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Multimorbidity as an important issue among women: results of a gender difference investigation in a large population-based cross-sectional study in West Asia

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ABSTRACT

Objectives To investigate the impact of gender on multimorbidity in northern Iran.

Design A cross-sectional analysis of the Golestan cohort data.

Setting Golestan Province, Iran.

Study population 49 946 residents (age 40–75 years) of Golestan Province, Iran.

Main outcome measures Researchers collected data related to multimorbidity, defined as co-existence of two or more chronic diseases in an individual, at the beginning of a representative cohort study which recruited its participants from 2004 to 2008. The researchers utilised simple and multiple Poisson regression models with robust variances to examine the simultaneous effects of multiple factors.

Results Women had a 25.0% prevalence of multimorbidity, whereas men had a 13.4% prevalence (p<0.001). Women of all age-groups had a higher prevalence of multimorbidity. Of note, multimorbidity began at a lower age (40–49 years) in women (17.3%) compared with men (8.6%) of the same age (p<0.001). This study identified significant interactions between gender as well as socioeconomic status, ethnicity, physical activity, marital status, education level and smoking (p<0.01).

Conclusion Prevention and control of multimorbidity requires health promotion programmes to increase public awareness about the modifiable risk factors, particularly among women.

Strengths and limitations of this study

- This is a large, population-based cross-sectional study, with detailed data provided on sociodemographic, lifestyle and behavioural risk factors.
- Trained, qualified medical researchers collected all of the data by interactive face-to-face interviews.
- Cross-sectional data analyses are susceptible to residual confounding and cannot determine the direction of an association.
- Another limitation of this investigation was possible recall bias resulting from the method of gathering medical history (self-report).

INTRODUCTION

Chronic diseases not only induce physical complications and social hardships for patients, but also present a heavy burden for healthcare systems. This issue can be further intensified by multimorbidity, the simultaneous occurrence of two or more chronic diseases in one person.[1–3] Multimorbidity is associated with a higher mortality risk and increased utilisation of healthcare services; therefore, it is a demanding situation for patients, their families and healthcare providers.[4–8]

Despite the increase in life expectancy among lower and middle income countries over the last decades, the growing prevalence of multimorbidity has led to a decreased quality of life in patients with chronic diseases, especially in populations with limited resources.[9 10] Patients with multimorbidity require specific medical care; however, the current clinical practice lacks practical guidelines to manage and treat these patients.[11–14] Current clinical practices for patients with multiple chronic diseases routinely deal with each individual disease rather than multiple diseases, and can result in increased expenses for patients

and healthcare systems, and possibly lead to unwanted adverse effects.[13 15 16]

Previous studies have shown a gender difference in patterns of multimorbidity. A systematic review of most previous studies indicated that women had a greater prevalence of multimorbidity compared with men.[17] This difference might be related to biological, sociocultural, environmental or economic factors. As these factors vary globally, their associations with multimorbidity might differ across populations.[18–22] Therefore, more research should be conducted on this topic.

We used baseline data from the Golestan Cohort Study (GCS), a large-scale prospective study in Western Asia, to explore the epidemiology of multimorbidity.[23] In this article we used detailed statistical analyses to examine the variability of the prevalence and determinants of multimorbidity among different age groups. We also investigated interactions between gender and multiple sociodemographic and lifestyle factors potentially associated with multimorbidity.

METHODS

This cross-sectional study analysed baseline data from the GCS. We analysed data from 49 946 Iranians, aged 40–75 years, who resided in Golestan Province in northeastern Iran. Participants had no current or previous diagnosis of any upper gastrointestinal cancers. The original cohort recruited its participants from 2004 to 2008.[24] The details of this study have been described elsewhere.[23]

Body mass index (BMI) was defined as underweight (<18.5 kg/m^2), normal (18.5–24.9 kg/m^2), overweight (25–29.9 kg/m^2), and obese (>30 kg/m^2). We divided participants into the following age clusters (age at the time of the interviews): 40–49, 50–60, and 61–75 years. In this mainly rural population, physical activity was defined based on occupational activity as follows: physically active (heavy or intense activity during employment) or physically inactive (all other participants). Participants' socioeconomic status (SES) comprised three levels (low, middle or high) according to the two-step cluster analysis[25] with the use of similarities for family assets, ethnicity, sex, employment status, age at onset of the first job, home ownership status and house size (surface area), and age.

