seem to be associated with reduced utilization of preventive health services (Peytremann-Bridevaux and Santos-Eggimann 2007). Indeed, obesity and alcohol abuse (but not smoking) are associated with utilization of a higher number of diagnostic services (Bertakis and Azari 2006). A study among disabled US adults, aged 65+ years, showed that, compared to nondisabled counterparts, those who had more BRFs were less likely to use preventive health services, such as cholesterol checks, influenza vaccines, mammograms, sigmoidoscopy/colonoscopy etc. (Kim et al. 2009).

The relationship between preventive health services utilization and presence of BRFs has not been investigated in large-scale studies or among adults from different European regions. Thus, the aim of the present study was to examine preventive health services utilization in adults aged 50+ years from 11 European countries, according to the presence of individual BRFs and BRF clusters.

Methods

Study population and sampling

The Survey of Health, Ageing and Retirement in Europe (SHARE) is a collaboration of approximately 150 researchers from at least sixteen countries and is coordinated by the Mannheim Research Institute for the Economics of Aging (MEA, Germany). **As Europe has the highest proportion of adults aged 65+ among the world regions, the main task of SHARE in 2002 was to prospectively examine the role of ageing in the health of adults aged 50+ years in the diverse cultural settings of Europe. The current paper presents data of a subsample of 16,125 adults, aged 50+ years, from the total sample of 27,444 adults** in 11 countries (Austria, Belgium, Denmark, France, Germany, Greece, Italy, Netherlands, Spain, Sweden and Switzerland) during the first wave (2004/05) of the study. The studied population in each country was selected according to the complex multistage stratification design of the study, assuring its representativeness. **This involved either the national population registers (stratified - simple random sampling), the regional/local population registers (multistage sampling) or telephone directories (single or multistage sampling).** The target population consisted of households with at least one individual aged 50+ years, who spoke the official language of the country where the survey took place. Adults were excluded if they were institutionalized or away from their houses during the survey period **(living in prison, nursing homes, etc)**. The weighted country-average household response rates ranged from 38.8% (Switzerland) to 81.0% (France), whereas the respective individual response rates were higher and ranged from 73.7% (Spain) to 93.3% (France). Discrepancies between household and individual response rates probably resulted from differing sampling frames, but are common in large-scale surveys (Borsch-Supan et al. 2005). Based on the selected 16,125 adults and the study sampling design, the total estimated population targeted by the study was ~57 million adults aged 50+ years. Detailed information on the SHARE study design (multistage sampling, recruitment procedures, response rates, ethical issues etc) is provided in earlier reports (Borsch-Supan et al. 2013; Borsch-Supan et al. 2005; Linardakis et al. 2014; Linardakis et al. 2013).

Questionnaires

Completion of the main questionnaire of the study was performed using computer-aided personal interviews (CAPIs). CAPIs were administered to all participants (n=27,444) and consisted of 21 modules, including demographic characteristics, physical and mental health, behavioral risks, etc. In certain modules, adults were presented with example show cards, in order to help them understand the questions and ensure the validity of the answers (Crimmins et al. 2011). The completion rate exceeded 97%. A supplementary, paper and pencil questionnaire was also self-administered to a subsample of participants (n=16,125). This included questions

about medical exams, social and psychological well-being etc. Response rate was ~81% and ranged from 70% (Sweden) to 93% (Greece) (Borsch-Supan et al. 2005).

Preventive health services utilization score (PHSUs)

Preventive health services utilization was assessed by a composite score (PHSUs), using twelve questions. The questions assessed whether participants: 1) had contact with a dentist/dental hygienist for routine control and/or prevention; 2) had a general practitioner (GP) for advice/prevention; 3) were assessed by a GP for physical activity; 4) received advice for regular exercise by a GP; 5) were assessed by a GP for body weight; 6) were asked by a GP for drug use or prescriptions; 7) had flu vaccinations in the preceding year; 8) had a mammogram in the two preceding years (this question was initially addressed to females only but was answered by males as well); 9) had ever had a sigmoidoscopy/colonoscopy; 10) were tested for hidden blood in stool in the preceding ten years; 11) were ever referred by a doctor to a physiotherapy or exercise program for joint pain and; 12) were ever referred by a doctor to an orthopedic surgeon for joint pain (Borsch-Supan et al. 2005). All questions were coded into a binary variable (0=no/never, 1=yes/at some time/every visit) and a composite score (range=0-12) was computed by summing responses (BenDebba et al. 2002; Caldwell and Kirby 2012). The score was subsequently rescaled to 0-100, with higher values indicating higher preventive health services utilization.

