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Gender differences and multiple determinants of perceived physical and mental health in Italy

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Parole chiave: Salute percepita, differenze di genere, salute mentale, salute fisica, determinanti di salute

Abstract

Background. *Perceived health is largely dependent on multiple socio-demographic and behavioral lifestyles and healthcare related factors. This could be accentuated when gender is taken into account. The aim of this study is to explore gender-related differences in multiple socio-demographic and behavioral lifestyles and healthcare related factors associated with individual health status and to identify those responsible for changes in perceived physical and mental health among men and women in Italy.*

Study design. *We conducted a cross-sectional retrospective study to investigate the association between multiple socio-demographic and behavioral lifestyles and healthcare related factors and individual health status of 99,479 adults in Italy, using data and information obtained from a nationwide survey.*

Methods. *To identify the factors that correlate with the perceived physical and mental health status between males and females, we employed a censored regression analysis, a Tobit model, stratifying the analysis by gender.*

Results. *Socio-demographic and behavioral lifestyles factors differently impact on males and females and this impact is stronger on perceived physical than mental health. The perceived physical and mental health status resulted better for men than for women. The integrated analysis of gender differences in socio-demographic and behavioral lifestyles and determinants of health revealed important inequalities, mainly related to citizenship and educational level, among the socio-demographic factors, and smoking habit and obesity, among the behavioral lifestyle factors.*

Conclusions. *Gender imbalances mainly fall into inequality in social inclusion, educational level, and healthy lifestyle. This demonstrates how gender differences are still abundantly present in the modern Italian society. Such information should be taken into consideration by policy makers when interventions to improve the health and quality of life of the population are planned or evaluated.*

Introduction

Health-related quality of life is gaining increased traction in the field of population health measurements, and the study of perceived health status provides governments, policy makers and other stakeholders with useful informations for planning and evaluation (1-3).

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The assessment of a population's health status should not be separated from considering the individual perception of physical and mental health. Moreover, the two domains are interconnected, as there is a strong link between them. Mental health is undoubtedly one of the main factors contributing to overall physical well-being. The scientific literature is full of evidence about the burden of mental diseases on individual well-being and quality of life (4-11).

Ohrnberger et al. studied the two components of health "capital", physical and mental health. To do so, they hypothesized several channels through which they may interact (12). Such channels include a number of mediator variables that represent the determinants of physical and mental health and can be grouped into socio-demographic (SOD), behavioral and lifestyle choices (BLS) and health and healthcare related (HRL) factors. Scientific literature is therefore uniform in considering health status as largely dependent on the environment, both natural and social, on various intrinsic individual, biological, psychological and behavioral factors, and in healthcare related factors (13-15). Analogously, we can assume that perceived health depends on SOD, BLS and HRL determinants. Citizenship, geographical area of residence, household income, education, employment, and other social indicators play a significant role in shaping the quality of life of individuals and communities (14, 16, 17). For instance, the role of citizenship, and therefore immigration, in overall perceived health has been widely studied. Acevedo-Garcia et al. (18) showed that first-generation immigrants in the United States had lower odds of poor self-related health compared to the third-generation. Lahana et al. (19) found that low income was associated with impaired physical and mental health. Physical and mental health may also impact upon each other via employment. Worse physical (or mental) health may imply a loss of wages or productivity reducing access to healthier foods and environments (20).

On the other side, BLS factors also contribute to improving or worsening the perceived health status of an individual. It is widely recognized that physical and mental health are associated with lifestyle choices such as physical activity, smoking habit, and diet (21).

Similarly, HRL factors also can have a very variable weight in contributing to the perceived health status of an individual (22-24). Inequalities in access to healthcare are also strongly related to worse overall perceived health (25, 26). The ease of access to health services can guarantee a faster functional recovery for an acute condition, while long waiting times for a surgical operation can determine an overall deterioration of perceived health and quality of life.

In addition to the above mentioned channels influencing health, one that has been studied more and more, as the awareness rose, is gender inequality. The SOD, BLS and HRL factors previously listed could accentuate the differences in perceived health when gender is taken into account (27). Gender is a social, rather than a biological construct, and varies with the roles, norms and values of a given society or era (28). Gender differences are manifested in behaviors, lifestyles, as well as in individual experience and in the different social role, in the incidence of multiple diseases, in mental health and disability, in the use of health services, in the attitude towards disease, perception of pain, in the overall perceived health (29-31).

1. Research Objectives and Hypotheses

It is reported in literature that women report worse health than men (27, 32-34). We argue that in modern Italian society, where gender discrimination is still present (35), there are significant differences in perceived

physical and mental health related to gender. In view of previous research, we expect that social inequalities and employment status, in Italian society, may especially disadvantage women, while lifestyle and unhealthy behaviors may disadvantage men (34).

Identifying and quantifying gender-related differences in perceived physical and mental health status, and defining what are the factors that determine a better or worse health, can be fundamental for policy makers, since it may emphasize the need of developing more targeted strategies to improve the quality of life of individuals.

Therefore, this study aims to explore gender-related differences in multiple SOD, BLS and HRL factors associated with individual health status and to identify those mainly responsible for changes in perceived physical and mental health among men and women.