Based on the possibility of gathering valid self-reported data during the feasibility phase of the GCS, we collected self-reported information for the following chronic diseases: cardiovascular disease, diabetes (types I and II), chronic obstructive pulmonary disease, chronic kidney disease, chronic liver disease, tuberculosis, gastro-oesophageal reflux disease (GORD), and cancers.[24] Respondents reported the presence of regurgitation or heartburn during the past 1–2 years, via a standard GORD questionnaire.[26 27] Participants who reported any symptoms during the mentioned time period were considered to have GORD.

In this study, we defined multimorbidity as the simultaneous occurrence of two or more of the above mentioned chronic diseases (non-acute conditions)[23] in the same person.[7 8 28]

Statistical analysis

We estimated multimorbidity among participants according to several sociodemographic and lifestyle factors. The Student's t-test, Mann-Whitney or χ^2 tests evaluated differences in the distribution of respondents according to sociodemographic factors and lifestyle factors between men and women whenever appropriate.

Occasions exist in which the OR can be misleading. Hence, we have used a model that could provide the prevalence ratio. Simple and multiple Poisson regressions were used with robust variances according to the method presented by Barros and Hirakata.[29] We sought to examine the possibility of a gender-based association between the studied factors and multimorbidity, calculated crude and adjusted prevalence ratios and tested it with the interaction (effect modification) test, and 95% CIs. The gender differences between determinants of multimorbidity (ie, interaction or effect modification) were evaluated in separate multiple Poisson regression models.

We have considered the design effects according to the generalised estimating equations method for all analyses. This method is a generalisation of the generalized linear model (GLM) that can handle the correlation of observation. The assumption of the GLM is the independence of observation which could be violated in studies that have intra-cluster correlations in cluster sampling or randomisation, as well as in longitudinal analysis of repeated measurements obtained from a subject.[30 31] All statistical analyses were performed using SPSS software (IBM Corporation, released 2013, IBM SPSS Statistics for Windows, version 22.0; Armonk, New York, USA). Two-sided p-values <0.05 were considered statistically significant.

RESULTS

This cross-sectional study enrolled 49 946 participants (aged 40–75 years) who predominantly resided in rural areas. Women comprised 28 748 (57.6%) participants. The Supplementary table shows the prevalence of self-reported chronic diseases in those with multimorbidity and the gender differences.

The results indicated an overall age-sex standardised prevalence for multimorbidity of 19.4% (95% CI 19.1% to 19.8%). Women had almost twice the prevalence (25.0%) compared with men (13.4%), with a difference of 11.7% (95% CI 11.0% to 12.4%) (p<0.001). Table 1 shows the prevalence of multimorbidity in all study participants according to gender, sociodemographic and lifestyle factors. Women had evidence of more multimorbidity in all age groups. Of note, compared with men, multimorbidity in women began at an earlier age (40–49 years). In this age group, 17.3% of women had multimorbidity compared with 8.6% for men (p<0.001).

Table 1 Prevalence of multimorbidity by gender according to **sociodemographic** and lifestyle factors

		Total		Men		Women		Difference	
		Overall	Multimorbidity	Overall	Multimorbidity	Overall	Multimorbidity	Men vs Women	p Value
Variables	Levels	n=49946	(%)	n=21198	(%)	n=28748	(%)	(%)	
Age (years)	40–49	23074	13.9	9012	8.6	14062	17.3	−8.7*	<0.001
	50–60	17512	22.7	7321	14.2	10191	28.8	−14.6*	<0.001
	61–75	9360	30.4	4865	20.9	4495	40.6	−19.7*	<0.001
Residential area	Rural	38354	20.2	16514	13.3	21840	25.4	−12.2*	<0.001
	Urban	11592	19.8	4684	13.8	6908	23.9	−10.0*	<0.001
Ethnicity	Turkmen	37253	19.6	16051	12.6	21202	24.9	−12.3*	<0.001
	Other†	12693	21.5	5147	15.8	7546	25.4	−9.5*	<0.001
Marital status	Unmarried	43873	18.6	20634	13.4	23239	23.3	−10.0*	<0.001
	Married	6073	30.6	564	14.2	5509	32.3	−18.1*	<0.001
Education	Illiterate	35060	23.4	10406	15.6	24654	26.7	−11.1*	<0.001
	≤5 years	8449	13.6	5545	11.7	2904	17.3	−5.5*	<0.001
	6–12 years	5376	10.9	4317	10.8	1059	11.1	−0.3	0.761
	University degree	1061	9.9	930	10.3	131	6.9	3.5	0.219
Employed	Yes	43415	18.5	17529	11.3	25886	23.3	−12.0*	<0.001
	No	6530	30.7	3668	23.1	2862	40.5	−17.4*	<0.001
Soc ioeconomic status	Good	18831	18.1	8703	12.7	10128	22.7	−10.0*	<0.001
	Medium	24001	20.5	9748	13.3	14253	25.4	−12.1*	<0.001
	Poor	7105	24.1	2741	15.9	4364	29.2	−13.3*	<0.001
Physical activity	Yes	15838	13.3	11308	10.2	4530	20.8	−10.6*	<0.001
	No	33947	23.2	9852	17.0	24095	25.8	−8.8*	<0.001
Body mass index (BMI)	Underweight	2380	17.4	1245	14.1	1135	21.0	−6.9*	<0.001
	Normal	17871	14.9	9596	11.3	8275	19.2	−7.9*	<0.001
	Overweight	16993	20.4	7271	14.4	9722	24.9	−10.6*	<0.001
	Obese	12694	27.4	3081	17.3	9613	30.7	−13.3*	<0.001
Smoking‡	Never	41323	21.1	13018	12.8	28305	24.9	−12.1*	<0.001
	Ex-smoker	3189	21.2	3064	20.3	125	44.0	−23.7*	<0.001
	Light smoker (<20 cigarettes/day)	3272	11.1	3013	9.9	259	25.5	−15.6*	<0.001
	Heavy smoker (≥20 cigarettes/day)	2161	13.0	2103	12.1	58	44.8	−32.7*	<0.001