Behavioral Risk Factors (BRFs)

Four health-related risky behaviors (BRFs), were assessed, namely high body weight, smoking habits, physical inactivity and risky alcohol consumption (Fine et al. 2004; Klein-Geltink et al. 2006; Linardakis et al. 2014; Linardakis et al. 2013).

High body weight was determined based on the body mass index (BMI) classifications of overweight and obesity (BMI $\geq$25.0 kg/m^2) (World Health Organization 2010) and on self-reported current weight (kg) and height (m) (Linardakis et al. 2014; Linardakis et al. 2013). Assessment of smoking habits was based on self-reported use of any tobacco products, such as cigarettes, cigars, cigarillos and pipes, during the year preceding the survey. Physical inactivity was defined as the lack of weekly engagement in moderate (e.g. walking) and/or vigorous (e.g. sports participation) activities during the research period. Finally, risky alcohol consumption was assessed by frequency and period of use, separately by gender. More details about the assessment of the aforementioned BRFs are provided elsewhere (Linardakis et al. 2014; Linardakis et al. 2013).

The prevalence of BRF accumulation (BRF clusters) was estimated by coding data for each risk factor separately into a binary variable (0=absence, 1=presence). The clustering of BRFs (having 0, 1, 2, 3 or 4 BRFs) was then calculated by adding the number of individual risk

factors (Fine et al. 2004; Linardakis et al. 2013). The accumulation of two or more factors (2+ BRFs) was considered to be an indication of increased risk for chronic diseases (Silva et al. 2013).

Physical health

Physical health, recorded by a validated scale via personal interviews, was determined by the presence of 12 conditions (chronic diseases) that had been diagnosed by a doctor in the preceding six months (Borsch-Supan et al. 2005; Jurges et al. 2008). These conditions included heart attack, high blood pressure or hypertension, high blood cholesterol, stroke, diabetes or high blood glucose, chronic lung disease, asthma, arthritis, osteoporosis, hip fracture or femoral fracture, cancer and stomach or duodenal ulcer/peptic ulcer. Each condition was coded into a binary variable (0=absence, 1=presence) and a total clustering score was then calculated by summing the resulted binary variables for each adult. The accumulation of 3+ conditions was considered to be an indication of multi-morbidity, taking into account that older adults tend to have higher rates of multi-morbidity.

Socio-economic characteristics

The social and demographic variables of gender, age (in years), living ('living alone' and 'living with partner/spouse'), retirement (yes/no) and education (total years of education) status were assessed in the current study (Linardakis et al. 2014; Linardakis et al. 2013). Financial status was recorded as the gross household income in the previous year. Reflecting the cross-national differences in household income, country-specific quartiles were computed and used (Hallberg 2006; Linardakis et al. 2014).

Due to the previously observed country differences in prevalence of BRFs (Linardakis et al. 2014; Linardakis et al. 2013), countries were further grouped into Northern (Denmark, Sweden), Central (Austria, Belgium, France, Germany, Netherlands, Switzerland) and Southern (Greece, Italy, Spain) European regions.

Statistical analysis

Data were analyzed using the SPSS software (IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp). Weights were applied according to the complex multistage stratification sampling design of the study, accounting for non-responses. **The prevalence and corresponding 95% confidence intervals (95% CIs) of the 12 PHSUs components and individual or BRF clusters were estimated.** Crude odds ratios (ORs) were calculated for participants having any of the four BRFs. Hierarchical cluster analysis was performed in order to identify relative and homogeneous groups in the components of the PHSUs and the Ward's method was used to assess the Euclidean distance of binary data. In addition, the mean PHSUs

was assessed by the presence and clustering of the four BRFs using analysis of covariance (according to the complex sampling design procedure), with gender, age, education, living status, country regions (north, central, south), physical health, retirement status and income as covariates. The corresponding 95% CIs were estimated according to the general linear complex sampling design. The same analysis was applied for adults with 2+ BRFs to determine differences in the PHSUs across the 11 countries.

Results

Mean age and years of education of participants were 64.2 and 10.0 years, respectively, whereas 25.7% were living alone (Table 1). The majority of participants (53.3%) lived in central Europe and 33.7% reported having no condition (disease). Adults with high body weight and physical inactivity had a higher prevalence of BRFs (59.6% and 68.9%, respectively). The clustering prevalence of 2+ BRFs was 52.7% (95% CIs: 51.9-53.5).

