

Economic analysis of a pragmatic randomised trial of home visits by a nurse to elderly people with hypertension in Mexico

Carmen García-Peña, MD, MsC, PhD,⁽¹⁾ Margaret Thorogood, PhD,⁽²⁾ David Wonderling, Ba, MSc,⁽³⁾ Sandra Reyes-Frausto, MD, MsC, PhD,⁽⁴⁾

García-Peña C, Thorogood M, Wonderling D, Reyes-Frausto S. Economic analysis of a pragmatic randomised trial of home visits by a nurse to elderly people with hypertension in Mexico. *Salud Publica Mex* 2002;44:14-20.

The English version of this paper is available at: <http://www.insp.mx/salud/index.htm>

García-Peña C, Thorogood M, Wonderling D, Reyes-Frausto S. Análisis económico de un ensayo clínico aleatorizado de visitas de enfermera en casa a ancianos con hipertensión en México. *Salud Publica Mex* 2002;44:14-20.

El texto completo en inglés de este artículo está disponible en: <http://www.insp.mx/salud/index.html>

Abstract

Objective. To analyse the costs and the effectiveness of an intervention of home visits made by nurses to elderly people versus usual care given by the family medicine units. **Material and Methods.** A sample of 4 777 subjects aged 60 years and over covered by the Mexican Institute of Social Security (Instituto Mexicano del Seguro Social, IMSS) were screened. Those with a systolic and/or diastolic blood pressure level higher or equal than 160/90 mm Hg were randomly allocated to the intervention or control groups. The intervention consisted of visits at home by nurses who gave health and lifestyle advice to the participants. The economic evaluation was considered from a health services and patient perspective. Direct and indirect costs were calculated as incremental. Effectiveness was measured in terms of cost per millimetre of mercury reduced. **Results.** Three hundred and forty five participants were allocated to the intervention group and compared with 338 controls. At the end of the intervention period the difference in the mean change in systolic blood pressure was 3.31 mm Hg (95% CI 6.32, 0.29; $p=0.03$) comparing with the control group. In diastolic blood pressure the difference was 3.67 (95% CI 5.22, 2.12; $p<0.001$). The total cost of the intervention was 101 901.66 pesos. The in-

Resumen

Objetivo. Analizar los costos y la efectividad de una intervención basada en visitas de enfermería en casa a ancianos hipertensos comparada con el tratamiento usual otorgado por el médico familiar. **Material y métodos.** Una muestra de 4 777 sujetos de 60 años y más derechohabientes del Instituto Mexicano del Seguro Social (IMSS) fueron sometidos a escrutinio. Aquellos con cifras sistólica o diastólica iguales o superiores a 160/90 mm Hg fueron asignados aleatoriamente al grupo de intervención o al control. La intervención consistió en visitas de enfermera en casa que daban promoción de la salud. La evaluación económica fue considerada desde una perspectiva del paciente y de los servicios de salud. Costos directos e indirectos fueron considerados como incrementales. La efectividad fue medida en términos de costo por mmHg reducido. **Resultados.** Trescientos cuarenta y cinco participantes fueron aleatorizados al grupo de intervención y comparados con 338 controles. Al final del periodo de intervención la diferencia en el cambio promedio en presión arterial sistólica fue de 3.31 mm Hg (IC 95% 6.32, 0.29; $p=0.03$) comparado con el grupo control. La diferencia en presión arterial diastólica fue de 3.67 mm Hg (IC 95% 5.22, 2.12; $p<0.001$). El costo total de la intervención fue de

This trial was funded by the National Council of Science and Technology, Mexico (Conacyt) and the Mexican Institute of Social Security (IMSS).

- (1) Area de Investigación en Servicios de Salud. Instituto Mexicano del Seguro Social. México, D.F., México.
- (2) Health Promotion Research Unit. London School of Hygiene and Tropical Medicine.
- (3) Cancer and Public Health Unit. London School of Hygiene and Tropical Medicine.
- (4) Department of Epidemiology and Public Health. University of Leicester, United Kingdom.

