

Socioeconomic inequalities in health and nutrition among older adults in Mexico

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Abstract

Objective. To analyze the socioeconomic inequalities in health among the population of older adults in Mexico. **Materials and methods.** Analysis of two national health surveys in Mexico (Ensanut 2012 and Ensanut 100k) in which inequality gradients are estimated for various health and nutrition outcomes of older adults over 60 years, using the Relative Index of Inequality (RII) and the Slope Index of Inequality (SII). **Results.** Older adults with lower socioeconomic status had worse levels of cognition, instrumental activities of daily living, depressive symptoms, muscle mass, low weight, and anemia. **Conclusions.** Substantial socioeconomic inequalities in health were observed in this study. Given the rapid growth of the population of older adults in Mexico, our results indicate that urgent actions are necessary to achieve health equity in this population group, particularly universal access to health, as well as universal coverage of health services.

Keywords: inequalities; health care; health status; aged

Resumen

Objetivo. Analizar las desigualdades socioeconómicas en salud entre la población de adultos mayores en México. **Material y métodos.** Análisis de dos encuestas nacionales de salud en México (Ensanut 2012 y Ensanut 100k) en las que se estiman los gradientes de desigualdad para diversos desenlaces en salud y nutrición de los adultos mayores de 60 años en adelante, usando el Índice Relativo de Desigualdad (RII) y el Índice de la Pendiente de Desigualdad (SII). **Resultados.** Los adultos mayores con menor nivel socioeconómico tuvieron peores niveles de cognición, actividades instrumentales de la vida diaria, síntomas depresivos, masa muscular y anemia. **Conclusiones.** Se observaron desigualdades socioeconómicas en salud sustanciales. Dado el rápido crecimiento de la población de adultos mayores en México, nuestros resultados indican que son necesarias acciones urgentes para lograr la equidad en salud en este grupo poblacional, particularmente lograr el acceso universal a la salud, así como la cobertura universal de los servicios de salud.

Palabras clave: desigualdad en salud; condiciones de salud; adulto mayor

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Health equity is a commitment that many of the countries have acquired as part of the 2030 Agenda for Sustainable Development.¹ It implies the creation of equal opportunities for the health and well-being of all individuals. However, across the world, especially in low- and middle-income countries, there are still profound differences and lags in terms of health equity. The population groups with the worst health outcomes (physical and mental) are also those that exhibit greater economic inequalities, such as lower levels of income and consumption, few educational opportunities, limited access to health services, as well as marginalization, exclusion, and discrimination.^{2,3}

International studies have shown that some socioeconomic conditions (educational level and income) are associated with multiple health outcomes in the older adult population, such as functional limitations,⁴ multimorbidity,⁵ frailty,⁶ gait speed,⁷ and oral health.⁸ For Mexico, significant associations have been reported for functional limitations,⁹ depression,¹⁰ auditory and visual impairment,¹¹ life expectancy and disability-free life expectancy.¹²

Despite this evidence, specific studies on socioeconomic inequalities in health are still scarce in low- and middle-income countries. In particular, they have used the educational level and income as covariates, meaning that the level of inequality is not quantified through indices that have been specifically designed for that purpose.¹³ Also, the results have not been sufficiently discussed from a health inequalities perspective.¹⁴

In the specific case of Mexico, socioeconomic inequality is still a major problem that affects mainly disadvantaged population groups (women, rural people, older adults, etc.). Analyzing the potential gaps in health and nutrition for older adults in Mexico from a perspective of health inequities would provide us needed and useful information for the promotion and management of health among this age group.

In this study, we analyze the socioeconomic inequalities in health and nutrition among the older adult population in Mexico. Our hypothesis is that older adults living with greater economic deficits will have worse results in the analyzed health and nutrition indicators.

Materials and methods

Study population

We used data from two national surveys with information on health and nutrition for the older adult population in Mexico: the National Health and Nutri-

tion Survey 2012 and the Health and Nutrition Survey 100k (Ensanut 2012 and Ensanut 100k by their Spanish acronyms, respectively).

The methodological details of the Ensanut 2012 have been described previously.¹⁵ Briefly, Ensanut 2012 was a probabilistic and multistage survey with a sample of 55 008 households. In each household, an adult aged 20 years or more was selected to respond to the individual questionnaire that included sociodemographic and health information. From this study, we selected a subsample of 5 846 individuals aged 60 years and over from localities of 100 000 inhabitants or less.