Methods

1. Study Design, Data and Population

We conducted a cross-sectional study to investigate the association between multiple SOD, BLS and HRL factors and individual health status, using data and information obtained from a national survey conducted in Italy. All data and indicators included in this study are based on the "Multiscope" survey on families "Health conditions and use of health services - 2013", conducted by the Italian National Institute of Statistics (ISTAT) in 2013 (36).

The health status of 99,479 adults (18 to 90 years old), with age <65 years (n=72,476), 65–79 years (n=19,271), and >80 years (n=7,732) were measured using one established perceived health status questionnaire, the 12-items Short Form health survey (SF-12), which incorporated physical and mental domains. Data from the ISTAT Multi-scope survey also included numerous SOD, BLS and HRL indicators.

2. Dependent Variables

In this study, we use the SF-12 subscales PCS (Physical Condition Scale) and MCS (Mental Condition Scale) as indicators of subjective physical and mental health condition, in order to identify and quantify gender-related differences in perceived health status in a significant sample of the Italian population.

The SF-12 (Gandek 1998) is a questionnaire that investigates the perception of an individual of its own psychophysical condition (37). The SF-12 score synthesis allows to build two indexes of the health status, one addressing the physical state (Physical component summary - PCS) and one addressing the psychological state (Mental component summary - MCS). Both PCS and MCS can only assume values ranging from 0 to 100. When the PCS or MCS value increases, the psychophysical condition gets better.

3. Stratification by Gender

In order to evaluate gender differences in the determinants of perceived physical and mental health, we stratified our analysis by gender (34). Of the whole sample of 99,479 subjects analysed, 47,134 were males and 52,155 were females. Throughout the manuscript, we conducted a separated analysis for these subsamples, in order to assess if the considered covariates affected PCS or MCS differently among males and females.

4. Independent and Control Variables

We included in our model of analysis several independent SOD and BLS variables that are considered as important health determinants in the literature (13-15). Among the SOD variables we included age (in years), citizenship (foreign vs italian),

geographic area of residence (North, Center or South of Italy), number of people in households, marital status, educational level, employment level, judgment on economic condition of the family, and main income. Among the BLS variables we included smoking status, physical activity and obesity.

Age is widely reported in literature as one of the main determinants of physical and mental health (38-40).

Citizenship, and consequently immigration, are recognized as important determinants of physical and mental health, and their effect on health and self-rated health is reported in the literature (18, 41, 42).

Similarly, the geographic area of residence was found to be associated with perceived health in some studies. Residents of rural areas may report worse health conditions than residents of more urbanized areas (43, 44). The number of people in a household and the marital status account for the familiar condition and can relate with mental health, particularly in women (45).

Abundant literature is present on the relationship between educational level and health (46, 47). Potentially avoidable factors associated with lower educational status account for almost half of all deaths among working-aged adults in the U.S. (47).

Similarly to education, income is also reported to be associated with physical and mental health (19, 48-52). For instance, negative socioeconomic changes occurring may increase the risk of incident mental disorders, particularly of mood disorders (48).

Smoking status, physical activity and obesity were added because of the known relationship between unhealthy lifestyles (52-55).

We also considered a large set of HRL factors as control variables of our model, which entered in our model through Principal Components (PCA), as better explained in the next paragraph. Many of these control variables are factorial and the choice of analyzing them in a PCA is also dictated by the poor readability and interpretability of such a large number of factors.

The list of all variables included in the study is reported in Table S1- Supplementary materials.

5. Statistical Analysis

We stratified the study population for the most relevant explanatory variables considered, i.e. age (divided in classes), citizenship, zone of residence, number of persons in the household, marital status, educational level, working position, judgment on economic sources of the family in the last year, primary income, smoking status, physical activity per week, obesity. To identify the factors that correlate with the perceived physical and mental health status between males and females, we employed a censored regression analysis, specifically a Tobit model (56). The Tobit model is useful when the dependent variable is left- or right-censored or both, as in the case of the perceived health indices used in this study, which can only assume values ranging from 0 to 100. Therefore, we have a lower and an upper bound for both the dependent variables. Since the focus of this manuscript was on perceived health status differences between genders, the regression model has the following form:

$$y_j^* = \beta_j X_j + \gamma_j PC_j + \varepsilon_j, \text{ with } \varepsilon_j \sim N(0, \sigma_j^2)$$

and

$$y_j = \{a \text{ if } y_j^* < a \; y_j^* \text{ if } a \le y_j^* \ge b \; b \text{ if } y_j^* > b.$$

Where y_j is the vector of observed PCS or MCS in the subsample of n_j subjects considered, with $j = 1$ for males and $j = 2$ for females (thus, $n_1 = 47{,}324$ and $n_2 = 52{,}155$), and y_j^* is the latent variable, $a = 0$ is the lower bound for the dependent variable and $b = 100$ is the upper bound for the dependent variable, β_i is the vector of parameters and X_j is the $n_j \times k$ matrix of k SOD and BLS (i.e. smoking status, physical activity and

obesity) explanatory variables (k =12), while ε_j is a normally distributed error term with mean zero and variance ${\sigma_j}^2$. In order to reduce the dimensionality of the variables not of primary interest, we applied a Principal Component Analysis (PCA) for mixture data, (57) i.e. both quantitative and qualitative variables, on the $n_j \times p$ matrix of control variables (i.e. life-style, specifically diet and weight control, and healthcare related variables, with $p = 40$). The Principal Components explaining at least the 90% of the total variance entered in the object PC_j, which has dimension $n_j \times r_j$, where $r_1 = 10$ and $r_2 = 12$. Meaning that for males, 10 Principal Components were selected, while 12 Principal Components were selected for females. γ_j was the vector of parameters associated to the r_j components in subsample j. The parameters were estimated through maximum likelihood.

