

Blood Cholesterol Reduction Following Community-Based Screening and Dietary Counseling

RAY JAMES,¹ ERIC VAN BEURDEN,² COLIN TYLER,³ DENISE HENRIKSON,² AND SUSAN ASH⁴

¹ National Centre for Research into Prevention of Drug Abuse, Western Australia; ² North Coast Health Promotion Services, Lismore, NSW 2480, Australia; ³ Health Education Services, Lismore, NSW 2480, Australia; ⁴ North Coast Heart Health Program, Lismore, NSW 2480, Australia

ABSTRACT: Screening for total blood cholesterol levels using Boehringer Mannheim Reflotrons was conducted at 52 sites over three and a half months on the North Coast of New South Wales, Australia, in 1987. Mixed teams of health staff and community volunteers screened 9,046 participants between the ages of 25 and 64. The mean age was 47, 60% were female, and the average blood cholesterol level was 5.36 mmol/L (207 mg/dL). While only 16% were smokers, nearly half of the sample was over 25 BMI. A total of 2,354 (26%) were found to be at moderate risk and 1,345 (15%) were at high risk. A brief dietary consultation was offered to the 41% who were over the recommended 5.5 mmol/L (213 mg/dL) level.

At a four month follow-up of 2,183 of these same individuals, the blood cholesterol level was lower in 76% of participants and BMI was lower in 65%. Mean blood cholesterol reduction was 8% after correction for regression towards the mean, and mean BMI reduction was 2%. A telephone survey of 100 participants who attended the retest revealed that 84% had changed their diet to reduce fat intake, with 68% switching to low-fat dairy products, 50% reducing meat intake, and 34% eating more fruit and vegetables. Our experience shows that community-based screening with dietary counseling can have a significant impact on the public's dietary behavior, and can therefore reduce the risk of cardiovascular disease.

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INTRODUCTION

The economic, social and personal costs of cardiovascular disease (CVD) led the Better Health Commission to make the reduction of CVD the number one health priority for Australia during the next decade (1). Since nearly 60% of all cardiovascular deaths are due to coronary heart disease (CHD) and Australia ranks 9th among developed nations for CHD, it is vital that health resources be

directed towards the prevention of heart disease (2).

Epidemiological explanations for the prevalence of CHD focus on the concept of "risk factors." Population studies, laboratory experiments and clinical trials indicate that the major risk factors are high blood cholesterol, smoking and high blood pressure (3-5). Studies by the National Heart Foundation of Australia indicate that 29% of the population smoke, 15% have high blood pressure, and about half of all adults have blood cholesterol levels above the recommended 5.5 mmol/L (213 mg/dL) level. The current mean blood cholesterol level for the Australian population is 5.65 mmol/L (219 mg/dL), and 20% have blood cholesterol concentrations above 6.5 mmol/L (251 mg/dL) (6).

While there have been large-scale public health campaigns over the past years to reduce the risk of smoking and hypertension, it was not until January 1984 that the Lipid Research Clinics Coronary Prevention Trial provided definitive evidence that lowering high blood cholesterol levels would reduce the risk of CHD (7). The high prevalence of CHD in Australia and the recent understanding of the role of blood cholesterol in developing heart disease has led to an interest in a population approach to reducing cholesterol levels through nutrition education. While the adoption of a diet that is substantially lower in saturated fat is a key component of this strategy, the authors chose to encourage the community to reduce total fats, following The Dietary Guidelines for Australians (1, 8).

After reviewing reports by Wynder (9), Greenland (10), and Lefebvre (11) on the feasibility of large-scale public screening programs for cholesterol determination and nutrition education, the North Coast Health Region of New South Wales, Australia, decided to implement a community-based intervention to lower blood cholesterol levels through dietary modification. In April 1987, a project team consisting of a health educator, a community nurse and a nutritionist was established and a campaign strategy adopted (12).

Address for correspondence: Eric van Beurden, Ph.D., Co-Director: North Coast Health Promotion Services, 31 Uralba St., Lismore, NSW 2480, Australia.

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SUBJECTS AND METHODS

The newly formed Heart Health Program Team was responsible for planning the intervention and for training the existing health staff and community volunteers to run cholesterol screening, counseling and referral events (SCORE) throughout the region (11). Each screening was conducted in a uniform, standardized manner, according to a protocol developed by the Heart Health Program Team (13). Total blood cholesterol assessment was performed using the Boehringer Mannheim Reflotron System, and nutrition counselling on how to reduce fat in the diet was given to those participants above the 5.5 mmol/L (213 mg/dL) level. This concentration is recommended as the threshold risk level by the Australian National Heart Foundation, as it indicates an increased risk of CHD for adults (14). Participants were charged \$2.00 to cover the cost of the reagents used in screening, and a free retest was offered to all participants who were over the recommended level. (It should be noted that Australian risk levels for blood cholesterol (213 mg/dL) are slightly higher than the current guidelines recommended by the NCEP in the U.S. (200 mg/dL).)