Regarding the Ensanut 100k (2018), a detailed description of the methodology and design of the survey has been published elsewhere.¹⁶ The target population was the households of the localities with 100 000 inhabitants or less. The survey included 11 441 households. One adult aged 20 years or more was selected in each household for applying an individual questionnaire in order to collect sociodemographic and health information. Within this group, 1 762 interviews were conducted with older adults aged 60 years and over.

Design

The comparison groups in this study were defined as follows. For the Ensanut 2012, we generated an asset index with a total of 16 dichotomous variables related to a set of characteristics of housing and ownership of household assets. Quartiles were generated from this index, of which the 4th quartile identifies the group with the best SES.

For the Ensanut 100k, the procedure was similar: an asset index was generated (with the same characteristics of housing and household assets), as described in its design.¹⁶ The sample was then divided into tertiles according to the SES, due to the sampling design (not done by the authors of this article). For this reason, the comparison group for the Ensanut 100k consists of the 1st tertile, representing households with lower socioeconomic status (SES).

The comparison groups for the analysis of the socioeconomic inequalities in health comprised the 4th quartile of the Ensanut 2012 for localities with 100 000 inhabitants or less (850 older adults) and the 1st tertile of the Ensanut 100k (1 182 older adults).

Definition of variables

Health outcomes

Cognitive function. Three indicators were used to assess the cognitive function of older adults. First, the self-

report of subjective memory complaint, which was defined as present if the individual claimed to have severe memory problems.¹⁷ Second, the verbal fluency test that evaluates an individual's ability to name all possible elements within a category (animals, proper names, plants) in a certain period, usually one minute. A higher number of evoked elements imply a better cognitive function.¹⁸ Third, using the verbal fluency test, a variable that determines the presence of cognitive impairment was defined, as recommended for the Mexican older adult population.¹⁸

Depressive symptoms. We used the short seven-item version of the Center for Epidemiologic Studies Depression Scale (CES-D). We determined the presence of clinically significant depressive symptoms when CES-D \geq 5.¹⁹

Functionality. We used the items that were comparable between the surveys for the difficulties in basic activities of daily living (ADL) and the difficulties in instrumental activities of daily living (IADL). We used the Katz scale²⁰ for ADL, which include bathing, dressing, and going to bed or getting out of bed. We also used the Lawton scale²¹ to assess IADL, such as preparing food, taking medications, and managing money. Participants who reported requiring help or being unable to carry out at least one of the above activities were considered to have impaired functional capacity.

Falls. The number of falls was measured based on an individual questionnaire, in which we asked older adults: how many falls have you had in the last twelve months?

Nutrition outcomes

Anthropometric measurements (weight, height, waist and calf circumferences), determination of capillary blood and measurement of blood pressure were carried out using standardized procedures.²²

Body Mass Index (BMI). The BMI was calculated using the weight (kg) and height (cm) ($BMI = \text{Weight [kg]} / \text{Height [m}^2\text{]}$) and classified according to the criteria of the World Health Organization (WHO): low weight (<18.5 kg/m²), normal (18.5 to 24.9 kg/m²), overweight (25.0 to 29.9 kg/m²) and obesity (\geq 30.0 kg/m²).

Calf circumference (CC). This was measured around the thickest part of the calf or at the midpoint between the knee and the base of the heel. As an approximation to the measurement of muscle mass, low muscle mass was defined as $CC < 31$ cm.

Waist circumference (WC). This was measured by identifying the midpoint between the lower rib and the iliac crest. Abdominal obesity was defined as $WC \geq 80$ cm in women and ≥ 90 cm in men.

Anemia. The concentration of hemoglobin (Hb) was determined in capillary blood by puncturing the ring finger, using a portable photometer (Hemocué). Anemia was defined considering the WHO criteria, adjusting Hb values by altitude over the sea level:²³ $Hb < 12$ g/dL in women, and < 13 g/dL in men.

Socioeconomic status

An asset index was generated, calculated separately for each survey, and used as an indicator of the SES, following a standard approach proposed by the WHO to estimate the permanent income of the household through the ownership of goods, certain characteristics of the housing, and access to certain services such as water, sanitation, and electricity.²⁴

Covariates

We included the following sociodemographic and health-related characteristics: sex (female=1), age, and the previous medical diagnosis (self-report) of the following chronic conditions: diabetes, hypertension, hypercholesterolemia, cardiovascular disease, cerebrovascular event, and cancer. With this information, we defined a variable that identifies the presence of multimorbidity in the older adult, where 1 represents having 2 or more conditions, and 0, having one condition or none.