→ TABLE 1

Table 2 presents the prevalence of the components of the PHSUs. The majority of participants (90.7%) **were seeing** a GP for advice/prevention, but 49.4% had been asked about physical activity and 49.8% had been checked about their weight status. With regards to diagnostic tests, 29.5% and 22.1% of participants **have** had a mammogram and a sigmoidoscopy/colonoscopy, respectively. Adults with high body weight had lower odds of seeing a dentist/dental hygienist (0.75, $p<0.05$) and having sigmoidoscopy/colonoscopy (0.70, $p<0.05$) and higher odds of receiving GP advice to exercise regularly (1.56, $p<0.05$), having their weight checked (1.35, $p<0.05$) and being referred to an orthopedic surgeon for joint pain (1.38, $p<0.05$). Smokers had lower odds of seeing a dentist/dental hygienist (0.86, $p<0.05$), having flu vaccinations (0.56, $p<0.05$), mammograms (0.76, $p<0.05$), sigmoidoscopy/ colonoscopy (0.72, $p<0.05$) and being tested for hidden blood in stool (0.63, $p<0.05$). Inactive adults had lower odds of being tested for hidden blood in stool (0.74, $p<0.05$) and higher odds of receiving GP advice to exercise regularly (1.36, $p<0.05$), having their weight checked (1.26, $p<0.05$) and being referred to physiotherapy (1.26, $p<0.05$) or an orthopedic surgeon for joint pain (1.26, $p<0.05$). Risky drinkers had lower odds of seeing a dentist/dental hygienist (0.66, $p<0.05$), having their weight checked (0.71, $p<0.05$), having mammograms (0.23, $p<0.05$) and being tested for hidden blood in stool (0.60, $p<0.05$).

→ TABLE 2

Based on the hierarchical cluster analysis, Figure 1 illustrates the various combinations of the twelve components of the PHSUs. Two main clusters emerged: 1) Orthopedic health issues (referral to physiotherapy and orthopedic surgeon) constitute a sub-cluster with common characteristics regarding diagnostic tests (sigmoidoscopy/colonoscopy and testing for hidden

blood in stool) and with having flu vaccinations, seeing a dentist/dental hygienist and having mammograms and; 2) Having a GP offer lifestyle advice (advice for regular exercise in relation with drug use, checking weight status, and general advice on prevention).

→ **FIGURE 1**

Table 3 presents the PHSUs according to presence and clustering of behavioral risk factors. **The overall mean score was 38.5 (95% CIs: 37.2-39.9).** Based on the estimation of population synthesis and reflecting different characteristics, a lower PHSUs was observed among adults with high, compared to normal, body weight (38.4 vs. 40.8, p=0.001), smokers, compared to non-smokers (37.7 vs. 40.4, p=0.001) and risky drinkers, compared to non-risky drinkers (36.6 vs. 40.0, p=0.008). PHSUs did not differ according to clustering of BRFs (p=0.218).

→ **TABLE 3**

Among adults with 2+ BRFs, mean PHSUs was significantly lower in Greece (28.0), compared to other countries (95% CIs: 26.5-29.5) (p<0.05). The highest PHSUs (47.2) was found in Austria (95% CIs: 45.6-48.8).

→ **FIGURE 2**

Discussion

The current study aimed to assess the relationship of preventive health services utilization and BRFs for chronic diseases, in a large-scale study of adults, aged 50+ years, from eleven European countries, thus adding to the evidence base in this topic. The main finding was that adults who were overweight/ obese, smoked and were physically inactive used significantly fewer preventive health services. Nevertheless, preventive health services utilization did not differ in adults at increased risk for chronic disease, as indicated by the presence of 2+ BRFs, compared to their counterparts. Preventive health services utilization by adults with 2+ BRFs differed between countries, with Greece displaying the lowest mean PHSUs.