Results from Tobit model are reported as estimated coefficient ($\hat{\beta}$) and 99% Confidence interval (99%CI). To highlight gender differences we compared the coefficients of significant factors between men and women, and when their sign was concordant the ratio between them was calculated to quantify the effect size.

Due to the size of our samples, we decided to interpret as indicative statistically significant difference, p-values lower than 0.01.

For all statistical analysis we used R, version 3.6.3, R Development Core Team, © The R Foundation.

Results

Among the study population (n = 99,479), 47.6% were males and 52.4% were females. The summary statistics of PCS and MCS, along with the sample size for each level of the considered covariates in X_j and stratified by gender are reported in Table 1.

Table 2 shows the results of the Tobit Model, stratified by gender.

Age resulted inversely correlated with perceived physical health both for males and females ($\hat{\beta}$=-0.053, p<0.001, $\hat{\beta}$ =-0.073, p<0.001, respectively). The gender difference is calculated and reported by the ratio between coefficients. Here, it resulted

Table 1 - Descriptive statistics of the study population

Variable	Male	Female
PCS		
Min	11	11
Max	70	69
Mean (sd)	51.4 (8.9)	49.1 (10.6)
Median (1st-3rd quartile)	55 (50-57)	54 (44-56)
MCS		
Min	8	7
Max	70	72
Mean (sd)	50.0 (9.3)	47.7 (10.3)
Median (1st-3rd quartile)	53 (46-56)	50 (42-55)
Age group	N (%)	N (%)
18-64	35,657 (75.3)	36,819 (70.6)
65-79	8,869 (18.7)	10,402 (19.9)
80-90	2,798 (6.0)	4,934 (9.5)

Citizenship		
Italian	44,958 (95.0)	49,140 (94.2)
Foreign	2,366 (5.0)	3,015 (5.8)
Zone of residence		
North	20,072 (42.4)	22,040 (42.2)
Center	8,355 (17.7)	9,474 (18.2)
South and Islands	18.897 (39.9)	20.641 (39.6)
Number in the household		
1	6,054 (12.8)	9,280 (17.8)
2	12,797 (27.0)	14,503 (27.8)
≥ 3	28,473 (60.2)	28,372 (54.4)
Marital status		
Married	20,080 (42.4)	24,910 (47.8)
Other (single/widowed/separated/divorced)	27,244 (57.6)	27,245 (52.2)
Educational level		
Primary school or no formal education	8,711 (18.4)	13,966 (26.8)
Secondary school	33,293 (70.4)	31,666 (60.7)
University degree	5,320 (11.2)	6,523 (12.5)
Working position		
Employed	24,765 (52.3)	17,513 (33.6)
Unemployed	5,066 (10.7)	5,023 (9.6)
Housewife	57 (0.1)	15,166 (29.1)
Student	2,366 (5.0)	2,687 (5.2)
Retired	13,889 (29.4)	10,009 (19.2)
Other conditions (unable to work. maintained)	1,181 (2.5)	1,757 (3.3)
Judgment on economic condition of the family in the last year		
Inadequate	17,921 (37.9)	20,810 (39.9)
Adequate	29,403 (62.1)	31,345 (60.1)
Primary Income		
Employe income	17,183 (30.3)	14,350 (27.5)
Self-employment	7,510 (15.9)	3,103 (6.0)
Retirement provision	13,947 (29.5)	15,392 (29.5)
Other incomes	1,668 (3.5)	1,792 (3.4)
Maintained by the family	7,016 (14.8)	17,518 (33.6)
Smoking status		
Never smoked	19,381 (41.0)	35,201 (67.5)
Ex-smoker	15,161 (32.0)	8,720 (16.7)
Smoker	12,782 (27.0)	8,234 (15.8)
Physical activity		
None	40,229 (85.0)	49,044 (94.0)
Light (1-2 days per week)	3,289 (7.0)	1,589 (3.0)
Moderate (3-5 days per week)	3,409 (7.2)	1,367 (2.6)
Heavy (6-7 days per week)	397 (0.8)	155 (0.3)
Obese		
No	41,390 (87.5)	46,537 (89.2)
Yes	5,934 (12.5)	5,618 (10.8)