Statistical analysis

Descriptive statistics were calculated in order to characterize the study populations of the localities with 100 000 inhabitants or less (Ensanut 2012 and Ensanut 100k). Two indices were explicitly proposed for making comparisons based on these inequalities in order to estimate the magnitude of health inequalities (absolute and relative): Relative Index of Inequality (RII) and Slope Index of Inequality (SII). RII and SII are summary measures that consider the distribution of the population across the different socioeconomic groups.¹³ They are continuous measures that assign a value to each group, based on its relative position in the cumulative population distribution for each socioeconomic indicator (income, education, index of assets). In both cases, higher values of these indices indicate greater socioeconomic inequalities in health. According to what has been suggested in

the literature,²⁵ we used generalized linear models with a logarithmic link function to calculate RII, and with an identity link function to calculate SII. In the first case, the estimated parameters have an interpretation as rate ratios, and in the second, as rate differences. Since these are basically regression models, both indices (RII and SII) are adjusted for potential confounders.

The characteristics of the participants were described using arithmetic means, standard deviations (SD) and proportions where appropriate. For the bivariate analyses, we used proportions or *t*-Student tests for the two surveys. In all the analyses, the complex design of the surveys was taken into account.

All statistical analyses were performed with Stata 15.1 (StataCorp LP, College Station, TX, USA). Point estimators, 95% confidence intervals, and *p* values were reported. Differences were considered significant if the *p* value was <0.05.

Ethical review

The Ethics and Research Committees of the National Institute of Public Health approved the implementation of the Ensanut 2012 and the Ensanut 100k. All participants received a detailed explanation of the survey procedures and signed an informed consent letter.

Results

The final sample consisted of 2 032 older adults aged 60 and over of the localities with 100 000 inhabitants or less; 58% were women, whose mean age was 70.9 years (SD 8.14). The average number of chronic diseases was 1.08 (SD 0.98), and the prevalence of multimorbidity was 32%. Table I shows the characteristics of the study population according to each survey; no significant differences were observed.

The outcomes in health and nutrition according to each survey are shown in table II. For the health outcomes, significant differences were observed in mental health: verbal fluency ($p<0.01$), and depressive symptoms ($p=0.01$). Regarding functionality, no significant differences were observed for the basic activities of daily life, although for the IADL, worse conditions were observed in all activities in the older adults of Ensanut 100k ($p<0.01$). The prevalence of falls in the last year was higher for those older adults who participated in Ensanut 100k ($p<0.01$). As for the nutrition outcomes, worse conditions were observed in the older adults of the Ensanut 100k for muscle mass ($p=0.01$), calf circumference ($p<0.01$), low weight ($p<0.01$) and the presence of anemia ($p<0.01$). However, they had a lower prevalence

of obesity ($p<0.01$) and abdominal obesity ($p=0.03$), and a higher prevalence of normal weight ($p<0.01$).

Table III shows the estimated socioeconomic inequalities in health and nutrition for the analyzed outcomes. Socioeconomic inequalities were observed (in absolute SII and relative RII scales) for the following health variables: verbal fluency (SII=-1.76, RII=0.17); depressive symptoms (SII=0.14, RII=1.45); difficulty in ADL (SII=-0.05, RII=0.56); difficulty in IADL (SII=0.20, RII=1.83), and prevalence of falls (SII=0.16, RII=1.51). In terms of nutrition outcomes, socioeconomic inequalities were observed in low muscle mass (SII=0.11, RII=1.72); calf circumference (SII=-1.30, RII =0.27); low weight (SII=0.01, RII=6.51), and incidence of anemia (SII=0.22, RII=2.80). In all these cases, the group of older adults who participated in the Ensanut 100k (i.e. those with a lower SES) exhibited the worst health conditions. However, it should also be mentioned that they had better conditions in terms of normal weight (SII=0.19, RII=1.92), obesity (SII=-0.15, RII=0.64); waist circumference (SII=-4.75, RII=0.009), and abdominal obesity (SII=-0.11, RII=0.90).

