

Determinants of Multimorbidity among The Elderly Population in Indonesia

Determinan Multimorbiditas pada Populasi Usia Lanjut di Indonesia

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Abstract

Multimorbidity is the presence of two or more chronic diseases in one person. Multimorbidity prevalence increases with age, especially in the elderly. This study aimed to determine the prevalence of multimorbidity in elderly population in Indonesia and its determinant. Data were taken from the fourth survey of the Indonesian Family Life Survey (IFLS) which held in 2007. IFLS is a continuing longitudinal socio-economic and health survey. The sample used in the analysis were 2,960 elderly (≥ 60 years). Logistic regression was performed to determine the prevalence and determinants of multimorbidity in the elderly. The prevalence of multimorbidity were 15.8 % and was higher among low educational level, unemployed, current smokers, mild physical activity, overweight/obese and lower consumption of vegetables and fruit. Multivariate analysis showed that low educational level, unemployed, current smoker and ex smoker, overweight/obese, mild physical activity and lower consumption of vegetables and fruit were associated with multimorbidity. The results showed that the prevalence of multimorbidity in Indonesian elderly is quite high especially those with poor health behaviors and low socioeconomic conditions. Strategies to increase healthy behaviors and improve socio-economic conditions may decrease the prevalence of multimorbidity.

Keywords: Determinant, elderly, multimorbidity

Abstrak

Multimorbiditas adalah kehadiran dua atau lebih penyakit kronis pada satu orang. Prevalensi multimorbiditas meningkat dengan usia, terutama pada lanjut usia (lansia). Penelitian ini bertujuan untuk mengetahui prevalensi dan determinan multimorbiditas pada lansia di Indonesia. Data diambil dari survei keempat Indonesian Family Life Survey (IFLS) yang diadakan pada tahun 2007. IFLS adalah survei sosial ekonomi dan kesehatan longitudinal di Indonesia. Sampel yang digunakan dalam analisis adalah 2.960 lansia (≥ 60 tahun). Regresi logistik dilakukan untuk menentukan prevalensi dan determinan multimorbiditas pada lansia. Hasil penelitian menunjukkan

prevalensi multimorbiditas sebesar 15,8%, dengan prevalensi lebih tinggi pada lansia yang overweight/obesitas, tingkat pendidikan rendah, tidak bekerja, perokok saat ini, aktivitas fisik ringan, *overweight/obesitas*, dan kurangnya konsumsi sayur dan buah. Analisis multivariat menunjukkan bahwa tingkat pendidikan yang rendah, tidak bekerja, perokok saat ini dan pernah merokok, *overweight/obesitas*, aktivitas fisik ringan, serta kurangnya konsumsi sayuran dan buah berhubungan dengan multimorbiditas. Hasil penelitian menunjukkan bahwa prevalensi multimorbiditas pada lansia Indonesia cukup tinggi terutama mereka dengan perilaku kesehatan yang buruk dan kondisi sosial ekonomi yang rendah. Strategi untuk meningkatkan perilaku sehat dan meningkatkan kondisi sosial-ekonomi dapat menurunkan prevalensi multimorbiditas pada lansia.

Kata kunci: Determinan, usia lanjut, multimorbiditas

Introduction

Worldwide, the proportion of people age 60 and over is growing faster than any other age group. In 2025, there will be a total of about 1.2 billion people over the age of 60. By 2050 there will be 2 billion with 80 percent of them living in developing countries and over half of the world's older people live in Asia.¹ In Indonesia, 16.5 million persons (7.8%) are over 60, which makes it the country with the tenth largest older population in the world and the third largest in Asia in 2012.^{2,3} The older population in Indonesia will reach 28.8 million (11.3%) by 2020.²

The country is currently undergoing both epidemiologic and demographic transitions, where the decline in

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both fertility and mortality rates in early life have resulted in increased life expectancy.⁴ According to the estimation of the United Nations, life expectancy at birth is expected to increase to 77.6 years in 2045. Based on data from Statistics Indonesia, life expectancy at birth is 69.65 years in 2011.⁵

The fact that more and more people are reaching their older adulthood has resulted in a change in the disease pattern such that chronic medical conditions.⁴ The shift from communicable to noncommunicable diseases (NCDs) is fast occurring in most of the developing world.¹ The prevalence of multimorbidity was increase with age and was substantial among older adults.^{5,6} A recent systematic review of 41 published studies worldwide reported the prevalence of multimorbidity in older persons range from 55 to 98%.^{7,8}

