ISSN 0025-7680

**ORIGINAL ARTICLE** MEDICINA (Buenos Aires) 2005; 65: 507-512

# DECREASE OF BLOOD PRESSURE BY COMMUNITY-BASED STRATEGIES

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**Abstract** In a cross section study performed in Rauch in 1997 we found a high prevalence of hypertension and low levels of treatment and control. To evaluate the impact of the community-based intervention activities on blood pressure (BP), we made a cohort study in 1526 inhabitants aged between 15 and 75 years in 2003. The initial study, the advice to consult the family doctor when alterations were found, the free provision of antihypertensive drugs, the press diffusion of the study results and a healthy lifestyle were included among the intervention activities. BP was measured in the subjects' residence by especially trained nurses, considering systolic BP (SBP) and diastolic BP (DBP) as the average of three measurements in one occasion. A total of 1307 subjects (85.65%) were re-interviewed. SBP decreased from 137.98 ± 0.57 to 132.49 ± 0.53 mm Hg ($p<0.01$) and DBP from 88.73 ± 0.38 to 81.87 ± 0.33 mm Hg ($p<0.01$). Pressure decrease was observed in all the age groups, in both sexes and in the subgroup without receiving antihypertensive drugs. The percentage with antihypertensive drugs increased from 12.2 to 20.4 ($p<0.01$). A significant relationship was observed between the percentiles of the BP changes and weight changes in subjects with and without antihypertensive drugs. Community-based intervention strategies were effective to BP control and, probably, to decrease the cardiovascular risk in a community with high prevalence of hypertension.

**Key words**: high blood pressure, community-based strategies, hypertension treatment and control

**Resumen** ***Descenso de la presión arterial por estrategias comunitarias***. La ciudad de Rauch presentaba en 1997 alta prevalencia de hipertensión arterial (HA) y bajos niveles de tratamiento y control. Para evaluar el impacto de actividades de intervención comunitarias sobre la presión arterial (PA) reencuestamos en el año 2003 a una cohorte de 1526 habitantes de 15-75 años. Las actividades de intervención fueron el estudio inicial, la indicación de concurrir a su médico cuando se hallaban alteraciones, la provisión gratuita de antihipertensivos y la difusión por medios masivos de los resultados del estudio y de hábitos saludables de vida. La PA fue medida en el domicilio por enfermeras especialmente entrenadas, considerando PA sistólica y diastólica (PAS y PAD) a los promedios de tres registros en una ocasión. Se reencuestaron 1307 individuos (85.65%). La PAS descendió de 137.98 ± 0.57 a 132.49 ± 0.53 mm Hg ($p<0.01$) y la PAD de 88.73 ± 0.38 a 81.87 ± 0.33 mm Hg ($p<0.01$). La PA disminuyó en ambos sexos, en todos los grupos etáreos y en el subgrupo sin antihipertensivos. El porcentaje de sujetos con antihipertensivos aumentó de 12.2 a 20.4 ($p<0.01$) y se observó una relación significativa entre los percentilos de los cambios de la PA y los cambios del peso en sujetos con y sin antihipertensivos. Las estrategias de intervención comunitaria fueron efectivas para controlar la PA y, probablemente, para disminuir el riesgo cardiovascular en una comunidad con alta prevalencia de HA.

**Palabras clave**: hipertensión arterial, estrategias comunitarias, tratamiento y control de la hipertensión arterial

Studies carried out in Argentina on urban population showed a high prevalence of hypertension[1-3], a high increase of blood pressure (BP) in a ten-year period, and an incidence of hypertension during that period of 64% in men with high normal BP[4]. It is known that systolic BP (SBP) increases with age and that the relationship between BP and cardiovascular risk is linear[5]. Hypertension and other health-risk factors trigger the development of cardiovascular diseases and in our country they are the leading death causes (34.2%)[6]. The knowledge of the prevalence of these factors is necessary before implementing the primary prevention programmes. It is also stated that more comprehensive investigations on the epidemiological area of hypertension are necessary and that those who implement primary prevention measurements can obtain more precise information from regional epidemiological studies in order to select better local measurements aimed at prevention[8].