Discussion

The results of this study corroborate what has been reported about socioeconomic inequalities in health and give empirical support to our hypothesis: older adults living under lower socioeconomic conditions exhibit worse levels in various health and nutrition outcomes.²⁶ These results are similar to those of certain previous studies of populations of older adults in that they also

Table I
DESCRIPTIVE CHARACTERISTICS OF THE STUDY
SAMPLE. MEXICO, ENSANUT 2012,*
ENSANUT 100K

Variable	Ensanut 2012 N=850	Ensanut 100k N=1 182	<i>p</i> -value [‡]
Sex (female=1)	54.55	59.11	0.36
Age (mean)	70.74 (8.73)	70.95 (8.00)	0.78
Number of chronic conditions	1.05 (1.01)	1.08 (0.98)	0.71
Multimorbidity (2 or more diseases)	29.74	32.52	0.58

* Ensanut 2012: localities with 100 000 inhabitants or less
[‡] 2 proportions or *t*-Student tests
 Values in cells are means (SD) or percentages

Table II
HEALTH AND NUTRITION CHARACTERISTICS OF THE STUDY SAMPLE.
MEXICO, ENSANUT 2012,* ENSANUT 100K

Variable	Ensanut 2012 N=850	Ensanut 100k N=1 182	p-value [‡]
Health characteristics			
Subjective memory complaint (severe = 1)	6.32	9.68	0.20
Cognitive impairment	3.80	3.56	0.85
Verbal fluency (number of evoked animals)	13.65 (6.44)	11.55 (5.63)	<0.01
Depressive symptoms	30.05	44.33	<0.01
Difficulties in basic activities of daily living (ADL)			
Bathing	12.89	7.65	0.02
Going to bed or getting out of bed	17.43	16.92	0.88
Dressing	13.30	10.07	0.28
At least one difficulty in ADL	27.73	21.62	0.14
Difficulties of instrumental activities of daily living (IADL)			
Preparing food	12.26	19.06	0.05
Taking medications	11.84	21.09	<0.01
Managing money	9.91	19.08	<0.01
At least one difficulty in IADL	23.84	46.18	<0.01
Prevalence of falls (last year)	32.8	50.11	<0.01
Nutrition characteristics			
Low muscle mass (severe = 1)	16.68	30.42	<0.01
Calf circumference (cm)	34.57 (3.83)	33.06 (3.51)	<0.01
Body Mass Index (BMI)			
Low weight	0.23	1.64	<0.01
Normal	20.82	39.71	<0.01
Overweight	40.75	34.14	0.23
Obesity	38.19	24.50	<0.01
Anemia	11.79	35.00	<0.01
Waist circumference (cm)	98.54 (12.00)	93.82 (11.35)	<0.01
Abdominal obesity	84.44	74.04	0.03

* Ensanut 2012: localities with 100 000 inhabitants or less
[‡] 2 proportions or t-Student tests
 Values in cells are means (SD) or percentages

report the use of indices comparable to ours (RII and SII), as well as some of the outcomes analyzed here.

For the cognitive function, a study conducted in England, in which socioeconomic inequality was considered in childhood (father's occupation) and in adulthood (occupation of the head of the household), found that older adults with a better SES had a better cognitive performance compared to those with a worse SES.²⁷ Specifically, it was reported that a lower SES in childhood resulted in a lower verbal memory, measured

through the evocation of correct words (SII=-4.72; 95%CI:-5.84,-3.61), and a similar association was found (SII=-6.67; 95%CI:-5.84,-3.61) for the same indicator in adulthood. In our study, which used the verbal fluency test (which consists in correctly evoking as many animals as possible), we found a similar association in direction and magnitude (SII=-1.76; 95%CI:-2.72,-0.79).

Regarding depression, a study with individuals aged 65 and over of Japan,²⁸ found that the older adults from the poorest income tertile had a higher

Table III
MEASURES OF INEQUALITIES IN HEALTH AND NUTRITION: ABSOLUTE T1-Q4 GAP, RELATIVE T1/Q4 GAP, SLOPE INEQUALITY INDEX (SII), AND RELATIVE INEQUALITY INDEX (RII). MEXICO, ENSANUT 2012,*
ENSANUT 100K