Multimorbidity can be defined as the presence of two or more chronic disease in the same person.^{5,8} Multimorbidity is a public health problem and a challenge for the health system. Multimorbidity impacts negatively on individuals and the health system as a whole.⁹ Major consequences of multimorbidity are disability and functional decline, poor quality of life, and high health care cost.^{7,10-12} It is also associated with increased mortality.⁵

Several studies both cross sectional and longitudinal have focused on exploring risk factors and determinants of multimorbidity.^{4,7,9,13-15} Older age, female gender and low socio-economic status are factors associated with multimorbidity.⁷ Socio-economic status in health have been widely studied using a number of indicators such as education, occupational social class, income and wealth and is consistently found to be an important determinant of multimorbidity.^{9,13-14,16-18} Living in rural area has been shown to be positively related to multimorbidity.^{9,13} Unhealthy behaviours, such as smoking, physical inactivity, unhealthy diet, obesity and other behaviours are associated with the development of diseases such as cancer, heart disease, stroke, and diabetes.¹⁹ Recent study found the association of lifestyle factors and multimorbidity.²⁰

The burden of multimorbidity has typically been studied in high income countries, very few of these studies conducted in low and middle income countries.^{4,13} As such, the prevalence and determinants of multimorbidity in Indonesia is relatively unknown. Because multimorbidity has an impact on quality of life, the knowledge about modifiable risk factors is valuable.^{5,11-12} Thus, the aims of this study were to determine the prevalence of multimorbidity in Indonesia and to examine its association with socio-economic and health behaviour determinants.

Methods

Data were taken from the fourth wave of the

Indonesian Family Life Survey (IFLS4 2007). IFLS is a continuing longitudinal socioeconomic and health survey. It is based on a sample of households representing about 83% of the Indonesian population living in 13 of the nation's 26 provinces in 1993. Within each of the 13 provinces, enumeration areas (EAs) were randomly chosen from a nationally representative sample frame used in the 1993 the National Socioeconomic Survey (SUSENAS) of about 60,000 households. The IFLS randomly selected 321 enumeration areas in the 13 provinces, oversampling urban EAs and EAs in smaller provinces to facilitate urban-rural and Javanese-non-Javanese comparisons. Within a selected EA, households were randomly selected based upon 1993 SUSENAS listings obtained from regional BPS office.²¹

The survey collects data on individual respondents, their families, their households, the communities in which they live, and the health and education facilities they use. The first wave (IFLS1) was administered in 1993, IFLS2 sought to reinterview the same respondents four years later. The next wave, IFLS3, was fielded on the full sample in 2000. IFLS4 was fielded in late 2007 and early 2008 on the same 1993 households and their splitoffs; 13,535 households and 44,103 individuals were interviewed.²¹

For this analysis, we applied a cut off age of 60 years, given that multimorbidity is high prevalence among 60 years and older. Thus, observations under the age of 60 years were dropped. Missing data on social and economic indicators, health behaviours, age, sex, residence, marital status and multimorbidity were deleted. The final sample used in the analysis was therefore $n = 2,960$.

Multimorbidity was based on the number of respondents self-reported diagnosis of chronic Non Communicable Diseases (NCDs) which was previously made by a health professional, examples of such NCDs are diabetes, hypertension, heart disease, stroke, lung diseases, asthma, cancer, arthritis and depression. There were assessed by self-reporting through answers to the question 'Has a doctor ever told you that you have any the following?' followed by a list of conditions. We selected eight chronic NCDs and also prevalent (defined by $\geq 1\%$) in our study population. Three chronic NCDs (liver disease, cancer and depression) were excluded due to the prevalence of $< 1\%$. Multimorbidity was defined as two or more chronic NCDs.

The independent variables were grouped into two determinants, socioeconomic and health behaviour. Demographic characteristic included age, gender, marital status and residence. Elderly age was classified into two groups (60-69 years and ≥ 70 years), gender was categorized as male and female, marital status was categorized as married and unmarried (single/divorce/widowed), place of residence was categorized as rural and urban.

Socio-economic determinants included education, employment and household expenditure. Respondents were asked the highest grade they had complete, and education level was categorized as no education, low (Primary School and Junior High School) and middle to high (Senior High School, Diploma and University), employment status was categorized as unemployed and employed, the household income was categorically coded into 5 quintiles and categorized as low (< quintile^{3rd}) and middle-high (\geq quintile^{3rd}).