Several **earlier** studies **have indicated that prevalence of BRFs contributes to increased healthcare and medical costs** (Anderson et al. 2005; Bertakis and Azari 2006; Hill et al. 2009; Sturm 2002; Vals et al. 2013). Some of these studies have examined the relationship of individual BRFs with the utilization of preventive health services (Anderson et al. 2005; Bertakis and Azari 2006; Littman et al. 2011; Ostbye et al. 2005; Peytremann-Bridevaux and Santos-Eggimann 2007) and suggested that the use of clinical preventive services is related to improved health status and management of health costs (Maciosek et al. 2010). Some findings, however, remain inconsistent. An earlier report on a smaller sample of the SHARE study showed that high body weight was not associated with reduced use of preventive services (Peytremann-Bridevaux and Santos-Eggimann 2007). The 2008 and 2009 Behavioral Risk Factor Surveillance System (BRFSS) of U.S. adults also showed that obese and normal-weight

individuals utilized preventive services in a similar scale (Littman et al. 2011). Nevertheless, it has been suggested that weight status should be emphasized by preventive health services, since obesity increases morbidity risk (Littman et al. 2011). Body mass index was positively associated with mean number of visits to diagnostic health services among primary care patients (Bertakis and Azari 2006). In contrast, the Health and Retirement Study (HRS), conducted in 4439 females aged 50–61 years and the Asset and Health Dynamics Among the Oldest Old (AHEAD) Study in 4045 females and 2154 males aged ≥70 years, found that higher body weight was associated with less frequent receipt of preventive services (Ostbye et al. 2005). **In a similar way,** the present study showed that high body weight was associated with some use of preventive services but participants with high body weight used fewer services, compared to those with normal body weight.

In the current study **also**, smokers and risky drinkers were found to use preventive services considerably less, compared to non-smokers and non-risky drinkers. This finding is in contrast to an earlier study, which showed that smoking and alcohol abuse was positively related to the number of visits to diagnostic health services among primary care patients (Bertakis and Azari 2006), but is in agreement to the 2008 BRFSS study in 415,509 U.S. adults, which showed that current smokers used preventive services significantly less and were less likely to receive influenza vaccinations or cancer screening, compared to non-smokers (Vander Weg et al. 2012). This emphasizes the need to guide smokers to targeted preventive clinical services, in order to decrease these individuals' risk for respiratory disease and cancer (Vander Weg et al. 2012).

In this study, physical inactivity was the most prevalent BRF, but utilization of preventive services did not differ between active and non-active participants. The relationship of physical inactivity with high body weight has been widely examined with regards to the resulting increased care costs and the frequency of health services utilization. An earlier study among U.S. adults aged 40+ years found that clustering of physical inactivity and overweight/obesity was associated with 27% (95% CI: 10–37%) of national health care charges (Anderson et al. 2005). The 2003 Canadian Community Health Survey showed that physical inactivity increases hospital stays and use of physician/nurse services and that inactive individuals spend 38% more days in hospital and use 5.5% more family physician visits, 13% more specialist services, and 12% more nurse visits, compared to active ones (Sari 2009).

The present study did not find any differences in preventive health services utilization according to multiple BRF clustering. The prevalence of multiple BRFs has been associated with increased economic burden on health systems (Anderson et al. 2005; Hill et al. 2009). To our knowledge, this is the first study to add to the evidence base by examining the use of health services by BRF clusters. The examination of utilization of preventive health services among adults with 2+ BRFs revealed that Greek participants used significantly fewer services, compared to their European counterparts. It should be noted that an earlier report **of the SHARE study, based on**

the same database but on a greater sample of participants with the same characteristics, found that Greek adults had the second highest prevalence (60.6%) of multiple BRFs (Linardakis et al. 2014). The combined high BRF prevalence and low use of preventive health services among Greek adults might have resulted from the observed increase in socioeconomic inequalities over the last decade, as well as the absence of a national policy on primary prevention (Lionis et al. 2009; Pavi et al. 2010; Tountas et al. 2002).

As mentioned above, findings regarding the use of preventive health services by adults with BRFs remain inconsistent. Some studies have indicated that potential reasons for individuals with some BRFs (such as high body weight or smoking) not using preventive health services are usually patient- **and/or physician**-related and include barriers such as **education and insurance status, equipment or facility-related barriers,** limited physical or economic access to health care, feeling of insecurity, fear of discomfort and competing demands due to management of chronic conditions **(Littman et al. 2011; Kim et al. 2009; Pavi et al. 2010; Vander Weg et al. 2012)**. **Ferrante et al. (2010) suggested that the most frequently provider-cited barriers to care delivery among obese women include a) difficulty in performing pelvic and breast exams; b) inadequate equipment; and c) challenges to overcoming patient barriers and refusals (Ferrante et al. 2010)**. **This is in agreement with the report that a high number of physicians do not have extra-large gowns or large-size exam tables, and these may cause refusal or fear of examination (Littman et al. 2011). Additionally, smokers might use fewer preventive services (e.g. vaccination or cancer screening) due to their overall low concerns about their health (Vander Weg et al. 2012). It therefore appears that t**hese barriers should be tackled **or taken into account** in order to increase preventive health services use by **individuals** with **BRFs**.