Received: 4-IV-2005 Accepted-3-VIII-2005

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The main factors contributing to a BP increase with age are genetic[9], intrauterine[10], and, after birth, cultural. Investigators from Framingham have recently reported that 90% of men and women without hypertension aged 55 to 65 years will develop hypertension when aged 80 to 85 years[11]. Recommended strategies to perform primary prevention of hypertension include an adequate mother-foetus nutrition; a normal weight maintenance; a decrease in alcohol intake; a moderate sodium consumption; a healthy eating plan that emphasises fruits, vegetables, and low fat dairy foods (Dietary Approaches to Stop Hypertension, DASH); a potassium supplementation; and a regular physical activity programme[12]. The relative importance of these facts can vary according to different communities, and their adequate identification and measurement are necessary for evaluating the results of the intervention.

Prevention and control of hypertension requires the complementary application of strategies targeted to general population together with others especially aimed at high risk individuals[12]. In Rauch in 1997, as an initial step of the implementation of prevention population-based strategies, we investigated the prevalence of hypertension (defined as the average of three BP measurements in two different occasions = 140/90 mm Hg) and of other cardiovascular risk factors. The results of that study were previously published[13]. In brief, we found a high prevalence of hypertension (43.20% in men and 28.50% in women), and obesity-overweight (54.81% in men and 44.65% in women), both of them augmented with aging. Only 4% of hypertensive subjects were controlled and only 32% of them were aware of their condition. Men showed a marked increment of hypertension prevalence and obesity-overweight between groups of 15-24 and 25-34 years, while women had delayed and more gradual increments. In male and female, respectively, the prevalence of hypercholesterolemia was 26.86% and 13.81%, the prevalence of diabetes was 3.42% and 1.53%, and the prevalence of tobacco consumption was 34.61% and 20.83%. Higher body mass index (BMI) and waist circumference identified subjects with higher blood pressure both for men under 54 years and women under 65 years. Age and waist circumference in the whole group, and alcohol consumption in men, were independently correlated with blood pressure; sodium excretion had no correlation.

The objective of this paper was to evaluate, after six years, the impact on BP of the prevalence survey performed in 1997 and of the subsequent community-based prevention activities developed in the period 1997-2003.

## Materials and Methods

The universe was the inhabitants of Rauch between 15 and 75 years of age. This city lies in the Centre-Southeast region of the province of Buenos Aires, 36° 45' 00'' south latitude and 59° 04' 00'' west longitude. It is 270 km far from Buenos Aires City. The annual average temperature is 13.8 °C. According to the last national census available in 1997 (1991 census), there were 13 909 inhabitants in Rauch, 8 246 between 15 and 75 years of age (4 166 men and 4 080 women). No abnormalities had been shown since 1991 to assume changes in the population.

In 1997, randomly chosen blocks were considered as units for the sampling; 1 526 inhabitants constituted the initial sample; their composition was previously described[13]. The initial survey was performed on subjects aged 15-75 years living in the randomly chosen blocks. Since the socio-economic features and the number of inhabitants were similar, a proportional probability was not taken into consideration. After six years of the initial survey on prevalence, a cohort study was performed as a second step.

The methodology and the techniques to obtain the data were the same in 1997 and in 2003. Three BP measurements were performed and weight and size were also measured. An epidemiological chart was also made. The subjects remained seated during the BP measurements. The right arm at the heart level was selected for the measurements and a mercury-scale sphygmomanometer was utilised. The lower edge of the cuff was no less than 3 cm above the bend of the elbow. The cuff measurements were 12.5 × 22.0 cm**.** SBP was the reading in the phase I, and diastolic BP (DBP) was the reading in the phase V. Three measurements were performed separated by five minutes. SBP and DBP were considered the mean of the three measurements. Weight was registered barefoot, with light clothes and using a personal scale calibrated before each measurement. Height was determined barefoot and with a metal tape measure. Personal information, smoking, alcohol and medicine intakes were included in the epidemiological chart.

Nurses from Hospital Municipal of Rauch conducted the survey, being previously selected and trained by the same instructors in 1997 and in 2003. They went to the domiciles to measure BP, weight, and height and to make the epidemiological chart.

The following community-based strategies were applied:

a) An initial survey performed in 1997 with the advice to consult the family doctor.

b) A release of the general results of the initial study to the representatives of the community organisations.

c) A release of the general results of the initial study to doctors and health workers.

d) The diffusion of the results of the initial study by the local press.

e) The publication of articles in the press on hypertension.

f) The provision of free antihypertensive drugs.

g) BP measurements by nurses to all subjects at the health centres for any cause.

h) Seminars given by a nutritionist promoting a healthy eating.

i) The promoting of vegetable gardens and a professional counselling together with the handing out of seeds free of charge.

j) The promoting of physical activity in a sports centre in charge of a physical education professor.