Health behaviour determinants include smoking, physical activity, diet behaviour and body mass index (BMI). Smoking status was categorized as non smoker, ex smoker and current smoker, *Body Mass Index* (BMI) was calculated as weight (kg)/height² (m²) and classified as underweight (<18.50 kg/m²); normal (18.50-24.99 kg/m²) and overweight/obese (\geq 25.00 kg/m²), physical activity was assessed by using questions about how many days respondents doing activity at least 10 minutes of vigorous activity, moderately activity and mild activity. Physical activity was categorized as vigorous activity, moderately activity and mild (all other), this variable was assessed by using questions on frequency of fruit and vegetable consumption with the question, "In the last week, how many times do you eat vegetables or fruit". Responses were on an eight point scale ('never' to 'seven times'). We classified participants as consuming fruit or vegetables at seven days, four to six times a week, and less than four times a week.

The main characteristics of the sample were investigated through descriptive analysis and this was followed by bivariate analysis using chi-square test to identify the variables significantly associated with multimorbidity. The variables found significant in the bivariate analysis at the $p < 0.25$ level were entered into multivariate analysis. Logistic regression analyses were performed to estimate odds ratios (ORs) and 95% confidence intervals (CIs) of multimorbidity associated with various factors. Data were analyzed using the SPSS software for Windows.

Results

The prevalence of the eight chronic NCDs is shown in Table 1. The most prevalent chronic NCDs reported across the sample were hypertension (25.3%) and arthritis (16.0%).

Table 2 provides the distribution of all variables grouped in socioeconomic and health behavioral determinants. The majority (63%) of the sample were 60-69 years. Fifty four percent of participants were female, 54% had middle education, 62% were married, 53% residing in rural and more than half (55%) were unemployed. Fifty five percent of participants were categorized as nonsmokers, 56% had normal weight, 81%

were categorized as mild physical activity, and 16% consumed vegetables or fruit at least once a day. Overall, the prevalence of multimorbidity was 15.8%.

Table 3 confirmed the association between socioeconomic and health behaviour determinants with multimorbidity. The prevalence of multimorbidity was significantly among high education level and unemployed. The distribution of multimorbidity related to health behavioural revealed statistically significant differences proportion. The prevalence of multimorbidity was higher among ex smokers, overweight/obese, among persons who had mild physical activity and among person who consumed of fruit and vegetables less than 4 times a week.

Table 4 confirmed multivariate analysis. The association between education with multimorbidity were slightly stronger (low education vs middle-high education

Table 1. Prevalence of Self-reported Chronic NCDs among Indonesian Elderly

Self-reported NCDs	n (%)
Hypertension	749 (25.3)
Diabetes	109 (3.7)
Asthma	146 (4.9)
Chronic lung diseases	90 (3.0)
Heart disease	99 (3.3)
Stroke	53 (1.8)
Arthritis	474 (16.0)
Gout	233 (7.9)

Table 2. Descriptive Statistics of All Variables

Characteristics	Categories	n (%)
Demographic variables		
Age (year)	60-69 y	1887 (63.8)
	\geq 70 y	1073 (36.3)
Sex	Male	1361 (46.0)
	Female	1599 (54.0)
Marital status	Married	1840 (62.2)
	Unmarried	1120 (37.8)
Residence	Urban	1395 (47.1)
	Rural	1565 (52.9)
Socioeconomic variables		
Education	Middle-High	301 (10.2)
	Low	1608 (54.3)
	No education	1051 (35.5)
Employment	Employed	1323 (44.7)
	Unemployed	1637 (55.3)
Expenditure	Middle-High (\geq quintile ^{3rd})	1776 (60.0)
	Low (< quintile ^{3rd})	1184 (40.0)
Health behavioural variables		
Smoking	Nonsmoker	1651 (55.8)
	Ex smoker	243 (8.2)
	Current smoker	1066 (36.0)
BMI	Underweight	743 (25.1)
	Normal	1679 (56.7)
	Overweight/Obese	538 (18.2)
Physical activity	Vigorous	251 (8.5)
	Moderate	299 (10.1)
	Mild	2410 (81.4)
Consumption of fruit and vegetables	At least once a day	478 (16.1)
	4-6 times a week	410 (13.9)
	< 4 times a week	1072 (70.0)
Multimorbidity	No	2492 (84.2)
	Yes	458 (15.8)