All participants found to have levels above 6.5 mmol/L (251 mg/dL) were encouraged to visit their family doctor for a full lipid profile. Doctors in the North Coast Region were contacted by the state branch of the National Heart Foundation (NHF) and encouraged to follow the guidelines set forth by the NHF for the treatment of hypercholesterolemia (14, 15). These doctors also received a copy of two NHF publications: *Update On Diet and Heart Disease* and *The Family Doctor's Coronary Risk Handbook* (14, 15). The New South Wales branch of the NHF also conducted two seminars on cholesterol and CHD for medical practitioners on the North Coast during the campaign.

The North Coast Cholesterol Check Campaign (NCCCC) ran from September 1 to December 15, 1987, in all ten planning areas of the North Coast Health Region. Over 350 health professionals and community volunteers were trained to run the SCOREs. Three hundred and eighty-five doctors in the region received the letter and publications from the NSW branch of the NHF.

The majority of SCOREs took place in shopping centers and community health centers; a few events were held in worksites and district hospitals. A team of eight staff members could screen and provide dietary counseling for 200 participants in seven hours. Screening stations were set up as follows:

- **Check-in:** Participants were asked to fill in a data card with name, address, sex, age, education level, previous cholesterol readings, smoking and exercise habits.
- **Height-weight:** Measurements were taken and recorded on the data card. These were later used to

calculate Body Mass Index (BMI) as $\text{WEIGHT in Kg} / (\text{HEIGHT in m})^2$.

- **Blood samples:** Participants moved from a waiting area to one of two Reflotrons used to analyze blood samples. Trained nurses took a finger-stick sample of blood and applied 32 ul to a Boehringer Mannheim reagent strip. Analysis took just under three minutes and participants could see their own blood cholesterol level when it appeared on the output screen of the Reflotron. As only total blood cholesterol was measured, fasting samples were not required (15).
- **Dietary counseling:** All participants over 5.5 mmol/L (213 mg/dL) were asked to speak with a "Cholesterol Advisor." Cholesterol Advisors used a "fact sheet" to discuss five ways to "eat less fat." The five suggestions were:
 - 1) Remove excess fat from meat.
 - 2) Switch to low fat dairy products.
 - 3) Use less butter, margarine and oils.
 - 4) Say no to greasy "take away" food.
 - 5) Check food labels for hidden fat.
- **Referral:** All participants between 5.5 mmol/L (213 mg/dL) and 6.5 mmol/L (251 mg/dL) were encouraged to see their family doctor for a complete lipid panel; those over 6.5 mmol/L (251 mg/dL) were strongly urged to see their doctor.
- **Follow up:** All participants with cholesterol levels over the 5.5 mmol/L (213 mg/dL) level (3,699) were sent a letter, three months post screening, to remind them of the retest and to ask them to call their local community health center to make an appointment for a second test. Appointment times of five minutes were given for retests (weight and non-fasting cholesterol only).

In addition to the retest, two telephone surveys were conducted. The first survey consisted of a random sample of 100 participants who had not attended the retest. Each of these people was asked questions regarding the initial screening, whether or not they had visited their doctor for a lipid panel, and why they had been unable to attend the retest.

The second survey consisted of 100 participants who had attended the retest. Each of these was asked whether they had visited their family doctor for a lipid panel and what changes they had made to their lifestyle as a result of the cholesterol screening campaign.

RESULTS

A total of 12,067 people were screened in 1987; 9,046 of these were between the ages of 25 and 64, the age range most often used by the NHF and other official surveys for analysis. Only these participants will be considered here. Results were encoded through an "error mask" into

Table 1. Cholesterol levels at first screening.

| Cholesterol Level (MMOL/L) | Male | | Female | | Subtotal | |
|----------------------------|-------|--------|--------|--------|----------|--------|
| | N | %* | N | %* | N | %* |
| < 3.50 | 173 | 4.8 | 174 | 3.2 | 347 | 3.8 |
| 3.50–4.49 | 656 | 18.3 | 1,059 | 19.4 | 1,715 | 19.0 |
| 4.50–5.49 | 1,343 | 37.5 | 1,942 | 35.5 | 3,285 | 36.3 |
| 5.50–6.49 | 907 | 25.3 | 1,447 | 26.5 | 2,345 | 26.0 |
| 6.50–7.49 | 362 | 10.1 | 583 | 10.7 | 945 | 10.4 |
| 7.50–8.49 | 97 | 2.7 | 177 | 3.2 | 274 | 3.0 |
| 8.50+ | 40 | 1.1 | 86 | 1.6 | 126 | 1.4 |
| Subtotal | 3,578 | 100.00 | 5,468 | 100.00 | 9,046 | 100.00 |

*The percentages may not add to 100 because of rounding.

an Open Access Database and analyzed using SAS on an NEC-APC IV computer (16).