Received on: January 1, 2001 • Accepted on: October 3, 2001

Address reprint requests to: Dra. Ma. del Carmen García-Peña. División de Investigación Epidemiológica y en Servicios de Salud, Edificio Bloque "B", Cuarto piso, Unidad de Congresos, Centro Médico Nacional Siglo XXI. Av. Cuauhtémoc 330, colonia Doctores. 06125 México, D.F., México.
E-mail: mcgp1@terra.com.mx

intervention cost per patient was 34.61 pesos (US\$3.78), (CI 95% 34.44, 35.46). The cost-effectiveness ratios was 10.46 pesos (US\$1.14) for systolic (CI 95% 129.31, 5.51) and 9.43 (US\$1.03) for diastolic (CI 95% 19.90, 2.49). **Conclusions.** The reduction in blood pressure obtained may well justify the small incremental cost of the intervention. The English version of this paper is available too at: <http://www.insp.mx/salud/index.htm>

Key words: hypertension; elderly population; cost effectiveness; Mexico

101,901.66 pesos. El costo por paciente fue de 34.61 pesos (US\$3.78), (IC 95% 34.44, 35.46). La razón de costo efectividad fue de 10.46 pesos (US\$1.14) para presión sistólica (IC 95% 129.31, 5.51) y 9.43 (US\$1.03) para presión diastólica (IC 95% 19.90, 2.49). **Conclusiones.** La reducción de la presión arterial parece valer el costo incremental de la intervención. El texto completo en inglés de este artículo también está disponible en: <http://www.insp.mx/salud/index.html>

Palabras clave: hipertensión; población anciana; costo-efectividad; México

The ageing population and the concomitant increasing prevalence of non-communicable diseases is an important issue in the health agenda of Mexico.^{1,2} Different ways of providing health care for the elderly are being studied to identify the most effective policies. A pragmatic randomised trial of home visits made by nurses to elderly people with hypertension in Mexico has reported the effectiveness of this intervention in reducing blood pressure levels at six months.^{3,4} There was a significant reduction in blood pressure, as well as an increased proportion of participants undertaking regular brisk walking. There was also a significant increase in the proportion of participants on hypotensive medication. However, there was no difference in weight reduction or salt excretion between the intervention and control group. Financial resources for health are inevitably limited and there are many competing demands. It is therefore important to determine the cost-effectiveness of a policy before recommending that it be incorporated in health care provided by the Mexican Institute of Social Security (Instituto Mexicano del Seguro Social (IMSS)). A number of studies have evaluated the cost and effects of antihypertensive drugs,⁵⁻⁸ but far fewer have evaluated health promotion strategies for reducing hypertension, and even fewer have considered the effect in old people. Health checks to reduce cardiovascular risk factors in the general population^{9,10} have been shown to be cost-effective although, this depends on the duration of the effect.

This report estimates the incremental costs and effects of home visits made by nurses to elderly people in comparison with the usual care provided by the family medicine units.

Material and Methods

The design of the trial, methods and main findings have been reported previously.^{3,4} Briefly, 4 777 participants aged 60 years and over were screened. Those previously known as hypertensives or those with new

diagnosis who had a systolic and/or diastolic blood pressure level higher or equal to 160/90 mm Hg respectively, were randomly allocated to the intervention or control arm. The intervention consisted of visits at home at least fortnightly by nurses during a six month period. The nurses were first given training about ageing, clinical aspects of hypertension, personal interviews, health behaviour change models, process of negotiation and ethical aspects of home visits. During visits, the nurse measured blood pressure and the nurse and patient reviewed information from the baseline health check, and discussed possible lifestyle changes. The nurse tried to guide their patients to a healthier lifestyle and suggested different alternative ways to achieve the changes and negotiated specific targets. The nurse also reviewed the pharmacological treatment and compliance was encouraged. The patient led the process of negotiation, while the nurse provided information about risks and benefits from lifestyle change. Both groups continued to receive the usual care provided by the family physicians. The trial did not interfere with the care given by the doctors at the family medicine units. A different team of nurses measured blood pressure and weighed the participants at baseline and at final follow-up. They also collected a sample of urine for calculating sodium excretion and administered a questionnaire to ascertain the presence of risk factors, use of medication and self-reported level of physical activity. There were 364 participants randomised to the intervention group and 354 to the control group. The 19 participants in the intervention group and 16 in the control group dropped out before the final evaluation. The flow of the subjects through the study is presented in Figure 1. Baseline characteristics of the participants are included in Table I.