Table 3. Associations between Multimorbidity with Demographic, Socio-economic, and Health Behaviour

Determinants	Categories	Multimorbidity		p value
		No (n=2492)	Yes (n=458)	
Demographic variables				
Age	60-69	1591 (84.3)	296 (15.7)	0.846
	≥ 70	901 (84.0)	172 (16.0)	
Gender	Male	1157 (85.0)	204 (15.0)	0.280
	Female	1335 (85.5)	264 (16.5)	
Marital status	Married	1565 (85.1)	275 (14.9)	0.109
	Unmarried	927 (82.8)	193 (17.2)	
Residence	Urban	1159 (85.1)	236 (16.9)	0.132
	Rural	1333 (85.2)	232 (14.8)	
Socio-economic variables				
Education	Middle-High	242 (80.4)	59 (19.6)	<0.001*
	Low	1320 (82.1)	288 (17.9)	
	No education	930 (88.5)	121 (11.5)	
Employment	Employed	1188 (89.8)	135 (10.2)	<0.001*
	Unemployed	1304 (79.7)	333 (20.3)	
Income (quintiles)	Middle-High (≥ quintile ^{3rd})	1507 (84.9)	269 (15.1)	0.245
	Low (< quintile ^{3rd})	985 (83.2)	199 (16.8)	
Health behavioural variables				
Smoking	Nonsmoker	1356 (82.1)	295 (17.9)	<0.000*
	Ex smoker	181 (74.5)	62 (25.5)	
	Current smoker	955 (89.6)	111 (10.4)	
BMI	Underweight	667 (89.8)	76 (10.2)	<0.000*
	Normal weight	1424 (84.4)	255 (15.2)	
	Overweight/Obese	401 (74.5)	137 (25.5)	
Physical activity	Vigorous	234 (93.2)	17 (6.8)	<0.001
	Moderate	269 (90.0)	30 (10.0)	
	Mild	1989 (82.5)	421 (17.5)	
Consumption of fruit and vegetables	At least once a day	418 (87.4)	60 (12.6)	<0.001*
	4-6 times a week	363 (88.5)	47 (11.5)	
	< 4 times a week	1711 (82.6)	361 (17.4)	

*Significance at level 0.05

Table 4. Multivariate Regression Analysis

Characteristic	Categories	B	SE	Sig.	Exp(B)	95%CI for Exp (B)	
						Lower	Upper
Socio-economic variables							
Education	Middle-High (Ref.)			0.000			
	Low	-0.589	0.182	0.033	0.678	0.475	0.969
	No education	0.177	0.165	0.285	1.193	0.863	1.649
Employment	Employed (Ref.)						
	Unemployed	0.608	0.119	0.000	1.837	1.456	2.318
Health behavioural variables							
Smoking	Nonsmoker (Ref.)			0.000			
	Ex smoker	0.488	0.168	0.004	1.629	1.173	2.263
	Current smoker	-0.374	0.127	0.003	0.688	0.536	0.883
BMI	Normal weight (Ref.)			0.000			
	Underweight	0.413	0.143	0.004	1.511	1.143	1.998
	Overweight/Obese	0.889	0.164	0.000	2.433	1.763	3.356
Physical activity	Vigorous (Ref.)			0.010			
	Moderate	0.164	0.324	0.611	1.179	0.635	2.222
	Mild	0.620	0.269	0.021	1.858	1.097	3.147
Consumption of fruit and vegetables	At least once a day (Ref.)			0.001			
	4-6 times a week	-0.136	0.213	0.524	0.873	0.575	1.325
	< 4 times a week	0.387	0.154	0.012	1.473	1.090	1.991

OR=0.678 (95%CI: 0.475 to 0.969). Employment status shown to be strongly associated with multimorbidity (unemployed vs employed OR=1.837 (1.456 to 2.318)). The association between smoking and multimorbidity were

slightly stronger (ex smokers vs nonsmokers OR=1.629 (95%CI: 1.173 to 2.263); current smoker vs nonsmoker OR= 0.688 (95%CI: 0.536 to 0.883)). The association between BMI and multimorbidity were strongly signifi-

cant (underweight vs normal weight OR=1.511 (0.143 to 1.998); overweight/obese vs normal weight OR=2.433 (1.763 to 3.356). Physical activity was associated with multimorbidity (mild vs vigorous OR=1.858 (1.097 to 3.147). Consumption of fruit and vegetables behaviour shown to be strongly associated with multimorbidity (less than 4 times a week vs at least once a day OR=1.473 (1.090 to 1.991).