The sample consisted of 60% females and 40% males; average age was 47; 30% reported having a previous cholesterol test. The mean blood total cholesterol was 5.36 mmol/L SD 1.19 (207 mg/dL SD = 46). For males the mean was 5.32 mmol/L SD = 1.16 (205 mg/dL SD = 42); 39% were above the 5.5 mmol/L (213 mg/dL) level and 13% of this total group had levels above 6.5 mmol/L (251 mg/dL). For females the mean was 5.39 mmol/L SD = 1.12 (208 mg/dL SD = 43); 42% were above the 5.5 mmol/L (213 mg/dL) level and 15% of this total group had levels above 6.5 mmol/L (251 mg/dL). The frequency distribution for the whole sample is shown in Table 1. Nearly half the sample was over 25 BMI (the Australian guideline for overweight (17)), 79% said they did not exercise regularly, and 18% said they were under treatment for hypertension. Sixteen percent of the sample were smokers. Comparisons of North Coast results with Australian national averages (18) indicate that the sample group had slightly lower cholesterol and slightly higher BMI levels. Self-reported smoking and exercise levels suggest that this group may be more "health conscious" than the Australian community at large.

The 3,699 participants with initial levels above 5.5 mmol/L (213 mg/dL) were invited for a retest. A total of 2,183 (59%) returned for the second test. In 76% of these, cholesterol levels were lower than at the initial screening and BMI values were lower in 65%. The average reduction for cholesterol was 9.9% and for BMI the average reduction was 1.9% (see Table 2). In correcting the observed 9.9% cholesterol reduction for the effects of regression towards the mean, 8.0% was shown to be attributable to the cholesterol screening campaign; regression accounting for the other 1.9%, using the method of Gardner and Heady (19) with a 5% coefficient of variation (20).

The telephone survey of 100 participants who attended the retest indicates that 93% remembered the dietary advice and 84% reported actually changing their diet. Sixty-eight percent said they had switched to low-fat

dairy products, 50% said they had reduced their meat consumption, and 34% reported eating more fruit and vegetables.

There were no significant demographic differences between the population with "raised blood cholesterol" who returned for the retest and those who did not return. The only detectable differences were in gender ratio and age, such that the "return group" consisted of 4% more females and persons, who were, on average, 1.9 years older than those who did not return.

DISCUSSION

A number of studies support the relationship between elevated blood cholesterol levels, atherosclerosis and CHD (21–24). The Lipid Research Coronary Prevention Trial (which used cholestyramine and diet) showed that lowering blood cholesterol levels will reduce the risk of CHD (7). In Australia, Plant and associates (25) have argued that even a 5% sustained reduction in cholesterol levels will save \$5.4 million a year in medical costs (1987 costs) for heart disease in New South Wales alone. These data provide a strong impetus for a large-scale, community-based strategy to reduce the "mass hypercholesterolemia" prevalent in the Australian population.

Present study results show that participants in the North Coast Cholesterol Check Campaign did reduce their total cholesterol level and their BMI. The retest group had an 8% reduction in mean blood cholesterol and a 2% reduction in BMI. It could be misleading to assume these changes were due to the screening/counseling intervention alone, without addressing possible errors in cholesterol sampling and the possibility of response bias due to non-representative self-selection from the general population.

Previous studies (26–28) have shown that the Boehringer Mannheim Reflotron System that was used in this intervention is accurate and precise when used according to the manufacturer's guidelines. Registered nurses who had completed a training program in the use of the Re-

Table 2. Cholesterol and BMI changes: Retest group mean scores.

| | 1st Screening | 2nd Screening | Change | 95% CL | p * |
|-------------------------|------------------|------------------|--------|------------|---------|
| Cholesterol (mmol/l) | 6.49 | 5.84 | 0.64 | 0.60–0.68 | < 0.001 |
| BMI | 25.55 | 25.05 | 0.50 | –0.46–0.54 | < 0.001 |

(- Paired t test)

N = 2183
Age 25-64

flotron were used to take and analyze all blood samples. A separate study conducted during the campaign indicated that the Reflotron operators were able to achieve a high degree of accuracy in the tests (29). (Cholesterol levels obtained on the Reflotron during the screening showed a high correlation with laboratory assays; $r = 0.92$, $p < 0.05$.)