Continued

Table 1 Continued

Variables	Levels	Total		Men		Women		Difference	
		Overall	Multimorbidity	Overall	Multimorbidity	Overall	Multimorbidity	Men vs Women	p Value
		n=49946	(%)	n=21198	(%)	n=28748	(%)	(%)	
Other tobacco use	Yes (ever)	4427	19.7	3749	17.7	678	30.8	−13.1*	<0.001
	No (never)	45519	20.1	17449	12.5	28070	24.9	−12.4*	<0.001
Opium	Yes (ever)	8489	19.6	6138	11.7	2351	24.0	−12.3*	<0.001
	No (never)	41457	22.7	15060	17.4	26397	36.2	−18.8*	<0.001
Alcohol	Yes (ever)	1721	20.2	1701	13.0	20	25.0	−12.1*	<0.001
	No (never)	48225	18.2	19497	18.2	28728	25.0	−6.8	0.435

*p<0.001.
†Other: Persian, Turk, Sistani, Baluch and Kurdish.
‡Individuals were defined as smokers if they had used cigarettes at least once weekly for 6 months.

Table 2 shows the results from multiple Poisson regression models. Men who were ex-smokers, non-Turkmen, married and physically inactive had a significantly higher chance of multimorbidity. Being in lower socioeconomic groups showed an association with multimorbidity only in women. Higher educational levels (compared with illiteracy) showed an inverse association with multimorbidity, mainly in women (p<0.001). Based on interaction analysis, a significantly stronger association existed between poor/middle SES with multimorbidity in women compared with men (p=0.033). The associations between non-Turkmen ethnicity groups (p=0.003), married status (p=0.041), physical inactivity (p=0.009) and ex- smoking (p=0.033) and the prevalence of multimorbidity was statistically significant in men only, or stronger in men compared with women. There was an inverse association between education and multimorbidity mainly in women (p for interaction <0.001).

DISCUSSION

This study examined gender-related determinants of multimorbidity in a cross-sectional analysis of a large cohort study that had more than 49 000 participants. Women of all ages had a higher overall prevalence of multimorbidity. Multimorbidity was not only prevalent in elderly people, it also affected participants aged 40–49 years. Gender interacted with sociodemographic factors of ethnicity, marital status, educational level, SES, physical activity and smoking in terms of multimorbidity prevalence. Past smoking history, non-Turkmen ethnic groups, married status and physical inactivity showed significant associations with multimorbidity in men. Lower socioeconomic groups were associated with multimorbidity, but only in women.

Despite current perceptions, this study revealed that multimorbidity was not confined to elderly people. The results showed that middle-age cohort participants (age <50) of both genders also suffered from this condition, and this observation has been supported by another study.[32] We observed that women had a greater burden of multimorbidity which supported the results from a study by Zielinski *et al* on a Swedish population.[33] A potential cause for more significant prevalence of multimorbidity among women could be their relatively higher tendency to share their conditions in self-reports.[34 35] There is evidence that women use more healthcare facilities, particularly public funded healthcare, compared with men.[36–38] Possible influences for this excess multimorbidity in women could be higher exposure to common risk factors for chronic diseases or gender inequality in access to healthcare.[7 8 39–42] It is worth mentioning that this information is related to data collected approximately 10 years ago at a subnational level.