*Definitions*

a) Age: that corresponding to 1997.

b) BP: mean of three measurements in one occasion.

c) Alcohol intake: grams of alcohol consumed per week.

d) Excessive alcohol intake: consumption of ≥ 30 g/day in men and ≥ 20 g/day in women.

e) Smoking: number of cigarettes per day.

f) Without antihypertensive drugs: subject without antihypertensive drugs either in 1997 or in 2003.

g) Treatment: hypertensive patient taking antihypertensive drugs.

*Statistics*

Age, BP, alcohol and cigarette consumption were expressed as arithmetic mean ± 1 ES in years, mm Hg, grams per week and cigarettes per day, respectively. To compare continuous variables between 1997 and 2003, paired T test was utilised. ANOVA with adjustment by age was used to compare continuous variables between quartiles of change of SBP. Chi square test was used to investigate the differences between the proportions; $p < 0.05$ was considered significant. Data were processed and analysed with SPSS 11.0 Program.

## Results

One thousand three hundred and seven subjects were re-interviewed (85.65%), 855 women and 452 men, aged 45.44 ± 0.46 years in 1997; some other subjects were not re-interviewed: 71 had died (4.65%) and 148 (9.70%) were not found due to several causes (moved to another city, out of home, etc.). Of the 71 dead subjects, ten (14.08%) died of cardiac failure, 5 (7.04%) of stroke, 4 (5.63%) of acute myocardial infarction, 2 (2.82%) of sudden death and 50 (70.42%) of non-cardiovascular diseases. The subjects who were not found (64 males and 84 females) were, in 1997, younger (33.51 ± 1.50 years old, $p<0.01$), had lower BP (130.65 ± 1.50 / 84.12 ± 0.98 vs. 137.98 ± 0.57 / 88.73 ± 0.38 mm Hg, $p<0.01$), lower BMI (24.28 ± 0.36 vs. 25.89 ± 0.15 kg/m$^2$, $p<0.01$) and lower alcohol intake ($p<0.01$) than those re-interviewed. Table 1 shows the composition of the cohort sample.

SBP decreased from 137.98 ± 0.57 to 132.49 ± 0.53 mm Hg ($p<0.01$), displacing the pressure curve to the left (Fig. 1), and DBP from 88.73 ± 0.38 to 81.87 to 0.33 mm Hg ($p<0.01$). The pressure decrease was observed in all the age groups (Fig. 2), it was significant in both sexes and also when the subgroup without antihypertensive drugs was considered (Table 2).

TABLE 1.– *Sample composition*

| Years of age | Men | Women | Total |
|---|---|---|---|
| 15-24 | 60 | 121 | 181 |
| 25-34 | 48 | 130 | 178 |
| 35-44 | 108 | 156 | 264 |
| 45-54 | 91 | 172 | 263 |
| 55-64 | 73 | 135 | 208 |
| 65-75 | 72 | 141 | 213 |
| 15-75 | 452 | 855 | 1307 |

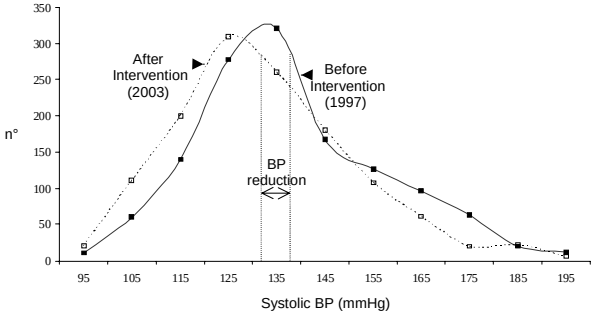


Fig. 1.– Distribution of systolic blood pressure (SBP) curves in 1997 and in 2003 showing a leftward displacement after intervention.