Costs

The evaluation was considered from a health services and patient perspective. All costs are reported in 1998 Mexican pesos and US dollars. Costs were not discount-

ed since the time period of the intervention was six months, apart from the cost of the sphygmomanometers, which was discounted assuming a capital life expectancy of five years and a discount rate of 6%. Costs which related to the process of research rather than the provision of the intervention were excluded. All the costs of the intervention were considered to be incremental to the cost of existing care since the family medicine units do not have an existing programme. Nurse time was recorded during the trial, including the duration of each visit, the time spent travelling, and time spent on general issues such as planning, codifying and reporting. The cost of transport was also included. Using this information, an average cost of a visit was calculated, which is the cost of nurse time during the consultation plus time spent travelling. The unit costs of the time of the nurses and their instructors were calculated from their salaries (17.50 pesos per hour for the nurses). Supplies and stationery costs were collected from institutional records. Equipment costs

(sphygmomanometers and stethoscopes) were collected from the institutional distributor. Clinic/office space was costed using the daily accounting cost of a room at IMSS. The impact of the intervention on the number of family physicians consultations was measured. Patient costs were investigated.

A cost for each patient was calculated by multiplying the number of visits that individual had received by the average cost of a visit plus the average of the other costs (equipment, office space, training, supplies). A confidence interval for mean cost, as well as mean effect, was calculated using the t-distribution with the variation in cost being attributable to the variation in the number of visits received. Similarly the difference in costs, or difference in effects was also calculated.

Cost/effectiveness was measured in terms of cost per millimetre of mercury reduced. Confidence intervals for the cost-effectiveness ratios were estimated using Fieller's method, which takes account of the skewness of the distribution of the ratio.¹¹