Variable	T1-Q4	T1/Q4	SII [†]	RII [‡]
Health characteristics				
Subjective memory complaint (severe = 1)	0.03 [0.20]	1.53 [0.17]	0.03 [0.19] (-0.01; 0.07)	1.44 [0.21] (0.80; 2.58)
Cognitive impairment	-0.01 [0.85]	0.94 [0.85]	-0.01 [0.64] (-0.03; 0.02)	0.91 [0.78] (0.48; 1.73)
Verbal fluency (number of evoked animals)	-2.10 [<0.01]	0.12 [<0.01]	-1.76 [<0.01] (-2.72; -0.79)	0.17 [<0.01] (0.07; 0.45)
Depressive symptoms	0.14 [<0.01]	1.48 [<0.01]	0.14 [0.01] (0.03; 0.25)	1.45 [<0.01] (1.10; 1.91)
Difficulties in ADL				
Bathing	-0.05 [0.02]	0.59 [0.03]	-0.05 [0.02] (-0.09; -0.01)	0.56 [0.01] (0.35; 0.89)
Going to bed or getting out of bed	-0.01 [0.88]	0.97 [0.88]	-0.01 [0.89] (-0.07; 0.06)	0.93 [0.71] (0.62; 1.39)
Dressing	-0.03 [0.28]	0.76 [0.31]	-0.04 [0.09] (-0.08; 0.01)	0.73 [0.22] (0.44; 1.21)
At least one difficulty in ADL	-0.06 [0.14]	0.78 [0.16]	-0.06 [0.09] (-0.13; 0.01)	0.75 [0.07] (0.54; 1.03)
Difficulties in IADL				
Preparing food	0.07 [0.05]	1.55 [0.04]	0.03 [0.28] (-0.02; 0.08)	1.52 [0.03] (1.02; 2.26)
Taking medications	0.09 [<0.01]	1.78 [<0.01]	0.06 [0.03] (0.004; 0.11)	1.69 [<0.01] (1.17; 2.45)
Managing money	0.09 [<0.01]	1.93 [0.003]	0.08 [<0.01] (0.02; 0.14)	1.86 [<0.01] (1.22; 2.83)
At least one difficulty in IADL	0.22 [<0.01]	1.94 [<0.01]	0.20 [<0.01] (0.11; 0.30)	1.83 [<0.01] (1.44; 2.33)
Prevalence of falls (last year)	0.17 [<0.01]	1.53 [<0.01]	0.16 [<0.01] (0.07; 0.25)	1.51 [<0.01] (1.23; 1.86)
Nutrition characteristics				
Low muscle mass	0.14 [<0.01]	1.82 [<0.01]	0.11 [<0.01] (0.02; 0.20)	1.72 [<0.01] (1.09; 2.72)
Calf circumference (cm)	-1.50 [<0.01]	0.22 [<0.01]	-1.30 [<0.01] (-2.06; -0.55)	0.27 [<0.01] (0.13; 0.58)
Body Mass Index (BMI)				
Low weight	0.01 [<0.01]	7.07 [<0.01]	0.01 [<0.01] (0.005; 0.02)	6.51 [<0.01] (2.04; 20.77)
Normal	0.19 [<0.01]	1.91 [<0.01]	0.19 [<0.01] (0.10; 0.27)	1.92 [<0.01] (1.44; 2.54)
Overweight	-0.07 [0.23]	0.84 [0.25]	-0.06 [<0.01] (-0.17; 0.04)	0.92 [0.57] (0.69; 1.22)

Obesity	-0.14 [<0.01]	0.64 [<0.01]	-0.15 [<0.01]	0.64 [<0.01]
			(-0.23; -0.06)	(0.45; 0.90)
Anemia	0.23 [<0.01]	2.97 [<0.01]	0.22 [<0.01]	2.80 [<0.01]
			(0.12; 0.31)	(1.87; 4.20)
Waist circumference (cm)	-4.72 [<0.01]	0.01 [<0.01]	-4.75 [<0.01]	0.01 [<0.01]
			(-6.78; -2.72)	(0.001; 0.07)
Abdominal obesity	-0.10 [0.03]	0.88 [0.03]	-0.11 [<0.01]	0.90 [<0.01]
			(-0.18; -0.03)	(0.83; 0.97)

* Ensanut 2012: localities with 100 000 inhabitants or less

‡ In parentheses, 95% confidence interval. Models adjusted for sex, age and multimorbidity.

p values are in square brackets

T1: Older adults in the 1st tertile (lower level) of the SES, Ensanut 100k

Q4: Older adults in the 4th quartile (higher level) of the SES, Ensanut 2012

ADL: Basic activities of daily living

IADL: Instrumental activities of daily living

prevalence of depressive symptoms compared to the wealthiest tertile: (SII=0.14, RII=2.03) for men, and women (SII=0.12, RII=1.83), a result similar to that reported here (SII=0.14, RII=1.45).

In terms of functionality, a study of older Argentinians²⁹ reported that men in the most deprived quintile reported greater difficulties in IADL (RII=1.78; 95%CI: 1.06,2.51), a similar magnitude to that reported in this study (RII=1.83). Meanwhile, a longitudinal study of older adults in South Korea³⁰ found a similar association for both men (RII=3.33; 95%CI: 1.45,7.63) and women (RII=2.19; 95%CI:1.44,3.33).