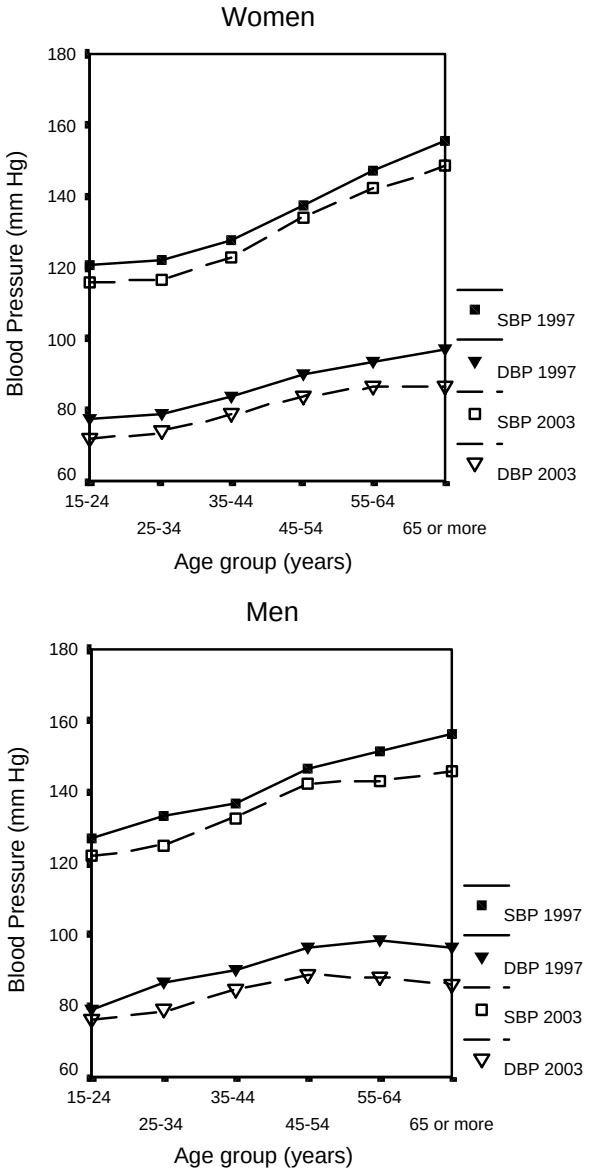


Fig. 2.– Systolic blood pressure (SBP) and diastolic blood pressure (DBP) of women and men of cohort, before (1997) and after (2003) intervention.

TABLE 2.– *Blood pressure differences in the whole cohort and in the subgroup without taking antihypertensive drugs*

| | Complete cohort (n = 1307) | | | Without antihypertensive drugs (n = 1015) | | |
|---|---|---|---|---|---|---|
| | Difference* (mm Hg) | SE | p | Difference* (mm Hg) | SE | p |
| Women | | | | | | |
| SBP | -5.06 | 0.55 | < 0.01 | -3.66 | 0.55 | < 0.01 |
| DBP | -6.61 | 0.41 | < 0.01 | -5.63 | 0.45 | < 0.01 |
| Men | | | | | | |
| SBP | -6.29 | 0.75 | < 0.01 | -5.25 | 0.77 | < 0.01 |
| DBP | -7.34 | 0.60 | < 0.01 | -6.42 | 0.66 | < 0.01 |

**Difference = BP year 2003 - BP year 1997*
*SE: standard errors of the mean*
*SBP: systolic blood pressure*
*DBP: diastolic blood pressure*

TABLE 3.– *Blood pressure and weight changes according to quartiles of systolic blood pressure change*

| | Quartiles of SBP Change | Age | | SBP Change | | DBP Change | | Weight Change* | |
|---|---|---|---|---|---|---|---|---|---|
| | | Media | SE | Media | SE | Media | SE | Media | SE |
| Women | | | | | | | | | |
| | 1 | 47.84 | 1.19 | -25.30 | 0.66 | -16.26 | 0.76 | -1.52 | 0.43 |
| | 2 | 43.27 | 1.14 | -9.69 | 0.21 | -9.23 | 0.61 | -0.71 | 0.46 |
| | 3 | 43.31 | 1.14 | -0.64 | 0.18 | -4.13 | 0.58 | -0.24 | 0.40 |
| | 4 | 46.75 | 1.09 | 14.17 | 0.63 | 2.60 | 0.70 | 0.88 | 0.40 |
| Men | | | | | | | | | |
| | 1 | 48.88 | 1.47 | -25.36 | 0.87 | -18.14 | 1.10 | -1.61 | 0.63 |
| | 2 | 43.59 | 1.58 | -9.83 | 0.27 | -8.87 | 0.82 | 0.32 | 0.48 |
| | 3 | 45.64 | 1.59 | -0.92 | 0.23 | -4.56 | 0.98 | 0.89 | 0.49 |
| | 4 | 44.59 | 1.43 | 13.68 | 0.99 | 3.75 | 0.87 | 1.34 | 0.51 |

In this six-year period, the percentage of subjects taking antihypertensive drugs increased from 12.2 to 20.4 ($p < 0.01$); 1.8% abandoned the treatment and 10.0% of the cohort subjects commenced it.