Discussion

This study used data from a national household survey to determine the prevalence of multimorbidity and its associated demographic, socio-economic and health behaviour determinants. Consistent with our findings, other author identified hypertension and arthritis are the most condition.^{4,13} Estimates of multimorbidity prevalence vary from country to country due to settings and definitions of multimorbidity. Fortin et al. found a prevalence rate ranging from 3.5% to 98.5% in primary care setting and 13.1% to 71.8% nationally.¹¹ In our study, the prevalence of multimorbidity (≥ 2 NCDs) was 15.7%, which is smaller to that of the another low- and middle-income countries was 53.8% in Bangladesh and high-income countries, e.g. 67.3% in German population, 58.6% in Southern Germany population, 55% in the Swedish population.^{4,18,22,23} It should, however be noted that the differences observed in multimorbidity between Indonesia and other countries may not comparable due to sociodemographic differences.

There was no differences of multimorbidity among the oldest age group (16.0%) with the youngest age group (15.7%). This finding was different with other studies which found that multimorbidity increasing with age.^{9,13} Similar, this study found no differences of multimorbidity among women and men also among married and unmarried. There was no differences of multimorbidity among who living in an urban and rural area, different with another studies which found that residing in urban area were associated with the presence of multimorbidity.^{9,13} This differences may due to sociocultural condition differences between Indonesia and another country.

In multivariate analysis, low educational level, unemployed, ex smokers and current smokers, overweight/obese, moderate, mild physical activity and consuming fruit and vegetables less than 4 times a week were still associated with a higher risk of multimorbidity. Socioeconomic position (SEP), defined by education, income, occupation, or a combination of these variables, has been linked to health outcomes in epidemiological studies carried out in many countries.²⁴

Present study shows that low educational level is associated with higher rates of.^{9,13} This findings consistent with other studies which found that low educational lev-

el was statistically significantly associated with a higher prevalence of multimorbidity compared to higher educational level.^{4,18,23} Education increases health-related knowledge, affects lifestyle behaviours and is strongly associated with family.²³ SES Growing evidence exists that SEP differences are also reflected in biological markers of disease. In a cohort study on cardiovascular risk factors among men in France and Northern Ireland, education was inversely associated with blood pressure and BMI but not with total cholesterol concentration.¹⁸

The prevalence of multimorbidity was higher among unemployed persons compared to employed persons. There are two main reasons why unemployment could conceivably affect health. First, it is related to standards of living and the material conditions of life, and second it is a stressful event which may become chronic and deprive an individual of a social role, meaningful daily existence and contact with others.²⁵ A survey in England found that employment significantly associated with level of physical activity. Higher proportions of unemployed men, and to some extent women, were sedentary and lower proportions regularly active, than those in employment.²⁶

Present study found that being overweight/obese, ex smokers, moderate, mild physical activity and consuming fruit and vegetables less than four times a week increases the risk of multimorbidity. Epidemiological studies have established important associations between lifestyle factors and disease.²⁴ Smoking, physical inactivity, unhealthy diet, obesity and other lifestyle behaviors are associated with the development of diseases such as cancer, heart disease, stroke, and diabetes.²⁷ Smoking substantially increases the risk of death from lung and other cancers, heart disease, stroke, chronic respiratory disease and other conditions. Globally, smoking causes about 71% of lung cancer, 42% of chronic respiratory disease and nearly 10% of cardiovascular disease.²⁸ A growing epidemiologic literature shows significant relationships between low and moderate intensity activities and reduced all-cause mortality, as well as morbidity and mortality from cardiovascular disease, stroke, cancer, and respiratory disease.²⁹ Fruit and vegetable consumption is one element of a healthy diet. Insufficient intake of fruit and vegetables is estimated to cause around 14% of gastrointestinal cancer deaths, about 11% of ischaemic heart disease deaths and about 9% of stroke deaths worldwide. Most of the benefit of consuming fruits and vegetables comes from reduction in cardiovascular disease, but fruits and vegetables also prevent cancer. The risk of coronary heart disease, ischaemic stroke and type 2 diabetes grows steadily with increasing body mass, as do the risks of cancers of the breast, colon, prostate and other organs. Chronic overweight contributes to osteoarthritis – a major cause of disability. Globally, 44%

of diabetes burden, 23% of ischaemic heart disease burden and 7–41% of certain cancer burdens are attributable to overweight and obesity.²⁸