Table 2 - Tobit model. Censored regression analysis

	Variable	PCS Male				PCS Female				Ratio/ Size	MCS Male				MCS Female				Ratio/ Size
		β	p-value	LB 99%	UB 99%	β	p-value	LB 99%	UB 99%		β	p-value	LB 99%	UB 99%	β	p-value	LB 99%	UB 99%	
	const	**53.205**	<0.001	52.691	53.720	**53.379**	<0.001	52.837	53.921	1.00	**49.929**	<0.001	49.160	50.697	**46.274**	<0.001	45.476	47.072	0.93
	Age	**-0.053**	<0.001	-0.061	-0.045	**-0.073**	<0.001	-0.081	-0.066	1.38	**-0.037**	<0.001	-0.048	-0.025	-0.010	0.017	-0.021	0.001	-
	Foreign Citizenship	**-0.446**	<0.001	-0.762	-0.131	**-0.864**	<0.001	-1.162	-0.566	1.93	0.399	0.029	-0.072	0.870	**0.810**	<0.001	0.372	1.248	-
	Zone residence - Center (North as reference)	**-0.086**	0.238	-0.273	0.102	-0.106	0.149	-0.295	0.083	-	**-0.376**	<0.001	-0.657	-0.096	**-0.479**	<0.001	-0.757	-0.201	1.27
	Zone residence - South and Islands (North as reference)	**-0.598**	<0.001	-0.749	-0.446	**-0.665**	<0.001	-0.822	-0.508	1.11	0.003	0.977	-0.224	0.229	**-0.238**	0.008	-0.469	-0.007	-
	Number in households	**-0.168**	<0.001	-0.230	-0.107	**-0.222**	<0.001	-0.285	-0.158	1.32	-0.082	0.022	-0.173	0.010	**-0.225**	<0.001	-0.318	-0.131	-
	Marital status - Married (Unmarried / widowed / divorced / separated as reference)	**0.449**	<0.001	0.278	0.619	**0.312**	<0.001	0.152	0.472	0.70	0.027	0.789	-0.229	0.282	0.105	0.250	-0.130	0.340	-
	Educational level - Secondary school (Primary or no formal education as reference)	**1.285**	<0.001	1.076	1.494	**0.808**	<0.001	0.602	1.014	0.63	0.104	0.392	-0.209	0.417	**0.323**	0.006	0.020	0.626	-
	Educational level - University degree (No formal education as reference)	**1.820**	<0.001	1.538	2.102	**1.086**	<0.001	0.803	1.368	0.60	-0.058	0.724	-0.480	0.364	0.137	0.396	-0.279	0.553	-
SOD factors	Employment: Unemployed (Employed as reference)	0.991	0.142	-0.748	2.731	-0.542	0.489	-2.559	1.476	-	**-2.892**	0.004	-5.493	-0.290	-1.418	0.218	-4.387	1.551	-
	Employment: Housewife (Employed as reference)	0.319	0.749	-2.253	2.892	-0.771	0.325	-2.788	1.245	-	-1.378	0.356	-5.224	2.469	-0.634	0.582	-3.602	2.333	-
	Employment: Student (Employed as reference)	0.399	0.562	-1.372	2.170	-0.797	0.313	-2.834	1.240	-	-1.829	0.075	-4.476	0.819	-1.526	0.190	-4.524	1.471	-
	Employment: Retired (Employed as reference)	0.257	0.706	-1.503	2.017	-0.171	0.828	-2.195	1.853	-	0.050	0.961	-2.582	2.681	0.343	0.766	-2.635	3.322	-
	Employment: Other conditions (Employed as reference)	-0.630	0.359	-2.401	1.140	-1.184	0.134	-3.218	0.850	-	-2.135	0.038	-4.783	0.512	-1.279	0.271	-4.273	1.714	-
	Judgment on economic condition	**0.293**	<0.001	0.147	0.439	**0.400**	<0.001	0.255	0.545	1.36	**2.056**	<0.001	1.838	2.274	**1.977**	<0.001	1.764	2.190	0.96
	Main income: Self-employment (Employee income as reference)	**0.274**	<0.001	0.073	0.475	-0.073	0.533	-0.377	0.230	-	**-1.145**	<0.001	-1.445	-0.844	-0.248	0.153	-0.694	0.199	-
	Main income: Retirement provision (Employee income as reference)	-0.080	0.907	-1.839	1.680	0.115	0.883	-1.905	2.136	-	1.880	0.066	-0.751	4.511	1.068	0.355	-1.905	4.040	-