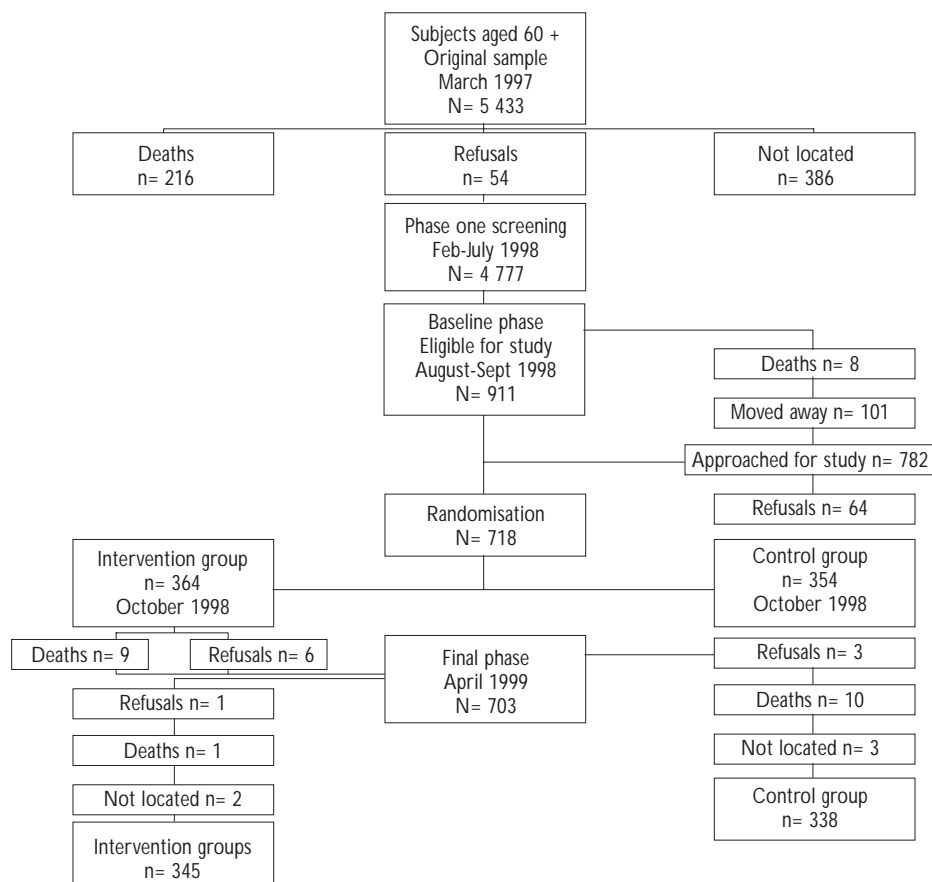


FIGURE 1. FLOW OF SUBJECTS THROUGH THE STUDY. MEXICAN INSTITUTE OF SOCIAL SECURITY (INSTITUTO MEXICANO DEL SEGURO SOCIAL), 1998

Table 1
BASELINE CHARACTERISTICS OF INTERVENTION AND CONTROL GROUPS. MEXICAN INSTITUTE OF SOCIAL SECURITY (INSTITUTO MEXICANO DEL SEGURO SOCIAL), 1998

	Control n=354	Intervention n=364
Mean age in years (SD)	70.34(6.92)	70.8(7.11)
Female, %	65.0	62.9
Education level, %		
Primary	57.6	55.0
Secondary	13.6	12.1
High school and more	3.4	5.5
Single, widowed or divorced, %	36.1	40.6
Lives alone, %	15.5	8.2
Income/month*, %		
\$10-\$109	55.6	56.6
\$110-\$209	21.5	26.1
\$210 and more	4.0	3.8
No own income	18.9	13.5
Lifestyle risk factors, %		
Current Smoking	14.2	12.5
Clinical risk factors, %		
Diabetes mellitus	26.0	27.1
Angina pectoris	1.7	2.2
Acute myocardial infarction	4.2	5.8
Renal failure	2.0	0.6
Hypercholesterolaemia	16.1	12.2
Previously known hypertension	81.4	83.2
Mean weight in Kg (SD)	67.1 (11.96)	68.4 (13.4)
Body mass index Kg/m ² (SD)	28.6 (4.83)	28.7 (5.21)
Sodium excretion in mmol/lit (SD)	95.2 (47.1)	94.9 (48.81)
Not regular walking, %	39.0	39.8
Not brisk walking, %	78.3	72.9
Mean blood pressure in mmHg (SD)		
Systolic	161.9(18.4)	162.1 (18.4)
Diastolic	90.8(9.4)	90.9 (10.4)
Blood pressure measurements, %		
Diastolic ≥ 90 mm Hg	39.0	39.3
Systolic ≥ 160 mm Hg	31.9	31.6
Diastolic ≥90 and systolic ≥160mm Hg	29.1	29.1

*American dollars

Results

At the end of the intervention period the difference in the mean change was a fall of 3.31 mm Hg (95% CI 6.32, 0.29, $p=0.03$) in systolic blood pressure and a fall

of 3.67 mm Hg (95% CI 5.22, 2.12 $p<0.001$) in diastolic blood pressure comparing the intervention group with the control group. In the intervention group, 12.9% of participants reported an increase in brisk walking, compared with 5.2% in the control group ($p=0.0004$), and the proportion of people not anti-hypertensive medication decreased from 28.4% to 15.9%, compared to a decrease from 32.2% to 26.9% in the control group ($p=0.001$).