Although three different lot numbers of reagents were used during the campaign, variability between lot numbers was minimal. Part of the strict quality control regime, attended on a daily basis, was the testing of the reagent in use. The daily log book shows only minimal variance between the lot numbers, which would not be significant enough to account for any of the observed change.

An 8% reduction of cholesterol levels in a large retest sample is, in itself, substantial for a public screening and education program (30–32). However, attendance both at the initial and retest screenings was dependent on self-selection. The possibility of response bias must therefore be considered before making any inference about the population at large. Conclusions concerning the initial sample are slightly biased towards older females, as this screening included 9% more females than would be expected from a random sample of the North Coast population, and the 25–35 year category had only one-third the expected number of males and two-thirds the expected number of females.

In the retest sample, with a 59% attendance rate, there was no detectable bias in the age/sex profile when viewed as a random selection of the participants requested to attend. Furthermore, in the phone survey of 100 participants who had failed to attend their retest, only three reported that they had stopped their diet and did not want to come, that they felt the retest was unnecessary or that they were on their own program; four reported that they had no reason for not attending. All others gave "valid" reasons for non-attendance (31 on holidays, 25 now seeing own physician, 18 had other appointments, 16 were not notified, 2 were sick, and 1 pregnant). Although data from the phone survey is questionable because of its subjective nature, it is consistent with the other indicators of minimal response bias in this program. One further indicator of minimal response bias is that among those who did return for retest, 24% actually had

levels above those recorded at the initial screening. There is thus little evidence that those who returned did so only to report a triumph.

It therefore seems apparent that this significant reduction in mean total cholesterol and BMI is attributable to the intervention. Previous screening and counseling interventions have reported mean blood cholesterol changes of between 3% and 15% (30–35). Nestle (36) reports that a good response to dietary modification is 10%; Ernst and Cleeman (37) suggest that a 10–15% reduction can be observed in three months if the individual maintains the dietary modifications. While these reductions might require more intense dietary counseling than this study's ten minute sessions, it is believed that a minimum 7% reduction should be achievable in intervention programs of a similar nature. It is likely that diffusion of the "Eat Less Fat" messages within the community and improved counseling of the "risk" group will improve blood cholesterol reduction in successive interventions.

CONCLUSIONS

The results of this campaign demonstrate that it is possible to effectively screen, counsel and follow-up large numbers of people, relatively quickly and inexpensively, in a community-based intervention. It is heartening to note that interventions trialed in the USA can be replicated in other developed nations with similar results.

This study also indicates that voluntary testing in community settings can help to identify a large percentage of moderate and high risk persons (41% in this study), and make them more aware of the relationship between elevated blood cholesterol levels, the risk of CHD, and the importance of reducing the amount of fat in their diet. As Rose (38) has so strongly emphasized, the great disadvantage of a "high-risk" strategy alone is that it ignores the relationship between lifestyle characteristics and social norms, and it ignores the fact that the greatest number of cardiovascular cases come from the population with moderately elevated risk. Rose (39) recommends a population-based approach aimed at reducing the distribution of the risk variable in all who participate. The present approach combines a population-based strategy

with counseling for those at high risk. The result appears to be both far-reaching and cost effective.

In addition, it is believed this intervention was successful because of a combination of factors: the screening/counseling event was easily accessible to the public and it provided quick feedback for a low cost. For those who required counseling, the message was simple and direct: behavioral steps were provided to guide the person towards the recommended goal, and a second test was offered to monitor progress.

It appears that on-site analysis, using a dry chemistry analyzer, in conjunction with immediate dietary counseling provided strong motivation for a significant number of this population to make health-enhancing changes in their diets.

In the next phase of the NCCCC the retest will be conducted three months after the first test; three months is judged to be an optimum time for behavior change and a maximum time for a high recall percentage (37, 40). Follow-up tests will also be conducted at 12 months for a stratified sample of the original screening population to estimate long-term maintenance of dietary change. A parallel study using a control group will provide a precise measure of the possible effect of regression towards the mean.

In conclusion, the major findings of this study are: it is possible to screen the blood cholesterol levels of large numbers of people; when this is combined with brief dietary counseling and a retest within four months, community members will make significant reductions in their cholesterol and BMI levels. As Plant and associates (25) have pointed out, "there is a need to actively support programs that are aimed at lowering cholesterol levels." The North Coast Cholesterol Check Campaign demonstrates the feasibility and effectiveness of community-based nutrition education programs for reducing the risks of cardiovascular disease.