Strengths and limitations

The main limitations of the current study relate to the cross-sectional design and the self-reported nature of the data collected. Nevertheless, validated questionnaires were used and example show cards were utilised to help participants understand the questions, thus decreasing the risk of any systematic errors (Borsch-Supan et al. 2005; Linardakis et al. 2014; Linardakis et al. 2013). Also, the various components of the PHSUs, as used in the present study, did not constitute equivalent parameters of prevention evaluation, but involved different levels of health prevention (primary, secondary, or tertiary prevention) (Permpongkosol 2011). For example, having a GP assess body weight and provide guidance (e.g. to increase physical activity) may not have the same preventable value as cancer screening. In addition, accessibility and opportunities to use the twelve preventive services comprising the PHSUs differ among countries, and the present study attempted to illustrate them through regional/country comparisons. Finally, the definitions of BRFs, as well as their numbers and cut-off points, might

differ to those reported in other studies (Linardakis et al. 2014; Linardakis et al. 2013). Although these weaknesses limit the external validity of the findings, our report allows epidemiological comparisons with similar large-scale studies, and adds to the evidence base of preventive services utilization according to presence of BRFs.

Conclusion

In conclusion, the current study showed that the individual BRFs of high body weight, smoking and risky alcohol consumption were associated with lower use of preventive health services in European adults aged 50+ years. Health services utilization did not differ by multiple BRF clustering, but Greek adults presenting with 2+ BRFs used significantly fewer preventive health services compared to other European populations. Primary prevention programmes should be developed to reduce BRF prevalence and promote the use of preventive health services in this population of European adults.

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Conflict of interest

The authors declare that they have no conflicts of interest.

Abbreviations

SHARE, Study of Health, Ageing and Retirement in Europe; BRFs, Behavioral Risk Factors; PHSUs, Preventive Health Services Utilization score.

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Table 1. Descriptive characteristics of 16,125 European adults, aged 50+ years, in the SHARE study.

			n	%
Gender		*males*	6,984	43.3
		females	9,141	56.7
Age, *years*	*mean ± standard deviation (range)*		64.2±9.8 (50-100)	
Education, *years*	*mean ± standard deviation (range)*		10.0±4.4 (0-21)	
Living status		*alone*	4,150	25.7
		with partner/spouse	11,954	74.1
European region		*North*	2,872	17.8
		Central	8,595	53.3
		South	4,658	28.9
Conditions (diseases)[a]		*none*	5,432	33.7
		1-2	8,184	50.8
		3+	2,500	15.5
Retirement status		*retired*	7,916	49.1
Income[b]		*lower quartile*	3,887	24.1
Behavioral risk factors	**High body weight**	*overweight, obese*	9,428	59.6
	Smoking	*smokers*	3,154	19.6
	Physical inactivity	*non-active*	11,104	68.9
	Alcohol consumption	*risky drinkers*	665	4.1
	Clustering	*2+ risk factors*	8,331	52.7

[a] Conditions refer to the following chronic diseases: heart attack, high blood pressure or hypertension, high blood cholesterol, stroke, diabetes or high blood sugar, chronic lung disease, asthma, arthritis, osteoporosis, hip fracture or femoral fracture, cancer and stomach or duodenal ulcer/peptic ulcer.

[b] Income was classified using country-specific quartiles.

Table 2. Relationship of behavioral risk factors and the components of the Preventive Health Services Utilization score (PHSUs) in European adults, aged 50+ years.