Alcohol intake decreased from 77.05 ± 4.77 to 67.91 ± 4.52 g/week ($p < 0.05$). The percentage of subjects with excessive alcohol intake decreased in men from 30.5 to 25.4, though it did not change in women.

When the sample was divided in quartiles of change of SBP, it was observed that in the upper quartile SBP increased 14.17 ± 0.63 mm Hg in women and 13.68 ± 0.99 mm Hg in men, whereas in the lower quartile it decreased 25.30 ± 0.66 mm Hg and 25.36 ± 0.87 mm Hg in women and men, respectively. The percentage of patients under treatment in 2003 was greater in the lower quartile of change of SBP than in the upper quartiles (29.6 against 17.7, 16.1, 18.7) ($p < 0.01$).

Body weight remained unchanged (69.56 ± 0.39 and 69.38 ± 0.41 kg) in 1 284 subjects between 1997 and 2003. However, when weight change was analyzed according to the quartiles of SBP changes, we found an increase of body weight from lower to higher quartiles. These weight differences between quartiles of the SBP changes were significant ($p < 0.01$) in both the whole cohort and when only the subjects without antihypertensive drugs were considered (Table 3 and Fig. 3).

Smoking did not show significant changes.

## Discussion

Since the type of intervention used required community-based strategies affecting the whole community, this study leaves aside the possibility of having a control group within

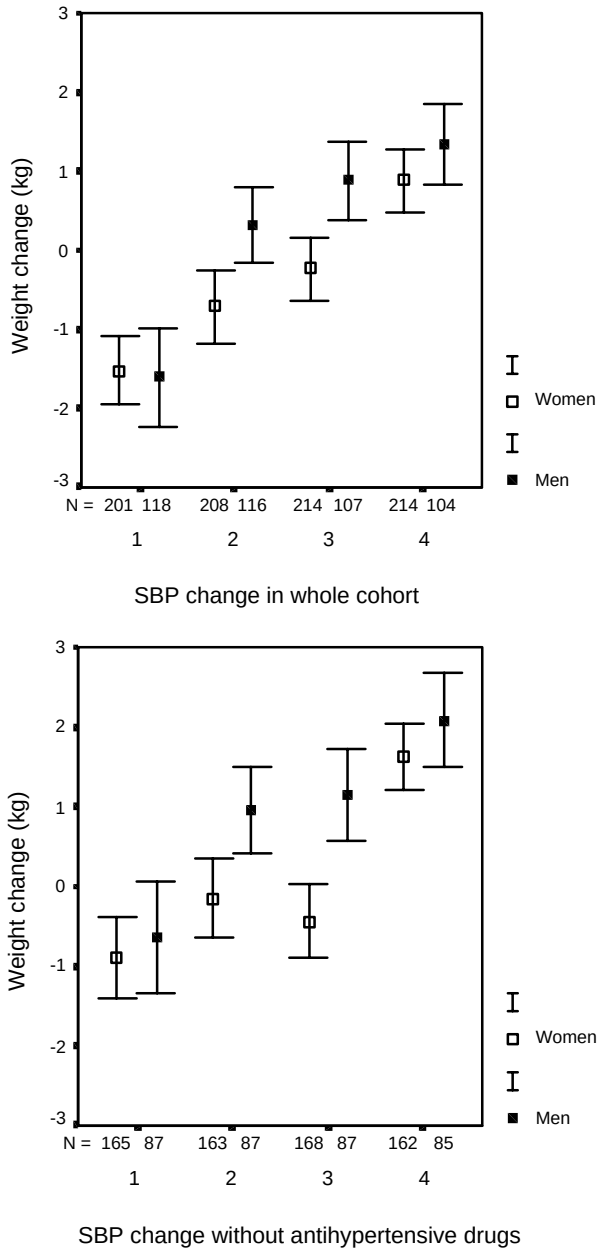


Fig. 3.– Body weight changes between 1997 and 2003 according to quartiles of SBP changes in the whole cohort and in subject without taking antihypertensive drugs.