Costs

Cost items related to the training course are described in Table II. Table III presents the costs of equipment. Indirect costs such as patient or family time were not included because when the nurses asked, none of the participants reported a cost value of the time spent during the visits. The total cost of the transport was \$7 207.60 pesos (US\$787.71), the average transport cost per visit was \$2.70 pesos (CI 95% 2.42, 2.95 pesos). The average time per consultation was 43.58 minutes (CI 95% 41.16, 45.89 min.). The total number of visits to the participants was 2 944 (mean for a participant 8.53, std. dev.=2.10). The total cost of the intervention nurses was 59 096.82 pesos (US\$6,180.99). The total cost of the intervention was then calculated as follows:

Cost = [number of consultations per patient average cost of a consultation (nurse time consultation+time travelling)+cost travelling] + other costs (equipment, office space, training, supplies) = 101 901.66 pesos (US\$11,136.79).

The average intervention cost per patient was 34.61 pesos (US\$3.78), ($p=0.000$, CI 95% 34.44, 35.46). This cost was not significantly different ($p=0.61$) in men and women (the cost for one woman was 35.05 pesos (US\$3.83) and for one man 34.78 pesos (US\$3.80)).

The total number of clinic visits to the family physicians by the participants was also calculated. There were 1 395 clinic visits in two hundred and sixty five participants (mean=5.26, std. dev.=2.57) in the intervention group and 1,392 visits in 259 participants (mean=5.37, std. dev.=1.85) in the control group. The difference between the groups was not significant ($p=0.22$).

Effects and cost/effectiveness ratios

The differences in the mean change of systolic and diastolic blood pressure were used as the effectiveness measurements. The cost-effectiveness of the intervention was 10.46 pesos (US\$1.14) per millimetre reduction in systolic blood pressure or 9.43 pesos (US\$1.03) per millimetre reduction in diastolic blood pressure. Confidence intervals for the cost-effectiveness ratios

Table II
**COST OF TRAINING. MEXICAN INSTITUTE OF SOCIAL SECURITY
 (INSTITUTO MEXICANO DEL SEGURO SOCIAL), 1998**

	Recruitment and training of nurses			Time	Cost in pesos	Cost in* dollars
	Per month	Per year	Per hour			
Value time of trainer team:						
Cardiologist	8 620.82	122 258.96	78.37	3 hrs	235.11	25.70
Geriatrician	8 620.82	122 258.96	78.37	4 hrs	313.48	34.26
Physical therapist	8 620.82	122 258.96	78.37	3 hrs	235.11	25.70
Psychiatrist	8 620.82	122 258.96	78.37	3 hrs	235.11	25.70
Supervisor	3 150.00	48 609.04	25.32	80 hrs	2 025.60	221.38
Researcher	8 620.82	122 258.96	78.37	80 hrs	6 269.60	685.20
Clinic space for course				Two weeks	11 500.00	1 256.83
Value time of nine nurses during the course	2 800.00			Two weeks	12 600.00	1 377.05
Partial total: training and clinic space					33 414.01	3 651.82

*Exchange rate 1998=9.15 pesos/dollar

Table III
**COST OF EQUIPMENT. MEXICAN INSTITUTE
 OF SOCIAL SECURITY (INSTITUTO MEXICANO
 DEL SEGURO SOCIAL), 1998**

Equipment	Cost per unit pesos	Total costs	
		Pesos	Dollars*
Sphygmomanometers (nine)*	255.96	2 303.64	251.76
Stethoscope (nine)	55.00	495.00	54.10
Uniforms for nine nurses	150.00	1 350.00	147.54
Total cost of supplies and stationery (sheets, photocopies, pencils, erasers)	5 242.19	5 242.19	572.92
Partial total: equipment		9 390.83	1 032.32

*Annualised +exchange rate 1998=9.15 pesos/dollar

are presented in Table IV. The cost of the control group is zero because a) the intervention is considered to be an incremental cost and b) the cost of family physician visits was not included as there was no significant difference between the trial arms. Variances and standard deviations of the effects (S_{ET}^2 , S_{EC}^2 and S_{ET}) assumed the values of change in systolic and diastolic blood pressure. The intervention cost per patient (C_T) was 34.61 pesos ($S_{CT}=4.86$, $S_{CT}^2=23.68$ pesos). Symbol r_T refers to the sample correlation coefficient of the cost an effect in the intervention group (Systolic $r_T=0.028$ and diastolic $r_T=0.003$). Table 4 includes values of the three coefficients of variation (C_{dd} , C_{nn} and C_{nd}) and the resulting confidence intervals for systolic and diastolic cost-effectiveness ratios.