			Estimated population		Behavioral risk factors			
					High body weight	**Smoking** *smokers*	**Physical inactivity**	**Alcohol consumption** *risky drinkers*
PHSUs Components	*Relevant questions*	**n**	**N**	**% (95% CIs)**	***crude Odds Ratios (ORs)***			
Seeing dentist/dental hygienist	*During the last twelve months, have you seen a dentist or a dental hygienist? Was that for routine control or prevention, for treatment, or for both?*	6,920	21,620,010	38.7 (37.6-40.0)	0.75 [b]	0.86 [b]	0.69 [b]	0.66 [b]
Having a general practitioner (GP) for advice and prevention	*For medical advice and prevention: Do you have a "general practitioner" (i.e. a doctor you usually turn to for your common health problems)?*	12,987	50,608,937	90.7 (90.2-91.2)	1.26 [b]	0.77 [b]	1.46 [b]	0.99
GP assesses physical activity	*How often does your general practitioner: 1) ask how much physical activity you do?*	7,429	27,567,416	49.4 (48.1-50.7)	1.27 [b]	0.89	1.03	0.93
GP advises on regular exercise	*2) tell you that you should get regular exercise?*	6,463	24,856,276	44.5 (43.2-45.9)	1.56 [b]	0.87	1.36 [b]	0.90
GP assesses body weight	*3) check your weight?*	7,371	27,774,310	49.8 (48.4-51.1)	1.35 [b]	0.79 [b]	1.26 [b]	0.71 [b]
GP asks about drug use or prescription	*4) ask you about any drugs you take, either bought over-the-counter or drugs prescribed by another doctor?*	7,061	26,163,903	46.9 (45.6-48.2)	1.15 [b]	0.91 [b]	1.21 [b]	0.82
Having flu vaccination	*In the last year, have you had a flu vaccination?*	5,547	20,346,523	36.5 (35.2-37.8)	1.17 [b]	0.56 [b]	1.32 [b]	0.77
Having a mammogram	*If you are a woman: In the last two years, have you had a mammogram (x-ray of the breast)?*	5,022 [a]	16,447,045	29.5 (28.3-30.7)	0.70 [b]	0.76 [b]	1.04	0.23 [b]
Having sigmoidoscopy or colonoscopy	*Have you ever had a sigmoidoscopy or colonoscopy?*	3,285	12,357,855	22.1 (21.0-23.3)	1.02	0.72 [b]	1.00	0.73

Tested for hidden blood in stool	*In the last ten years, have you had a test that detects blood in your stool?*	3,143	13,894,693	24.9 (23.8-26.0)	0.95	0.63 [b]	0.74 [b]	0.60 [b]
Referral to a physiotherapy or exercise program for joint pain	*Have you ever been ... ... sent to physiotherapy or an exercise program for your joint pain?*	3,634	13,348,240	23.9 (22.8-25.1)	1.19 [b]	0.84 [b]	1.26 [b]	0.58 [b]
Referral to an orthopedic surgeon for joint pain	*Have you ever been ... ... sent by a doctor to an orthopedic surgeon for the joint pain that you presently have?*	2,789	11,980,172	21.5 (20.3-22.7)	1.38 [b]	0.74 [b]	1.26 [b]	0.46 [b]

GP: General Practitioner; 95% CIs: 95% confidence intervals.

[a] 4,966 females (50.5%) and 56 males (1.0%) had had a mammogram in the two preceding years.

[b] Significant at the <0.05 level.

Table 3. Total Preventive Health Services Utilization score (PHSUs) in European adults aged 50+, according to presence and clustering of behavioral risk factors.

			Estimated population		Preventive Health Services Utilization score [a]	
BRFs		**n**	**N**	**%**	**Mean (95% CIs)**	***p*-value**
High body weight	*overweight, obese*	9,319	22,023,760	60.2	38.4 (37.6-39.3)	0.001
	normal	6,297	33,349,232	39.8	40.8 (40.2-41.5)	
Smoking	*smokers*	3,080	10,435,728	18.8	37.7 (36.5-38.8)	0.001
	non/ex-smokers	12,536	44,937,264	81.2	40.4 (39.8-40.9)	
Physical inactivity	*non-actives*	10,716	39,122,525	70.7	39.9 (39.3-40.5)	0.799
	active	4,900	16,250,467	29.3	39.8 (38.9-40.7)	
Alcohol consumption	*risky drinkers*	646	2,168,600	3.9	36.6 (34.3-38.8)	0.008
	non-risky drinkers	14,970	53,204,392	96.1	40.0 (39.5-40.5)	
Clustering of the four BRFs	*none*	1,576	5,007,348	9.0	39.0 (37.5-40.6)	0.218
	1	5,803	20,888,300	37.7	39.7 (38.8-40.6)	
	2	6,833	24,574,689	44.4	40.5 (39.8-41.3)	
	3	1,324	4,572,215	8.3	38.5 (36.8-40.2)	
	4	80	330,440	0.6	35.8 (29.8-41.7)	

BRFs: Behavioral Risk Factors; 95% CIs: 95% confidence intervals.