BLS factors	Main income: Other income (Employee income as reference)	0.015	0.982	-1.679	1.708	0.408	0.595	-1.569	2.385	-	0.216	0.826	-2.315	2.748	0.907	0.422	-2.002	3.816	-	
	Main income: Maintained by family (Employee income as reference)	-0.028	0.967	-1.779	1.723	0.787	0.315	-1.231	2.804	-	0.758	0.456	-1.860	3.376	1.140	0.323	-1.829	4.109	-	
	Smoking status: Ex-smoker (Never Smoked as reference)	**-0.222**	0.002	-0.407	-0.038	**-0.241**	0.009	-0.479	-0.002	1.08	**0.950**	<0.001	0.675	1.226	**0.763**	<0.001	0.413	1.114	0.80	
	Smoking status: Smoker (Never Smoked as reference)	**-0.194**	0.003	-0.360	-0.027	**-0.484**	<0.001	-0.676	-0.291	2.50	**0.889**	<0.001	0.640	1.138	**1.069**	<0.001	0.786	1.353	1.20	
	Physical activity: Light (None as reference)	0.222	0.034	-0.048	0.492	0.218	0.157	-0.179	0.616	-	-0.030	0.848	-0.434	0.373	-0.140	0.536	-0.725	0.444	-	
	Physical activity: Moderate (None as reference)	0.156	0.136	-0.113	0.425	0.347	0.036	-0.080	0.775	-	**0.610**	<0.001	0.208	1.013	0.454	0.063	-0.175	1.082	-	
	Physical activity: Heavy (None as reference)	0.325	0.250	-0.402	1.052	0.808	0.091	-0.424	2.040	-	**1.197**	0.005	0.110	2.284	-0.098	0.890	-1.911	1.715	-	
	Obese: Yes (No as reference)	**-0.245**	0.002	-0.448	-0.041	**-0.795**	<0.001	-1.017	-0.573	3.25	0.285	0.016	-0.020	0.589	**0.533**	<0.001	0.206	0.860	-	
Principal components	PC1	**-1.331**	<0.001	-1.359	-1.303	**1.848**	<0.001	1.818	1.878		**-0.766**	<0.001	-0.809	-0.724	**1.062**	<0.001	1.018	1.106		
	PC2	**-0.751**	<0.001	-0.783	-0.719	**0.173**	<0.001	0.142	0.204		**-0.474**	<0.001	-0.522	-0.426	**0.136**	<0.001	0.090	0.181		
	PC3	**0.908**	<0.001	0.871	0.945	**-0.984**	<0.001	-1.021	-0.948		**0.491**	<0.001	0.436	0.546	**-0.637**	<0.001	-0.691	-0.583		
	PC4	**1.280**	<0.001	1.223	1.336	**0.858**	<0.001	0.809	0.907		**0.831**	<0.001	0.746	0.915	**0.633**	<0.001	0.561	0.706		
	PC5	**-0.150**	<0.001	-0.223	-0.077	**1.238**	<0.001	1.165	1.310		**-0.239**	<0.001	-0.348	-0.129	**1.050**	<0.001	0.943	1.157		
	PC6	**3.450**	<0.001	3.358	3.542	**-3.087**	<0.001	-3.166	-3.008		**2.500**	<0.001	2.362	2.637	**-2.331**	<0.001	-2.447	-2.215		
	PC7	**-2.559**	<0.001	-2.659	-2.459	**1.651**	<0.001	1.556	1.747		**-1.596**	<0.001	-1.746	-1.446	**-1.095**	<0.001	-1.235	-0.955		
	PC8	**-0.838**	<0.001	-0.950	-0.727	**-2.759**	<0.001	-2.855	-2.663		**-0.637**	<0.001	-0.804	-0.470	**-2.271**	<0.001	-2.412	-2.130		
	PC9	**-0.305**	<0.001	-0.424	-0.186	**0.234**	<0.001	0.129	0.339		**2.069**	<0.001	1.891	2.247	**-0.831**	<0.001	-0.985	-0.677		
	PC10	**4.654**	<0.001	4.517	4.792	**-0.626**	<0.001	-0.738	-0.514		**2.190**	<0.001	1.985	2.395	**-0.846**	<0.001	-1.011	-0.681		
	PC11					**1.177**	<0.001	1.054	1.300						**-4.464**	<0.001	-4.645	-4.283		
	PC12					**-5.552**	<0.001	-5.686	-5.417						**-1.029**	<0.001	-1.227	-0.831		
		Log-likelihood		-148,387		Log-likelihood		-166,840			Log-likelihood		-167,424		Log-likelihood		-186,990			
		Pseudo-R2		0.131		Pseudo-R2		0.154			Pseudo-R2		0.031		Pseudo-R2		0.044			
		Akaike criterion		296,846.9		Akaike criterion		333,755.6			Akaike criterion		334,920		Akaike criterion		374,056.3			
		Schwarz's Bayesian criterion		297,162.4		Schwarz's Bayesian criterion		334,092.4			Schwarz's Bayesian criterion		335,236		Schwarz's Bayesian criterion		374,393			

Values in bold denote significant coefficients. i.e. p-value < 0.01.

in 1.38, which means that for females the effect of age on PCS is 1.38 times higher than for males. Perceived mental health also decreased at increasing age, but the association is statistically significant only for males ($\hat{\beta}$=-0.037, p<0.001).

Among the SOD variables, citizenship resulted significantly associated with PCS both in males and females ($\hat{\beta}$=-0.446, p=0.001 and $\hat{\beta}$=-0.864, p<0.001, respectively). The size of the difference in the coefficient (ratio=1.93) means that being a foreign citizen compared to having Italian citizenship reduces the physical state for both genders, but for females this reduction is almost doubled. On the contrary, citizenship was associated with an increase in MCS only in females ($\hat{\beta}$=0.810, p<0.001).

As the number of people living in a household increased by a single unit, the perceived physical health decreased in both genders ($\hat{\beta}$=-0.168, p<0.001 in males; $\hat{\beta}$=-0.222, p<0.001 in females), but this reduction was greater for females (ratio=1.32). The number of people living in a household resulted significantly associated with mental health only among females.

Educational level showed a peculiar trend: taking no formal education/primary school degree as reference, an higher level of education (secondary school or university degree) was associated with a better perceived physical health both for males (secondary school: $\hat{\beta}$=1.285, p<0.001; university degree: $\hat{\beta}$=1.820, p<0.001) and females (secondary school: $\hat{\beta}$=0.808, p<0.001; university degree: $\hat{\beta}$=1.086, p<0.001); this beneficial effect was stronger for males, with a ratio=0.63 for the "secondary school" level and a ratio=0.60 for the "university degree" level. As for the perceived mental health, the educational level had a significant association only for females and only when considering the "secondary school" level ($\hat{\beta}$=0.323, p=0.006).