This study showed a significant association between low SES and multimorbidity among women, a finding suggested by earlier studies.[43 44] This might partially be explained by differences in lifestyle attributed to SES. Low

Table 2 Crude and adjusted prevalence ratio (PR) based on simple and multiple Poisson regression.

		Men				Women				
		Crude		Adjusted†		Crude		Adjusted†		Interaction‡
Variables	Levels	PR	95% CI	PR	95% CI	PR	95% CI	PR	95% CI	p Value
Age (years)	40–49	Ref.		Ref.		Ref.		Ref.		
	50–60	1.64	(1.50 to 1.80)**	1.46	(1.32 to 1.61)**	1.66	(1.58 to 1.76)**	1.51	(1.43 to 1.60)**	0.282
	61–75	2.42	(2.20 to 2.65)**	1.87	(1.67 to 2.10)**	2.34	(2.20 to 2.49)**	2.06	(1.92 to 2.21)**	
Residential area	Rural	Ref.		Ref.		Ref.		Ref.		0.280
	Urban	1.04	(0.95 to 1.14)	0.93	(0.84 to 1.03)	0.94	(0.89 to 0.99)*	0.98	(0.92 to 1.05)	
Ethnicity	Turkmen	Ref.		Ref.		Ref.		Ref.		0.003
	Other§	1.26	(1.16 to 1.36)**	1.24	(1.14 to 1.35)**	1.02	(0.97 to 1.07)	1.09	(1.03 to 1.15)*	
Marital status	Unmarried	Ref.		Ref.		Ref.		Ref.		0.042
	Married	0.94	(0.75 to 1.18)	1.22	(0.97 to 1.54)	0.72	(0.68 to 0.76)**	0.98	(0.92 to 1.04)	
Education	Illiterate	Ref.		Ref.		Ref.		Ref.		0.000
	≤5 years	0.75	(0.69 to 0.82)**	0.91	(0.82 to 1.00)	0.65	(0.59 to 0.71)**	0.81	(0.73 to 0.89)**	
	6–12 years	0.69	(0.63 to 0.77)**	0.91	(0.80 to 1.03)	0.42	(0.35 to 0.50)**	0.57	(0.47 to 0.69)**	
	University degree	0.66	(0.54 to 0.81)**	0.90	(0.72 to 1.13)	0.26	(0.13 to 0.50)**	0.37	(0.19 to 0.72)*	
Employed	Yes	Ref.		Ref.		Ref.		Ref.		0.225
	No	2.04	(1.88 to 2.21)**	1.35	(1.23 to 1.48)**	1.74	(1.63 to 1.85)**	1.27	(1.18 to 1.35)**	
Socioeconomic status	Good	Ref.		Ref.		Ref.		Ref.		0.033
	Medium	1.05	(0.97 to 1.14)	0.95	(0.86 to 1.05)	1.12	(1.06 to 1.18)**	1.08	(1.02 to 1.14)*	
	Poor	1.26	(1.12 to 1.40)**	1.04	(0.91 to 1.18)	1.28	(1.20 to 1.38)**	1.11	(1.03 to 1.19)*	
Physical activity	Yes	Ref.		Ref.		Ref.		Ref.		0.009
	No	1.66	(1.54 to 1.79)**	1.28	(1.18 to 1.39)**	1.24	(1.16 to 1.33)**	1.12	(1.04 to 1.21)*	
Body mass index	Normal	Ref.		Ref.		Ref.		Ref.		0.594
	Underweight	1.25	(1.06 to 1.46)	1.04	(0.89 to 1.22)	1.09	(0.95 to 1.25)	0.93	(0.81 to 1.07)	
	Overweight	1.28	(1.17 to 1.39)**	1.46	(1.34 to 1.60)**	1.30	(1.22 to 1.38)**	1.43	(1.34 to 1.52)**	
	Obese	1.54	(1.39 to 1.71)**	1.85	(1.66 to 2.06)**	1.60	(1.50 to 1.70)**	1.87	(1.75 to 1.99)**	
Smoking	Never	Ref.		Ref.		Ref.		Ref.		0.033
	Ex-smoker	1.59	(1.45 to 1.74)**	1.25	(1.13 to 1.39)**	1.77	(1.35 to 2.30)**	1.22	(0.93 to 1.59)	
	Light smoker (<20 cigarettes/day)	0.77	(0.68 to 0.88)**	0.78	(0.69 to 0.89)**	1.02	(0.80 to 1.30)	0.89	(0.70 to 1.14)	
	Heavy smoker (≥20 cigarettes/day)	0.95	(0.83 to 1.08)	0.87	(0.76 to 1.00)	1.80	(1.22 to 2.64)**	1.33	(0.90 to 1.96)	