[a] Total score ranges from 0 to 100, with a higher score indicating greater use of preventive health services. **The overall mean score was 38.5 (95% CIs: 37.2-39.9).**

Comparisons were examined using analysis of covariance (according to the complex sample design procedure), with gender, age (years), education (years), living with partner/spouse, country regions (north, central, south), physical health, retirement status and income level as covariates.

Figure legends

Fig. 1 Cluster analysis dendogram of the twelve components of the Preventive Health Services Utilization score (PHSUs) in European adults, aged 50+ years.

Footnote to Fig.1:

GP: general practitioner.

Hierarchical cluster analysis (Ward's method was used to assess the Euclidean distance of binary data).

Two main clusters emerged from the current analysis: i) Orthopedic health issues (referral to physiotherapy and orthopedic surgeon) constitute a sub-cluster with common characteristics regarding diagnostic tests (sigmoidoscopy/colonoscopy and testing for hidden blood in stool) and with having flu vaccinations, seeing a dentist/dental hygienist and having mammograms and; ii) Having a GP offer lifestyle advice (advice for regular exercise, in relation to drug use, checking weight status, and general advice on prevention).

Fig. 2 Preventive Health Services Utilization score (PHSUs) **in n=8,238** adults, aged 50+ years, with 2+ behavioral risk factors across eleven European countries.

Footnote to Fig.2:

PHSUs: Preventive Health Services Utilization score.

Estimations of mean values and 95% confidence intervals (95% CIs, indicated by bars) were based on complex samples.

The overall mean PHSU score in adults with 2+ BRFs was 39.4 (95% CIs: 38.8-39.9).

Figure 1:

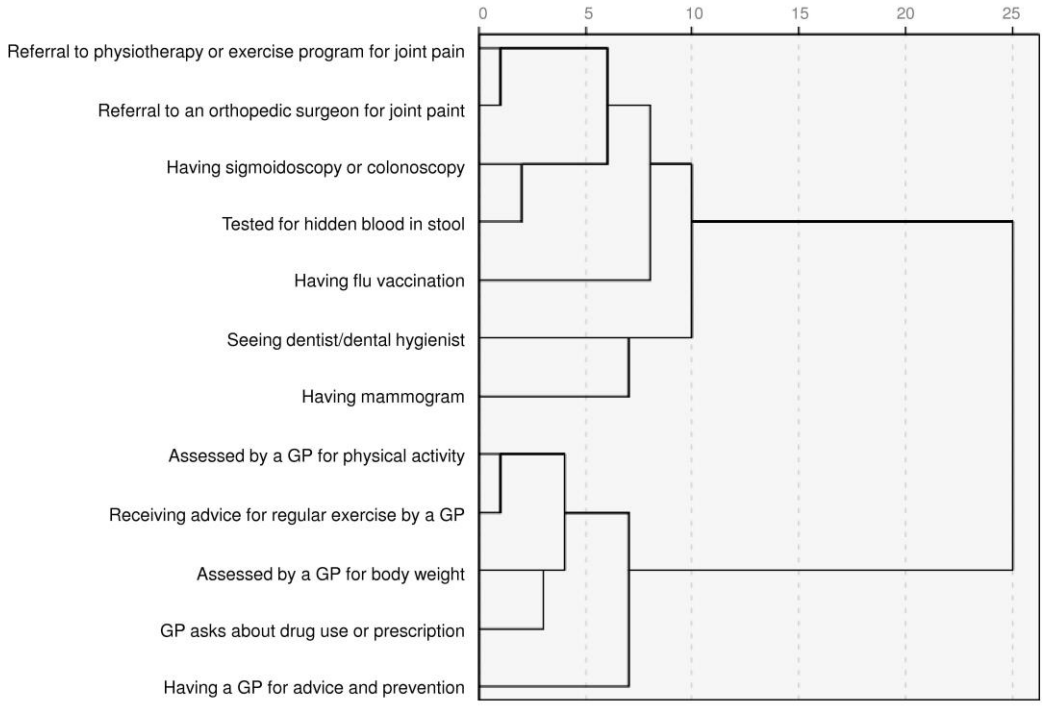
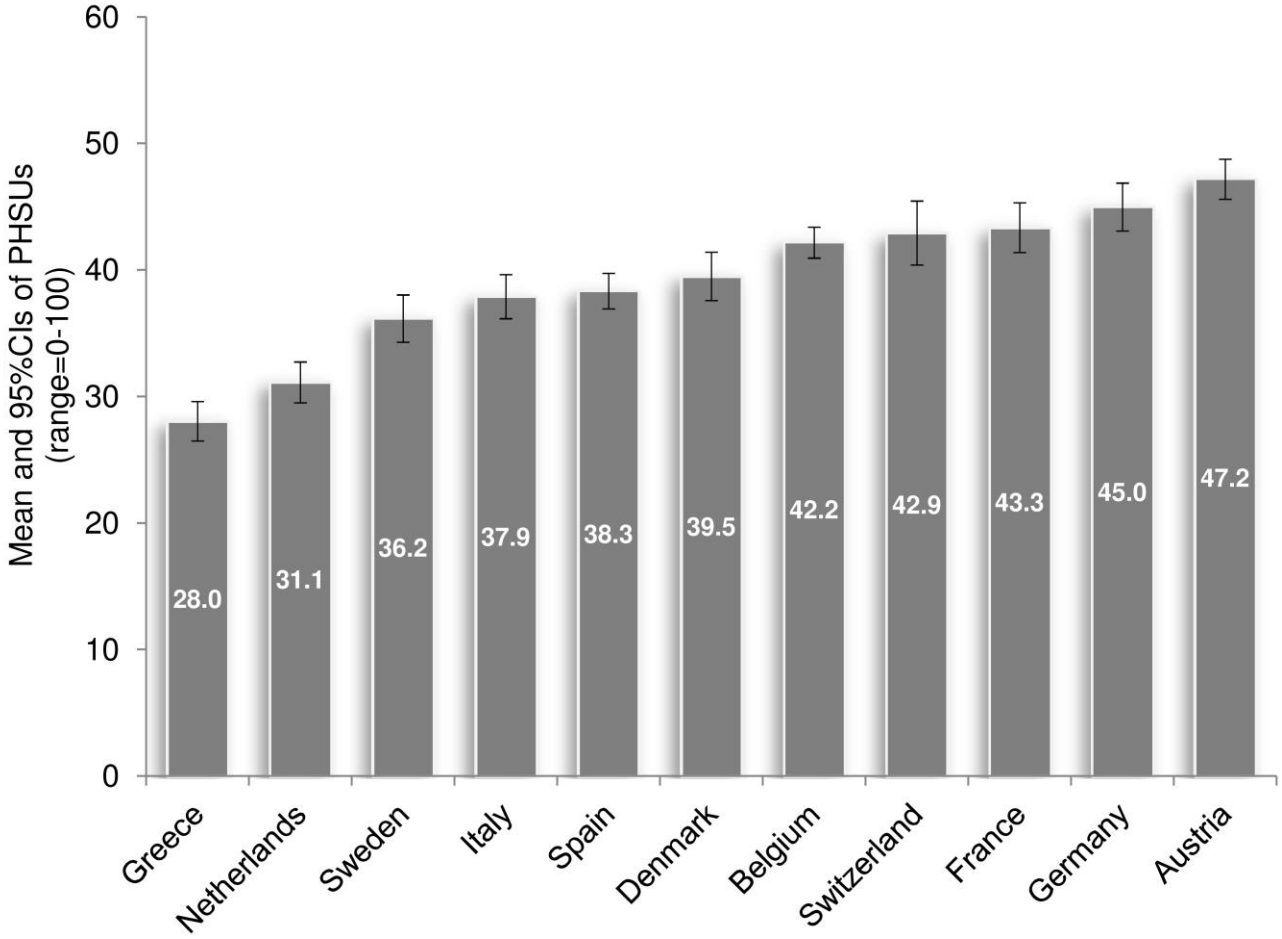

0
5
10
15
20
25
Referral to physiotherapy or exercise program for joint pain
Referral to an orthopedic surgeon for joint paint
Having sigmoidoscopy or colonoscopy
Tested for hidden blood in stool
Having flu vaccination
Seeing dentist/dental hygienist
Having mammogram
Assessed by a GP for physical activity
Receiving advice for regular exercise by a GP
Assessed by a GP for body weight
GP asks about drug use or prescription
Having a GP for advice and prevention

Figure 2:


Mean and 95%CIs of PHSUs
(range=0-100)
60
50
40
30
20
10
0
28.0
31.1
36.2
37.9
38.3
39.5
42.2
42.9
43.3
45.0
47.2
Greece
Netherlands
Sweden
Italy
Spain
Denmark
Belgium
Switzerland
France
Germany
Austria