Taking the "Employed" category as reference, the various employment categories showed no significant association with perceived health, with the relevant exception of "Unemployed" category for the perceived mental health in males ($\hat{\beta}$=-2.892, p=0.004).

Judging the economic condition of the family in the last year as adequate/appropriate was associated with better perceived physical and mental health, both in males ($\hat{\beta}$=0.293, p<0.001 and $\hat{\beta}$=2.056, p<0.001) and females ($\hat{\beta}$=0.400, p<0.001 and $\hat{\beta}$=1.977, p<0.001).

For what concerns BLS determinants, being an ex-smoker or an active smoker was associated with a worst perceived physical health both for males ($\hat{\beta}$=-0.222, p=0.002 and $\hat{\beta}$=-0.194, p=0.003, respectively) and females ($\hat{\beta}$=-0.241, p=0.009 and $\hat{\beta}$=-0.484, p<0.001, respectively), while the same conditions - ex-smoker and smoker - were associated with an improved perceived mental health in both genders (males: $\hat{\beta}$=0.950, p<0.001 and $\hat{\beta}$=0.889, p<0.001, respectively; females: $\hat{\beta}$=0.763, p<0.001 and $\hat{\beta}$=1.069 p<0.001, respectively).

Subjects with BMI greater than 30 exhibited a lower perceived physical health in both genders ($\hat{\beta}$= -0.245, p=0.002 and $\hat{\beta}$=-0.795, p<0.001, respectively). On the contrary, obesity (BMI>30) was associated with a better perceived mental health in females ($\hat{\beta}$= 0.533, p<0.001).

Discussion

In this study we explored gender-related differences in multiple SOD and BLS factors associated with individual health status and searched those mainly responsible for changes in perceived physical and mental health between males and females in a significant sample of the Italian population. From our results, numerous SOD and BLS determinants impact on the scores of the physical and mental health: having or not Italian citizenship; residing in a northern,

central or southern Italian region, number of people in the households; education; economic condition and lifestyle, and so on. This confirms the impact of SOD and BLS determinants on population health (13-15).

Overall, accounting for gender we also highlighted important and significant differences in the determinants of perceived health especially for the physical component of health. This means that the SOD and BLS factors differently impact on males and females and this impact is stronger on perceived physical than mental health. From our analysis the perceived physical and mental health status resulted better for men than for women. Notably, we found that the perceived health decreases with increasing age, in a statistically significant way. This confirms Ross & Bird's (34) and other authors' findings (33, 38, 39), although in a different population. it seems that for females the effect of increasing age on reduced perceived physical health is higher than for males.

We found that citizenship is a driver of perceived health, and that being a foreigner in Italy is associated with a lower perceived physical status. For women this reduction in perceived physical health is stronger. This may be attributable to work and social inequalities that, especially in young age, may contribute to an overall worst health status in non-Italian citizen women when compared to men. In recent years, Italy has been subject to an important immigration, especially composed of females, in line with the feminization of migratory flows (58). Since 2000, multi-ethnic Italy has been developing mainly thanks to Eastern Europe (59). According to Italian National Institute of Statistics' data, half of the resident migrants in 2017 came from the Balkans, Moldova, Russia, Ukraine, and Turkey (60). Many women migrated to Italy found manual labor jobs (cleaning, housekeeping, caregiving, farm work); these women are also often subject to discrimination and mistreatment (61). Furthermore, the difficulty of accessing healthcare services for foreign citizens should not be underestimated (62, 63). Language difficulties, fear of repatriation and other individual, social and cultural factors may discourage these working women to seek the healthcare they need and may lead to a worsening of physical health.

This state of the women's condition is also reflected inside the household, mainly in the mental health state. A higher number of people living in a household corresponds to a worse physical health both among males and females. Mental health, instead, is influenced by it only among women. This may be given to the fact that the Italian society, even if it has been through a radical modernization in the last decades, is still a patriarchal society, where women, even if working and with a career, are still those who are taking charge of caring for the household and for the children (49). Therefore, when the components of a household increase, it may have a worsening impact on perceived mental health status in women (64).

Among the other SOD determinants, educational level shows a peculiar relationship with perceived health. A higher level of education is associated with a better perceived physical health for both genders, but more for males. As expected and reported in other studies, females with a low educational level report significantly lower health when compared with males (65). Individuals with a higher level of study possess a greater health literacy and therefore a greater capacity for comprehension of the disease and orientation towards its prevention, diagnosis, and treatment (66, 67).

On the contrary, employment categories show no significant association with perceived health. The only relevant exception is the unemployed category which resulted associated with the lower perceived mental health in males. It should be remembered that this survey was conducted in 2013,

right after the *anni horribili* for the Italian economy due to the crisis of the years 2008–2009 and 2011–2012, which greatly affected many southern European countries. One possible explanation is that citizens' health levels have been affected by the prolonged period of economic uncertainty and austerity (68). This is in line with the association between judgement on economic condition and health.