In this study, we found significant inequalities in health for two anthropometric indicators (calf circumference and low muscle mass). Older adults with worse SES reported a higher prevalence of low muscle mass and a smaller average diameter of the calf circumference. To the best of our knowledge, this would be the first study to report this result. The evidence supports that muscle mass is strongly implicated in the maintenance of an independent life in old age.³¹ Older adults with reduced calf circumference are in more risk of frailty and functional impairment. This result highlights the importance of identifying older adults with problems of muscle mass loss, who could also be the target of potential interventions for physical strengthening.

In our study, older adults with lower SES had the highest prevalence of anemia. We did not find similar results in health inequalities for this indicator in the older adult population. However, it is important to note that a recent study reported significant inequalities for the prevalence of anemia in infants and non-pregnant women in 45 low- and middle-income countries.³² This result highlights the importance of analyzing this indicator in the older adult population, due mainly to the negative

consequences that anemia may have on outcomes such as functional dependence, life quality and mortality.

Interestingly, we found that the prevalence of obesity and abdominal obesity was lower among older adults with worse SES, and so was the average diameter of the waist circumference. This result is different from what was reported in a study of older adult women in Korea.³³ In that study, the prevalence of obesity was found to be higher in women with lower educational level; however, there was no significant association with the income. In our case, it can be hypothesized that older adults with lower SES in Mexico still do not have severe problems of obesity as do their counterparts with a higher SES; therefore, it is likely that the socioeconomic deficiencies with which they live accentuate the problems of low weight, malnutrition, and anemia. In any case, it is necessary to conduct additional studies with more robust designs that will allow determining whether socioeconomic inequalities translate either into obesity or malnutrition for the older adult population with more considerable socioeconomic lags.

This study was subject to some limitations. First, it was not possible to build a SES gradient using only the Ensanut 100k, since this survey was representative of the lowest tertile of the SES by design. In that sense, we had to use the highest quartile of the SES of Ensanut 2012 (although restricting our sample to localities with 100 000 inhabitants or less) in order to carry out the estimation of health inequalities. It is assumed that health and nutrition conditions of older adults in Mexico have undergone some modifications in the period of six years (2012 to 2018); however, these possible modifications cannot be estimated until the current version of the Ensanut 2018-2019 is available. Even so, the magnitude of the inequalities observed in this study is similar to

that of the results of studies that have estimated health inequalities among the population of older adults at the international level. Second, given that we use the self-report of chronic diseases, it is possible that the most economically disadvantaged groups—as the older adults of the Ensanut 100k—have less access to health services, and therefore less knowledge about the diseases they suffer, and thus the prevalence of these diseases may be underestimated. This would imply that the gaps observed in the analyzed indicators may be wider.

In conclusion, our study shows that there are important socioeconomic inequalities in health and nutrition for older adults in Mexico, so that those with the worst SES exhibit the lowest levels of well-being. This result has two important implications. First, given that socioeconomic health inequalities represent one of the most critical challenges faced by health systems at the global level, it is necessary to achieve universal access to health, as well as universal coverage of health services, because the notion of equity in health requires this. Second, that achieving equity in health requires a change in the practice of public health, by shifting the focus from the individuals and their risk behaviors to a multidisciplinary and intersectoral approach with an emphasis on the empowerment of individuals and their communities so that they may have control over their lives and circumstances.

Declaration of conflict of interests. The authors declare that they have no conflict of interests.