This study have several strengths and limitations. A major strength of this study was the use of data from a large nationally representative sample. This made it possible to examine relationships between multimorbidity and various determinants of health. To my knowledge, this study is the first to examine the determinants of multimorbidity among Indonesian elderly. The study also have some limitations. First, this study was largely based on the subjects self reports and not measured independently by an expert, which could have introduced some bias. Furthermore, it should be stated that the chronic conditions highlighted in this study were self-reported, and therefore possibilities of information bias that might have contributed to underreporting of the prevalences cannot be overlooked, especially because individuals tend to underreport poor health. The measure of multimorbidity was thus a count that did not take into account the intensity or severity of disease. The study also misses out on the hidden chronic disease, which may be unknown to patients, and discovered only by expert diagnosis. Second, this study cross sectional data limiting us to draw causal inferences.

Conclusion

The results showed that the prevalence of multimorbidity in Indonesian elderly is quite high. Elderly with poor health behaviors and low socio-economic conditions increase the risk of multimorbidity. Since multimorbidity may cause significant functional decline, one of the relevant implications relating to my findings is that researches and policy-makers should work together to develop effective programmes to reduce the burden of multimorbidity. Strategies to increase healthy behaviour and improve socio-economic conditions may decrease the prevalence of multimorbidity in the Indonesian elderly.

Suggestion

Appropriate health promotion strategies that encourage desirable food habits and other lifestyle factors need to be implemented to maximise the quality of life for elderly populations and reduce the cost of health care. The socio-economic environment is a powerful and potentially modifiable factor, and public policy is a key instrument to improve this environment, particularly in area such as social security and urban design. Unemployment do not necessarily lead to poverty, it depends what income sources are available, how quickly people are re-employed or repartner. The governments can built social security programmes for those without work and minimum wage for those with.

References

1. World Health Organization. Active Ageing: A Policy Framework [online]. Geneva: World Health Organization; 2002 [cited 2015 Dec 7]. Available from: http://whqlibdoc.who.int/hq/2002/who_nmh_nph_02.8.pdf.
2. World Health Organization. Older Persons in Emergencies: An Active Ageing Perspective [online]. Geneva: World Health Organization: 2008 [cited 2015 Nov 15]. Available from: http://whqlibdoc.who.int/publications/9789241563642_eng.pdf.
3. Kementerian Kesehatan Republik Indonesia. Gambaran Kesehatan Lanjut Usia di Indonesia. Buletin Jendela Data dan Informasi. 2015; 1: 25-8.
4. Khanam MA, Streatfield PK, Kabir ZN, Qiu C, Cornelius C, Wahlin A. Prevalence and patterns of multimorbidity among elderly people in rural Bangladesh: a cross-sectional study. *Journal of Health, Population and Nutrition*. 2011; 29: 406-14.
5. Boyd CM, Fortin M. Future of multimorbidity research: how should understanding of multimorbidity inform health system design? *Public Health Review*. 2010; 32(2): 451–74.
6. Barnett K, Mercer SW, Norbury M, Watt G, Wyke S, Guthrie B. Epidemiology of multimorbidity and implications for health care, and medical education: a cross-sectional study. *The Lancet*. 2012; 380 (9836): 37-45.
7. Marengoni A, Angleman S, Melis R, Mangialasche F, Karp A, Garmen A, et al. Aging with multimorbidity: A systematic review of the literature. *Ageing Research Reviews*. 2011; 10: 430–9.
8. Valderas JM, Fortin M, Mercer S. Research on patients with multiple health conditions: different constructs, different views, one voice. *Journal of Comorbidity*. 2011; 1: 1-3.
9. Alaba O, Chola L. The social determinants of multimorbidity in South Africa. *International Journal for Equity in Health*. 2015; 12: 65.
10. Marengoni A, von Strauss E, Rizzuto D, Winblad B, Fratiglioni L. The impact of chronic multimorbidity and disability on functional decline and survival in elderly persons. A community-based, longitudinal study. *Journal of Internal Medicine*. 2009; 265 (2): 288–95.
11. Fortin M, Bravo G, Hudon C, Lapointe L, Almirall J, Dubois MF, et al. Relationship between multimorbidity and health-related quality of life of patients in primary care. *Quality of Life Research*. 2006; 15: 83-91.
12. McDaid O, Hanly MJ, Richardson K, Kee F, Kenny Ra, Savva GM, et al. The effect of multiple chronic conditions on self-rated health, disability and quality of life among the older populations of Northern Ireland and the Republic of Ireland: a comparison of two nationally representative cross sectional surveys. *BMJ Open* 2013; 3:e002571.
13. Nancy Phaswana-Mafuya N, Peltzer K, Chirinda W, Musekiwa A, Kose Z, Hoosain E, et al. Self-reported prevalence of chronic non-communicable diseases and associated factors among older adults in South Africa. *Global Health Action*. 2015; 6: 20936.
14. Agborsangaya CB, Lau D, Lahtinen M, Cooke T, Johnson JA. Multimorbidity prevalence and patterns across socioeconomic determinants: a cross-sectional survey. *BMC Public Health*. 2012; 12: 201.
15. Demirchyan A, Petrosyan V, Thompson ME: Gender differences in predictors of self-rated health in Armenia: a population-based study of an economy in transition. *International Journal for Equity in Health*. 2012; 11: 67.