In terms of primary source of income, being self-employed is significantly associated with a better perceived physical health and with a lower perceived mental health only for males. This is interesting because self-employed males feel better physically but are more stressed, in essence. This is in line with previous findings (69).

Our results also underline the association between BLS factors and perceived health. Unhealthy lifestyles, such as smoking habits, low frequency of physical activity and obesity resulted associated with worst perceived physical health. The biggest gender difference highlighted by our study in these domains was linked to the different impact of obesity on male and female perceived physical health. The impact of obesity on females physical health is higher than on males. One explanation for this may be led back to biological factors. A number of studies have positively correlated the experience of pain with an increase in body mass index (70, 71). Obesity is hypothesised to lead to pain because of excess mechanical stresses and its proinflammatory state (72). Moreover, there is an interconnection between obesity and sedentary life, which in our study was also linked to perceived physical health (73). Scientific literature in this area clearly suggests that men and women differ in their responses to pain, with increased pain sensitivity and risk for clinical pain commonly being observed among women (30, 74). Women report more severe levels of pain (31). Given that pain has a strong effect on perceived physical status, this can impact on the effect of obesity on perceived physical health among females, as suggested by our findings.

Our study therefore sheds the light on some determinants of perceived health, and on how such determinants can differently impact genders. This demonstrates the importance of the study on gender medicine and on the SOD and BLS determinants of health. It seems necessary to consider more the different biological, social, but also physical and mental responses between genders. This must then also be reflected in the response of the welfare services (health and social) to the different health needs expressed by subjects belonging to different genders.

This study presents some limitations. Categorizing the participants in two genders excludes eventual gender dysphoria or other individual sensitivity. This is an ex ante limitation that could not be controlled or modified in our analysis, but should be considered for the interpretation of the results and for further studies on the same topic. This study aimed also to describe the health status of the Italian population, which could be useful for diachronic evaluation over time. In other words, assessing and monitoring the state of physical and mental health of a population in a given time window is fundamental. It is equally appropriate to check for any changes over time. Some stressors could impact physical and mental health of the population. Moreover, the reliability of our results may have been influenced by the self-reported nature of the questionnaires used to gather data on self-perceived health status: collecting information of personal experiences through a self-report may incur bias (75). However, the SF-12 questionnaire is a well-known, reliable and validated tool (37). Lastly, the cross-sectional design of our study used does not allow inferences on the temporal relationship between some of the analyzed variables and only showing

measures of associations. Therefore, in the future, repeating similar research, also using a prospective design, could contribute to investigate changes in the perceived health status of the Italian population.

Conclusions

The integrated analysis of gender differences in SOD and BLS determinants of health revealed important inequalities. Gender differences in the determinants of perceived health is evident especially in the physical component of health. The main gender differences were related to citizenship and educational level, among the SOD factors, and smoking habit and obesity, among the BLS factors. Therefore, explanations of gender differences and imbalances mainly fall into gender inequality in social inclusion, educational level, and healthy lifestyle. This demonstrates how gender differences are still abundantly present in modern Italian society. Such information should be taken into great consideration by governments, policy makers and other stakeholders when interventions to improve the health and quality of life of the population are planned or evaluated.

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Availability of data and material: The data used in the study are controlled by a third party, the Italian National Institute of Statistics (ISTAT), and cannot be shared publicly as such. However, ISTAT releases anonymized individual data upon request with a valid reason for study purposes. Interested researchers can replicate our study findings by registering with the Istat contact center (https://contact.istat.it/registrazione.php) and applying to gain access to the data of the survey "Health conditions and use of health services", conducted by the ISTAT in 2013.
Authors contributions: Davide Golinelli, Andrea Bucci, and Erik Boetto conceived and designed the work. Davide Golinelli, Andrea Bucci and Elisa Maietti acquired, analyzed and interpreted the data. Davide Golinelli, Andrea Bucci, and Erik Boetto reviewed the literature and wrote the manuscript. Elisa Maietti and Fabrizio Toscano helped in the analyses, interpreted the data and reviewed the manuscript. Davide Golinelli, Andrea Bucci, Erik Boetto and Fabrizio Toscano interpreted the data and reviewed and edited the final manuscript in collaboration with Maria Pia Fantini for intellectual contents. All authors read and approved the final manuscript.

Riassunto

Differenze di genere e molteplici determinanti dello stato di salute percepito fisico e mentale in Italia

Introduzione. Lo stato di salute percepita dipende da multipli fattori socio-demografici, di comportamento/stile di vita e correlati alla salute fisica e all'assistenza sanitaria. Questo è ulteriormente accentuato quando il genere viene considerato. L'obiettivo di questo studio è di esplorare differenze correlate al genere in multipli fattori socio-demografici, di comportamento/stile di vita e correlati alla salute fisica ed all'assistenza sanitaria associati con lo stato di salute percepito individuale e di identificare quelli maggiormente responsabili di cambiamenti dello stato di salute fisico e mentale percepito in uomini e donne in Italia.

Disegno dello studio. Abbiamo condotto uno studio trasversale e retrospettivo per indagare l'associazione tra multipli fattori socio-demografici, di comportamento/stile di vita e correlati alla salute fisica e all'assistenza sanitaria e lo stato di salute percepito individuale di of 99,479 adulti, utilizzando dati ed informazioni ottenuti da un sondaggio nazionale condotto in Italia.