References

1. United Nations General Assembly. Transforming our world: the 2030 Agenda for Sustainable Development [internet]. New York: UN, 2015 [cited 2019 March 8]. Available from: http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E
2. De Andrade LO, Pellegrini-Filho A, Solar O, Rigoli F, Malagon L, Castell-Florit P, et al. Social determinants of health, universal health coverage, and sustainable development: case studies from Latin American countries. *Lancet*. 2015;385(9975):1343-51. [https://doi.org/10.1016/S0140-6736\(14\)61494-X](https://doi.org/10.1016/S0140-6736(14)61494-X)
3. Mujica OJ, Haeblerer M, Teague J, Santos-Burgoa C, Galvão LA. Health inequalities by gradients of access to water and sanitation between countries in the Americas, 1990 and 2010. *Rev Panam Salud Publica*. 2015;38(5):347-54. Available from: <http://iris.paho.org/xmlui/handle/123456789/18392>
4. von dem Knesebeck O, Vonneilich N, Lüdecke D. Income and functional limitations among the aged in Europe: a trend analysis in 16 countries. *J Epidemiol Community Health*. 2017;71(6):584-91. <https://doi.org/10.1136/jech-2016-208369>
5. Kunna R, San Sebastian M, Stewart-Williams J. Measurement and decomposition of socioeconomic inequality in single and multimorbidity in older adults in China and Ghana: results from the WHO study on global AGEing and adult health (SAGE). *Int J Equity Health*. 2017;16(1):79. <https://doi.org/10.1186/s12939-017-0578-y>
6. Hoogendijk EO, Rijnhart JJM, Kowal P, Pérez-Zepeda MU, Cesari M, Abizanda P, et al. Socioeconomic inequalities in frailty among older adults in six low- and middle-income countries: Results from the WHO Study on global AGEing and adult health (SAGE). *Maturitas*. 2018;115:56-63. <https://doi.org/10.1016/j.maturitas.2018.06.011>
7. Busch T de A, Duarte YA, Pires-Nunes D, Lebrão ML, Satya-Naslavsky M, dos Santos-Rodrigues A, et al. Factors associated with lower gait speed among the elderly living in a developing country: a cross-sectional population-based study. *BMC Geriatr*. 2015;15:35. <https://doi.org/10.1186/s12877-015-0031-2>
8. Kailembo A, Preet R, Stewart-Williams J. Socioeconomic inequality in self-reported unmet need for oral health services in adults aged 50 years and over in China, Ghana, and India. *Int J Equity Health*. 2018;17(1):99. <https://doi.org/10.1186/s12939-018-0812-2>
9. Hosseinpoor AR, Bergen N, Kostanjsek N, Kowal P, Officer A, Chatterji S. Socio-demographic patterns of disability among older adult populations of low-income and middle-income countries: results from World Health Survey. *Int J Public Health*. 2016;61(3):337-45. <https://doi.org/10.1007/s00038-015-0742-3>
10. Brinda EM, Rajkumar AP, Attermann J, Gerdtham UG, Enemark U, Jacob KS. Health, social, and economic variables associated with depression among older people in low and middle-income countries: WHO study on global AGEing and Adult Health. *Am J Geriatr Psychiatry*. 2016;24(12):1196-208. <https://doi.org/10.1016/j.jagp.2016.07.016>
11. Andrade FCD, López-Ortega M. Educational differences in health among middle-aged and older adults in Brazil and Mexico. *J Aging Health*. 2017;29(6):923-50. <https://doi.org/10.1177/0898264317705781>
12. Santosa A, Schröders J, Vaezghasemi M, Ng N. Inequality in disability-free life expectancies among older men and women in six countries with developing economies. *J Epidemiol Community Health*. 2016;70(9):855-61. <https://doi.org/10.1136/jech-2015-206640>
13. Kakwani N, Wagstaff A, van Doorslaer E. Socioeconomic inequalities in health: Measurement, computation, and statistical inference. *J Econom*. 1997;77(1):87-103. [https://doi.org/10.1016/S0304-4076\(96\)01807-6](https://doi.org/10.1016/S0304-4076(96)01807-6)
14. Stringhini S, Bovet P. Socioeconomic status and risk factors for non-communicable diseases in low-income and lower-middle-income countries. *Lancet Glob Health*. 2017;5(3):e230-1. [https://doi.org/10.1016/S2214-109X\(17\)30054-2](https://doi.org/10.1016/S2214-109X(17)30054-2)
15. Manrique-Espinoza B, Salinas-Rodríguez A, Moreno-Tamayo KM, Acosta-Castillo I, Sosa-Ortiz AL, Gutiérrez-Robledo LM, et al. Health conditions and functional status of older adults in Mexico. *Salud Publica Mex*. 2013;55(suppl 2):S323-31. <https://doi.org/10.21149/spm.v55s2.5131>
16. Romero-Martínez M, Shamah-Levy T, Cuevas-Nasu L, Gaona-Pineda EB, Gómez-Acosta LM, Mendoza-Alvarado LR, et al. Metodología de la Encuesta Nacional de Salud y Nutrición para localidades con menos de 100 000 habitantes (Ensanut 100k). *Salud Publica Mex*. 2019;61(5):678-84. <https://doi.org/10.21149/10539>
17. Steinberg SI, Negash S, Sammel MD, Bogner H, Harel BT, Livney MG, et al. Subjective memory complaints, cognitive performance, and psychological factors in healthy older adults. *Am J Alzheimers Dis Other Demen*. 2013;28(8):776-83. <https://doi.org/10.1177/1533317513504817>
18. Chávez-Oliveros M, Rodríguez-Agudelo Y, Acosta-Castillo I, García-Ramírez N, Rojas de la Torre G, Sosa-Ortiz A. Fluidez verbal-semántica en adultos mayores mexicanos: valores normativos. *Neurología*. 2015;30(4):189-94. <https://doi.org/10.1016/j.nrl.2013.12.013>
19. Salinas-Rodríguez A, Manrique-Espinoza B, Acosta-Castillo GI, Franco-Núñez A, Rosas-Carrasco O, Gutiérrez-Robledo LM, et al. Validation of a cutoff point for the short version of the depression scale of the center for epidemiologic studies in older Mexican adults. *Salud Publica Mex*. 2014;56(3):275-85. <https://doi.org/10.21149/spm.v56i3.7209>