16. Gjonca e, Tabassum F, Breeze E. Socioeconomic differences in physical disability at older age. *Journal of Epidemiology and Community Health* 2009; 65: 928-35.
17. Schafer I, Hanssen H, Schon G, Hofels S, Altiner A, Dahlhaus A, Gensichen J, Riedel-Heller S, Weyerer S, Blank WA, et al: The influence of age, gender and socio-economic status on multimorbidity patterns in primary care. First results from the multicare cohort study. *BMC Health Service Research*. 2012;12: 89.
18. Nagel G, Peter R, Braig S, Hermann S, Rohrmann S, Linseisen J. The impact of education on risk factors and the occurrence of multimorbidity in the EPICHeidelberg cohort. *BMC Public Health*. 2008; 8: 384.
19. Loeff M, Walach H: The combined effects of healthy lifestyle behaviors on all cause mortality: A systematic review and meta-analysis. *Preventive Medicine*. 2012, 55: 163–170.
20. Fortin M, Haggerty J, Almirall J, Bouhali T, Sasseville M, Lemieux M. Lifestyle factors and multimorbidity: a cross sectional study. *BMC Public Health*. 2014; 14: 686.
21. Strauss J, Witoelar F, Sikoki B, Wattie AM. The fourth wafe of the Indonesia Family Life Survey: overview and field report volume 1 [working paper online]. RAND Labor and Population; 2009 [cited 2013 Dec 5]. Available from: catalog.ihsn.org/index.php/catalog/2370/download/37394.
22. Kirchberger I, Meisinger C, Heier M, Zimmermann A-K, Thorand B, Autenrieth CS, et al. Patterns of multimorbidity in the aged population. Results from the KORA-Age Study. *PLoS One*. 2012; 7: e30556.
23. Marengoni A, Winblad B, Karp A, Fratiglioni L. Prevalence of chronic diseases and multimorbidity among the elderly population in Sweden. *American Journal of Public Health*. 2008; 98: 1198-2000.
24. Schneiderman N. Psychosocial, behavioral, and biological aspects of chronic diseases. American Psychological Society .2004; 6: 247-51.
25. Locker, D. Social determinants of health and disease. In: Scamble G, ed. *Sociology as applied to medicine*. 6th ed. Edingurgh: Saunders Elsevier; 2008.p.18-37.
26. He XZ, Baker DW. Differences in leisure-time, household, and work-related physical activity by race, ethnicity, and education. *Journal of General Internal Medicine*. 2005; 20: 259-66.
27. Loeff M, Walach H. The combined effects of healthy lifestyle behaviours on all cause mortality: a systematic review and meta-analysis. *Preventive Medicine*. 2012; 55: 163-170.
28. World Health Organization. *Global health risks: mortality and burden of disease attributable to selected major risks*. Geneva: WHO Press; 2009.
29. DiPietro L. Physical activity in aging: Changes in patterns and their relationship to health and function. *Journals of Gerontology*. 2001; 56A(Special Issue II): 13-22.