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RESUME Ce rapport indique les résultats d'un programme communautaire d'éducation en nutrition visant à réduire les taux sanguins de cholestérol par la diminution de gras total dans l'alimentation. L'intervention regroupait le dépistage du cholestérol, la consultation diététique, les références de cas et le suivi.

L'examen du taux de cholestérol total dans le sang selon la méthode Boehringer Mannheim Reflotrons a été réalisé dans 52 endroits publics différents pendant une période de trois mois et demi sur la Côte Nord du New South Wales, Australie en 1987. Des équipes mixtes de personnel de la santé et de bénévoles de la communauté ont examiné 9046 participants de 25 à 64 ans. L'âge moyen était de 47 ans, 60% étant des femmes et le taux moyen de cholestérol sanguin de 5,36 mmol/l (207 mg/dl). Les fumeurs constituaient 16% de l'échantillon et près de la moitié avait un indice de masse corporelle (IMC) supérieur à 25. Soixante-dix pour cent des participants n'avaient jamais subi d'examen de leur cholestérol sanguin auparavant

tandis que seulement 11% de l'échantillon connaissait son taux de cholestérol. On a dénombré 2354 (26%) cas à risque modéré et 1345 (15%) cas à risque élevé. Les participants présentant un taux de cholestérol sanguin supérieur au taux recommandé de 5.5 mmol/l (213 mg/dl), soit 41% ont bénéficié d'une brève séance de consultation diététique.

Le suivi après quatre mois, effectué auprès de 2183 participants ayant obtenu une consultation, a révélé un taux inférieur de cholestérol chez 76% d'entre eux tandis que l'IMC était moins élevé pour 65% des cas. Le pourcentage de diminution moyenne s'élevait à 8% pour le cholestérol après ajustement de la régression vers la moyenne et à 2% pour l'IMC. Parmi les 84% de participants réexaminés ayant mentionné avoir réduit leur apport en gras dans leur alimentation, 68% ont choisi des produits laitiers plus faible en gras, 50% ont diminué leur consommation de viande et 34% ont augmenté leur consommation de fruits et légumes. Notre expérience démontre l'efficacité possible de l'impact d'un dépistage associé à la consultation diététique dans la communauté sur le comportement alimentaire, ce qui pourrait réduire les risques de maladie cardio-vasculaire.

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RESUMEN En este artículo se reportan los resultados de un programa en comunidad de educación nutricional, para bajar los niveles de colesterol via reducir el consumo de grasa en la dieta. La intervención dirigida al público en general, incluyó la detección de personas con altos niveles de colesterol, orientación dietética, referencia y seguimiento. La detección de niveles totales de colesterol usando el método de "Boehringer Mannheim Reflotrons" se realizó en 52 lugares públicos, durante tres meses y medio, en las Costa Norte de New South Wales, Australia, en 1987. Equipos de personal de salud y voluntarios de la comunidad muestrearon 9,046 participantes entre los 25 y los 64 años de edad. La edad promedio fue de 47 años, 60% fueron mujeres, y el nivel promedio de colesterol fue de 5.36 mmol/L (207 mg/dL). Mientras solo un 16% fueron fumadores, casi la mitad de la muestra tuvieron un índice de masa corporal (BMI) de 25. 70% de la muestra reportaron no haber hecho pruebas de colesterol previas, solo un 11% tenía conocimiento de su nivel de colesterol. Un total de 2,345 (26%) se encontraron con riesgo moderado y 1,345 (15%) con de alto riesgo. Una breve consulta dietética fue llevada a cabo con 41% del grupo con colesterol sobre el límite recomendado de 5.5 mmol/L (213 mg/dL). En el seguimiento a los cuatro meses con 2,183 de estos individuos, se encontro que el nivel de colesterol disminuyó en 76% de los participantes, y el BMI también fue menor en 65%. El promedio de colesterol en sangre se redujo en un 8% despues de corregir para la regression al promedio, así mismo, la reducción en BMI fue del 2%. Los participantes a quienes se les repitió la prueba, reportaron modificaciones a sus hábitos de alimentación: 84% redujeron el consumo de grasa, 68% cambiaron a productos lácteos bajos en grasa, 50% disminuyeron su consumo de carne, y 34% incrementaron su consumo de frutas y verduras. Nuestra experiencia muestra que un proyecto de detección con base en la comunidad, con una orientación dietética fue capaz de producir cambios en los hábitos y conductas alimentarias del público y reducir el riesgo de enfermedad cardiovascular.

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