Table IV
**COEFFICIENTS OF VARIATION AND CONFIDENCE
 INTERVALS FOR COST EFFECTIVENESS RATIOS.
 MEXICAN INSTITUTE OF SOCIAL SECURITY (INSTITUTO
 MEXICANO DEL SEGURO SOCIAL), 1998**

	Systolic blood pressure	Diastolic blood pressure
Coefficient of variation of numerator of R^* (C_{nn})	0.0000573	0.0000573
Coefficient of variation of denominator of R^* (C_{dd})	0.22	0.0410
Coefficient of variation of denominator/numerator of R^* (C_{nd})	0.0000688	0.00000315
Cost effectiveness ratio (R^*)		
Pesos	10.46	9.43
US\$	1.14	1.03
95% Confidence Interval		
Pesos	129.31 5.51	19.90 2.49
US\$	14.13 0.60	2.17 0.27

Discussion

Much research has been published in the area of effective antihypertensive therapy, patient management guidelines and life-style management, but optimal methods for the delivery of care have not been fully explored. With this perspective, the aim of this study was to measure the incremental costs and effects of home visits by a nurse to elderly people with hypertension in Mexico.

The cost effectiveness of the intervention was 10.5 pesos (US\$1.1) per mm Hg reduction of systolic blood pressure and 9.4 pesos (US\$1.0) per mm Hg reduction of diastolic blood pressure. This seems on face value to be a cost-effective intervention. However, it is not possible to draw a firm conclusion because it is not possible to make comparisons with alternative health care interventions based in Mexico which used other measures of effectiveness. The tool of economic analysis has emerged only recently in Mexico and little information exists. We cannot determine, therefore, if nurse visits to the elderly is the most cost-effective alternative. However, the estimated cost per millimetre of mercury reduction in blood pressure suggests that this intervention will prove to be highly cost effective.

This study is based on an outcome of reduction in blood pressure, which is an immediate outcome. We do not have any information on the sustainability of the intervention, and the future benefits of the intervention in terms of mortality, morbidity or quality of life are unknown. Because the target group is elderly, it is not possible to model the effects of blood pressure reduction on mortality. Models for estimating life years gained after blood pressure reduction have been criticised for discriminating against older people, due to a shorter life expectancy of older people.¹² Unfortunately, models have not been developed for people over 70 years old. As a consequence the utilization of modelling would underestimate the cost-effectiveness ratio.

The number of clinic consultations with the family physician was not statistically different between the groups. If future benefits are achieved in the intervention group, it is possible that there will be a decrease in utilisation rates for second and third levels of care and a decrease in the disability rates. On the other hand the intervention lead to increased prescribing of antihypertensive drugs and this has not been considered in our estimate of cost. Indirect costs were not included in the analysis because none of the participants reported any. One of the reasons for this was that the nurse always arranged the appointment with the participant and he/she could choose a time that was convenient. By arranging home visits at times that are convenient to the participant, indirect costs can be greatly reduced. Many health policy makers argue that health promotion practices and preventive care are a way of reducing health care costs. However, the idea that health promotion and preventive strategies are cheap and will save money, is too simplistic. Indeed, in the case of the elderly population, health promotion activities could add to the costs of the medical expend-

iture but they will also represent future benefits in terms of a better quality of life, a decrease in disability and the possibility of a successful ageing.¹³