Continued

Table 2 Continued

Variables	Levels	Men				Women				Interaction‡
		Crude		Adjusted†		Crude		Adjusted†		
		PR	95% CI	PR	95% CI	PR	95% CI	PR	95% CI	p Value
Other tobacco use	No (never)	Ref.		Ref.		Ref.		Ref.		0.945
	Yes (ever)	1.42	(1.30 to 1.55)**	0.99	(0.89 to 1.09)	1.24	(1.08 to 1.42)*	0.98	(0.85 to 1.13)	
Opium	No (never)	Ref.		Ref.		Ref.		Ref.		0.558
	Yes (ever)	1.49	(1.38 to 1.61)**	1.50	(1.37 to 1.64)**	1.51	(1.40 to 1.62)**	1.45	(1.35 to 1.57)**	
Alcohol	No (never)	Ref.		Ref.		Ref.		Ref.		0.401
	Yes (ever)	1.40	(1.25 to 1.58)**	1.31	(1.15 to 1.49)**	1.00	(0.42 to 2.40)	0.94	(0.39 to 2.25)	

*p<0.01; **p<0.001.
†Prevalence ratios were adjusted for baseline variables.
‡Difference between sexes (p value for interaction refers to the Wald test).
§Other: Persian, Turk, Sistani, Baluch and Kurdish.

SES might reduce care-seeking in patients with chronic diseases.[43] This might produce a paradox, as lower healthcare use might translate to lower documented morbidity. This study's findings indicated that low and middle SES had an association with multimorbidity in women, which has supported the assertion that women are at higher risk from the adverse effects of poverty, payment inequality and health disparities.[45] Khanam *et al* concluded that gender differences in SES, living and working environments, lifestyle factors and life-events might affect the occurrence and outcome of multimorbidity among women.[46]

A previous study revealed that inactivity might increase the risk of breast and colorectal cancers, diabetes mellitus and ischaemic heart diseases.[47] Autenrieth *et al* discovered an inverse association between physical activity and multimorbidity among men.[35] Another study reported no association between multimorbidity and physical activity for either men or women.[48] We observed an association between sedentary occupations that involved decreased physical activity and multimorbidity, which was more evident in men. This might be due to the proportionately longer hours that men spend in sedentary occupations.

In this study the prevalence ratio of multimorbidity significantly decreased with increased education level; the association was more obvious in women. Similarly, other studies showed a decreased likelihood of multimorbidity among better-educated populations.[39 42 49]

The GCS enrolled participants above 40 years of age whose cultural, educational and social basis was shaped around the 1970s – a time of limited access to primary healthcare facilities, particularly in rural areas.[50] However, after the 1980s, there was a substantial improvement in health, life expectancy, control of communicable diseases and SES in Iran.[25 50] Iran was among the few countries that reached WHO defined millennium development goals before 2015.[51] We observed that education was defined as a protective factor for multimorbidity. In this population, women had a literacy rate below 20%.[24] The latest report, released in 2014, has shown a tremendous increase in women's literacy in Golestan Province, which is over 80%.[52] The improvements in health, education and other SES have decreased health inequalities which may influence disease patterns, including multimorbidity, in succeeding generations.

Access to affordable health services, as a human right, is a necessity for improved quality of life. Despite the considerable progress in community health in recent decades, there is an increasing prevalence of chronic diseases.[53] Some global movements related to healthy lifestyles have underlined the need for multi-dimensionality collaborations for health promotion as stated in the Ottawa Charter.[53–57] The findings of this study and recommendations by WHO[53] indicate that specific national and sub-national health policies for men and women of different age groups and SES should be implemented.

The possible changes in demographic characteristics and lifestyle habits of the Iranian population over the past decades and the current study sampling methods

(regional vs national) should be taken into consideration. Future studies that assess more representative samples or at the national level are recommended.

CONCLUSION

The findings of this study confirm that multimorbidity is an important health issue for all individuals above 40 years of age, with particular emphasis on women with lower SES and educational levels. Men with decreased physical activity who are married and are former smokers also have a higher risk for multimorbidity.

Defining priority interventions and multisectorial policies that tackle multimorbidity in both men and women, as well as focusing increased attention on middle-aged populations, are required. In order to control multimorbidity, particularly in women, we recommend the use of health promotion and educational methods to enhance public awareness about modifiable risk factors such as physical activity and smoking.

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