Metodi. Per identificare i fattori correlati con le differenze di stato di salute fisico e mentale percepito in uomini e donne, abbiamo utilizzato una *censored regression analysis*, un modello Tobit, stratificando l'analisi per genere.

Risultati. Fattori socio-demografici di comportamento/stile di vita impattano diversamente in maschi e femmine e questo impatto è maggiore per lo stato di salute percepito fisico rispetto a quello mentale. Lo stato di salute fisico e mentale percepito è risultato migliore per gli uomini che per le donne. L'analisi integrata delle differenze di genere nei determinanti di salute socio-demografici e di comportamento/stile di vita ha rivelato importanti disuguaglianze, principalmente collegate alla cittadinanza e al livello di istruzione, tra i fattori socio-demografici, e all'abitudine tabagica e all'obesità, tra i fattori correlati ai comportamenti/stili di vita.

Conclusioni. Le differenze di genere ricadono principalmente nelle diseguaglianze relative all'inclusione sociale, al livello di istruzione e ad uno stile di vita

Table S1 - Supplementary materials. Independent variables description: Socio-demographic, lifestyle and healthcare related factors included in the study. SOD: Socio-demographic factors; BLS: Behavioral/Lifestyle factors; Healthcare-related factors.

SOD		
	Age	Age in years
	Citizenship	Italian, Foreign citizen
	Zone of residence	Being resident in Northern, Central or Southern+Island Italian Region
	Number in households	Number of household components
	Marital status	Being Married or Unmarried/Widowed/Divorced/Separated
	Educational level	No formal education/having attended primary school, secondary school or having a University degree
	Employment level	Employment level: employed, unemployed, housewife, student, retired, other
	Judgment on economic condition	Judgment on economic status of the family in the last year: Adequate or Inadequate
	Main income	Main source of income: self-employment, retirement provision, income from assets, mantained by family, other
BLS		
	Smoking status	Smoking status: never smoked, ex-smoker, smoker
	Physical activity -	Relevant physical activity in days per week: none, light, moderate, heavy
	Obesity	Obesity: BMI ≤ 30 or BMI > 30
	Weight control	Weight control: rarely, 1 or more times a week
	Diet	Being on a diet
HRL		
	Rehabilitation	Had rehabilitation in the last 3 months
	Home assistance	Being in home assistance
	Urgent care access	Had urgent care access in the last 3 months
	Number of drugs	Number of drugs regularly assumed (different drugs regularly taken)
	Disease	Had a disease in the last 4 week
	Fractures	Had a fracture in the last 4 weeks
	Medical visits	Had a medical visit in the last 4 weeks
	Number of medical visits	Number of medical visits in the last 4 weeks
	Diagnostic examinations	Number of diagnostic examinations in the last 4 weeks
	Day-hospital	Number of day-hospital access in the last 3 months
	Hospitalisation	Number of hospitalisation in the last 12 months
	Number of surgical operations	Number of surgery operations in the last 12 months
	Confined to bed	Being confined to bed in the last year
	Disability	Having disability or functional limitations
	Movement limitations	Having difficulty in movements
	Presence of a Chronic disease	Having a chronic disease
	Diabetes	Having diabetes
	Osteoporosis	Having osteoporosis
	Multimorbidity	Having three or more chronic diseases/multimorbidity
	Use of drugs in last 2 weeks	Used drugs in the last 2 weeks
	Hypertension	Never had hypertension, had hypertension in the past, have hypertension now

Angina	Never had angina as reference, had angina pectoris in the past, have angina pectoris now
Other heart disease	Never had other heart diseases, had other heart diseases in the past, have other heart diseases now
Arthrosis	Never had arthrosis, had arthrosis in the past, have arthrosis now
Cancer	Never had cancer, had cancer in the past, have cancer now
Depression	Never had depression, had depression in the past, have depression now
Anxiety	Never had anxiety, had anxiety in the past, have anxiety now
Eating disorders	Never had eating disorders, had eating disorders in the past, have eating disorders now
Thyroid disease	Never had thyroid disease, had thyroid disease in the past, have thyroid disease now
Kidney failure	Never had kidney failure, had kidney disease in the past, have kidney failure now
Handicap	Having a single handicap among mobility handicap, mental handicap, sensory handicap, or having two or more types of handicap
Limitation	Having no, moderate or severe physical limitation in the last 6 months
Blood glucose control	Blood glucose control: never, at least 1 time/year or every 2-5 years
Blood pressure control	Blood pressure control: never, at least 1 time/year or every 2-5 years
Cholesterol control	Cholesterol control: never, at least 1 time/year or every 2-5 years
Celiac disease	Never had celiac disease, had celiac disease in the past, have celiac disease now
Asthma	Never had asthma, had asthma in the past, have asthma now
Migraine	Never had migraine, had migraine in the past, have migraine now

sano. Questo dimostra come le differenze di genere sono ancora abbondantemente presenti nella moderna società italiana. Queste informazioni dovrebbero essere prese in considerazione dai *policy makers* ogni qualvolta debbano pianificare o valutare interventi volti al miglioramento della salute e della qualità di vita della popolazione.

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