Recognition that health can be promoted for the elderly to improve the quality of life has increased in the last few years¹⁴ but the process by which research data are incorporated into a clinical setting is complicated. Economic features, organisational aspects, uncertainty about the usefulness of the results, technical barriers are some of the obstacles in the process of linking research into policy.¹⁵ Ensuring that the health promotion strategy that we tested is effective is an important step, but not enough. As is true everywhere in the world, institutional resources in Mexico will remain limited and interventions for the elderly must be shown to be cost-effective if they are to compete against the resource demands of other worthwhile interventions. The intervention evaluated in this study has been shown to be effective at very small cost, but whether this represents good value compared with other health interventions remains to be determined. Moreover, there is, as yet, no relevant data on the effectiveness or cost of other possible interventions aimed at blood pressure reduction in an elderly Mexican population, such as self help groups and future research has to be done in this area.

This study is important because introduces the tool of the economic analysis in the arena of health promotion for elderly people. In México, health system has to be reorganized in order to response to the growing needs of this group of age and research is a key element in this process. Hypertension and their consequences (stroke and coronary heart disease) is the most important cause of mortality and disability among the elderly. Cost-effective strategies that improves health and promotes healthy aging are crucial if we want to diminish an increasing utilization of third level hospitals and the subsequent costs.

References

1. Secretaría de Salud. Boletín de Información Estadística, Recursos y Servicios. México, D.F.: SSA;1997.
2. Secretaría de Salud. Encuesta Nacional de Enfermedades Crónicas. México, D.F.: Dirección General de Epidemiología, 1996.
3. García-Peña C, Thorogood M, Armstrong B, Reyes S, Muñoz O. Pragmatic Randomised Trial of Home Visits by a Nurse to Elderly People with Hypertension in Mexico. *Int J Epidemiol* 2001.
4. García-Peña C, Thorogood M, Reyes S, Salmerón-Castro J, Durán C. The prevalence and Treatment of Hypertension in Elderly Population. *Salud Publica Mex* 2001;43:415-420.
5. Kaplan N. Cost Considerations in the drug treatment of the Mexican Institute of Social Security hypertension. Is older better? *Pharmacoeconomics* 1996;9:283-285.

6. Johannesson M. The cost effectiveness of hypertension treatment in Sweden. *Pharmacoeconomics* 1995;7:242-250.
7. Edelson D, Weinstein M, Tosteson A, Willims L, Lee T, Goldman L. Long-term cost-effectiveness of various initial monotherapies for mild to moderate hypertension. *JAMA* 1990;263:407-413.
8. Mancia G, Giannattasio C. Benefit and costs of anti-hypertensive treatment. *Eur Heart J* 1995;17 (Suppl A):25-28.
9. Wonderling D, McDermott Ch, Buxton M, Kinmonth A, Pyke S, Thompson S. Costs and cost effectiveness of cardiovascular screening and intervention: the British Family Heart Study. *BMJ* 1996;312:1269-1273.
10. Wonderling D, Langham S, Buxton M, Normand Ch, McDermott CH. What can be concluded from the Oxcheck and British Family Heart Studies: commentary on cost effectiveness analyses. *BMJ* 1996;312:1274-1278.
11. Chaundhary M, Steams S. Estimating confidence intervals for cost-effectiveness ratios: An example from a randomized trial. *Stat Med* 1996;15:1447-1458.
12. Johannesson N, Johansson P. Is the evaluation of a QALY gained independent of age? Some empirical evidence. *J Health Economics* 1997;16:589-599.
13. Kennie D. Preventive Care for Elderly People. Londres: Cambridge University Press, 1993:310.
14. Kalache A. Health promotion. En: Ebrahim S, Kalache A, ed. *Epidemiology in old age*. Londres: Latimer Trend, 1996:156.
15. Lewando-Hundt G, Al Zaroo S (2000). Evaluation the dissemination of health promotion research. En: Thorogood M, Coombes Y. *Evaluation Health Promotion. Practice and Methods*. Oxford (UK): Oxford University Press, 2000:151.