the community. Some cohort studies utilised non-intervened cities as control group where a mild decrease of BP was found, but lesser than that obtained by the intervened cities[14]. However, those control groups lost more than half of the cohort and, in particular, less-educated subjects who have a high risk to develop hypertension[15, 16]. These problems make it difficult to interpret the findings. Furthermore, it has been stated that in non-intervened communities, BP increases with age. INTERSALT study[17] showed that inhabitants aged 20 to 59 years from industrialised communities have BP increases of approximately 0.5-0.6 mm Hg per year. On the basis of these data and taking into consideration the relationship between SBP and age observed in Rauch in 1997, we expected an increase from 3 to 4 mm Hg in SBP after six years. This study shows a consistent decrease of SBP and DBP in both sexes and in all the age groups, after both the initial epidemiological survey and the application of community–based intervention strategies. The high percentage of subjects who were re-interviewed (85.6%) and the fact that all the survey takers observed a decrease in BP contribute to give reliability to the results. The intervention strategies did not form part of a structured programme with a personalised follow-up, but they consisted of a set of more general measures applied to the whole population.

This BP decrease is probably due to several factors. On the one hand, it was observed an increase of the percentage of subjects under pharmacological treatment with antihypertensive drugs. BP measurement performed on the initial survey and, especially, the free provision of antihypertensive drugs could contribute to that outcome. However, BP decrease was also present in those subjects who did not take antihypertensive drugs, so that other complementary factors should be taken into account such as the absence of weight increase or a decrease in alcohol consumption.

During a period of time, BP of each individual may go up, go down or have no change; the BP effect of the whole cohort depends on the combination of these individual changes. To prevent BP increase with ageing it is essential to identify the variables explaining these different BP behaviours. In this study, when the BP changes were percentiled, in the upper percentile of SBP change an increase of 14 mm Hg was observed in women and a 13 mm Hg increase in men; whereas in the lower percentile a decrease of 25 mm Hg was found in both sexes. Part of these differences is due to an increase in the percentage of subjects taking antihypertensive drugs. However, the parallelism found between weight changes and BP changes found in the subgroup without taking antihypertensive drugs suggests that the prevention of weight increase was one of the main aspects in the prevention of the BP increase with ageing. This fact can probably be explained by community-based education to change eating habits and to an increase in physical activity.

Several studies have shown that weight loss and sodium consumption are the best measurements for the prevention of BP increase and for the primary prevention of hypertension[18-21]. Although BP decrease obtained in these studies could be considered minimal (1-3 mm Hg), it has been estimated that decreasing 2 mm Hg of a community SBP decreases 6% the annual mortality caused by stroke, 4% coronary heart disease and 3% all-causes mortality[12, 22]. In our study the 5 mm Hg decrease observed in SBP was greater and could decrease 14, 9 and 7% the

annual mortality by stroke, coronary heart disease and all-causes mortality, respectively[12, 22]. It is important to highlight that high prevalence of hypertension and overweight-obesity and low levels of treatment and control were found in Rauch in 1997[13]. Thus, the high risk level of this community may explain the particularly outstanding benefits obtained. Two additional facts could broaden the effects of the intervention: first initial sample represented a high percentage of the population, and, second Rauch has a small number of professionals within a unified health system.

It should be noted that several of the measurements recommended for the primary prevention of BP increase can produce additional benefits, since they can impact on other factors of cardiovascular risk. Thus, for example, obesity reduction[23] and regular exercise[24] improve lipid profile and decrease glycaemia.

To our knowledge, this is the first study in Argentina showing BP decrease in a community by a prevalence survey and by the applying of community-based measurements of prevention and treatment of hypertension. These results reassure the validity of the low cost local resources to solve community health problems. The wide community-based characteristic of the employed strategies makes us suppose that they can be applied beyond Rauch population to communities with similar features, but its application should be designed for the particular characteristics of each community.

**Acknowledgements:** The authors are very grateful to the nurses who carried out the survey: Marcela Constantino, Alejandra Patané, Elizabet Catalana, Graciela Silva, Myriam García, Vanesa Vázquez, María Puglia, Soledad Juriorena and Cristina Lavallen. Libertad Teruel and Silvina Fernández collaborated in the coordination and paperwork.

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