20. Katz S, Branch LG, Branson MH, Papsidero JA, Beck JC, Greer DS. Active life expectancy. *N Engl J Med*. 1983;309:1218-24. <https://doi.org/10.1056/NEJM198311173092005>
21. Lawton MP, Brody EM. Assessment of older people: Self maintaining and instrumental activities of daily living. *Gerontologist*. 1969;9:179-86. https://doi.org/10.1093/geront/9.3_Part_1.179
22. Habicht JP. Standardization of quantitative epidemiological methods in the field. *Bol Oficina Sanit Panam*. 1974;76(5):375-84. Available from: <http://iris.paho.org/xmlui/handle/123456789/10766>
23. Cohen JH, Haas JD. Hemoglobin correction factors for estimating the prevalence of iron deficiency anemia in pregnant women residing at high altitudes in Bolivia. *Rev Panam Salud Publica*. 1999;6(6):392-9. <https://doi.org/10.1590/s1020-49891999001100004>
24. Howe LD, Galobardes B, Matijasevich A, Gordon D, Johnston D, Onwujekwe O, et al. Measuring socio-economic position for epidemiological studies in low- and middle-income countries: a methods of measurement in epidemiology paper. *Int J Epidemiol*. 2012;41:871-86. <https://doi.org/10.1093/ije/dys037>
25. Khang YH, Yun SC, Lynch JW. Monitoring trends in socioeconomic health inequalities: it matters how you measure. *BMC Publ Health*. 2008;8:66. <https://doi.org/10.1186/1471-2458-8-66>
26. United Nations. Health inequalities in old age. Department of Economic and Social Affairs programme on ageing [internet]. UN, 2018 [cited 2019 Jan 12]. Available from: <https://www.un.org/development/desa/ageing/wp-content/uploads/sites/24/2018/04/Health-Inequalities-in-Old-Age.pdf>
27. Hurst L, Stafford M, Cooper R, Hardy R, Richards M, Kuh D. Lifetime socioeconomic inequalities in physical and cognitive aging. *Am J Public Health*. 2013;103(9):1641-8. <https://doi.org/10.2105/AJPH.2013.301240>
28. Haseda M, Kondo N, Ashida T, Tani Y, Takagi D, Kondo K. Community social capital, built environment, and income-based inequality in depressive symptoms among older people in Japan: An ecological study from the JAGES Project. *J Epidemiol*. 2018;28(3):108-16. <https://doi.org/10.2188/jea.JE20160216>
29. Rodríguez López S, Colantonio SE, Celton DE. Socioeconomic inequalities in self-reported health and physical functioning in Argentina: findings from the national survey on quality of life of older adults 2012 (ENCAVIAM). *J Biosoc Sci*. 2017;49(5):597-610. <https://doi.org/10.1017/S0021932016000651>
30. Jang SN, Cho SI, Kawachi I. Is socioeconomic disparity in disability improving among Korean elders? *Soc Sci Med*. 2010;71(2):282-7. <https://doi.org/10.1016/j.socscimed.2010.03.037>
31. Landi F, Onder G, Russo A, Liperoti R. Calf circumference, frailty and physical performance among older adults living in the community. *Clin Nutr*. 2014;33(3):539-44. <https://doi.org/10.1016/j.clnu.2013.07.013>
32. Yang F, Liu X, Zha P. Trends in socioeconomic inequalities and prevalence of anemia among children and nonpregnant women in low- and middle-income countries. *JAMA Netw Open*. 2018;1(5):e182899. <https://doi.org/10.1001/jamanetworkopen.2018.2899>
33. Choi E, Cho HN, Seo DH, Park B, Park S, Cho J, et al. Socioeconomic inequalities in obesity among Korean women aged 19-79 years: the 2016 Korean Study of Women's Health-Related Issues. *Epidemiol Health*. 2019;41:e2019005. <https://doi.org/10.4178/epih.e2019005>