The value of a woman's life, and a cost-benefit analysis of mass-screening for cancer of the breast and cervix (*)

by

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INTRODUCTION

"A Pig in a Poke"

Under normal circumstances no person or company will invest their money without making sure that there is a good chance of getting more out of their investment than they put in. In other terms, the predicted ratio of benefits to costs, called the benefit:cost ratio, must be greater than unity before the investment is approved. When funds to invest are scarce, the threshold value rises higher than unity.

(*) This article is a summary of the economic aspects of a Ph. D. thesis defended in 1982 at the School of Public Health of the Université Libre de Bruxelles. The author wishes to thank Prof. E.-S. Kirschén (DULBEA, ULB) and Dr. Y. Fassin (Directeur, C.D.J.B.) for their unfailing help and direction during the preparation of the aforesaid thesis.
The ever-increasing deficit in the public sector in Belgium and many other countries, and the prolonged international economic crisis makes imperative the establishment of a system of priorities in public-spending. The most logical approach would be to invest only in the most advantageous projects as ordered by their benefit:cost ratios.

As the situation stands most directors of public health projects are hard put to justify the cost of their own project in the face of rivalry from other public health projects, and from non-health-orientated public projects. How is one to decide between programmes concerning cancer-detection, vaccination, health-education, or medical research?

How is one to decide between any of these and constructing a bridge or motorway?

The difficulty arises from the non-monetary nature of the benefits of public-health programmes, these generally concerning human lives and health.

Projects whose benefit concerns essentially savings in human lives may be ordered in terms of cost per life saved. This cost-effectiveness approach, however, still does not enable one to decide, for example with an ordered list of 20 projects, whether one should go ahead with the best one, two, three, five, ten or even all twenty projects. Nor does it allow one to decide between projects involving savings in human lives and projects involving savings in time or improvement in health and quality of life.

What is lacking in an accepted estimation of the monetary value of life and good health. It is evident that societies in general do not place an infinite value on human life, as witnessed
by the continuing existence of war, murder, suicide and
starvation. More simply, in a given society, not all spending
is health-orientated, the health budget being limited and its
level reflecting the collective concern for good health.

Once an estimate of the value of human life and health is
accepted, then it becomes possible to judge the acceptability
of individual public-health projects, and to compare different
projects whose returns are of a widely differing nature.

In this context, the following pages will attempt to estimate
the benefit, in terms of premature deaths avoided, of the mass-
screening for breast and cervical cancer carried out by the
Clinique de Dépistage Jules Bordet (CDJB) from 1964-1978. An
estimation of the monetary value of these premature deaths
avoided will be made and compared with the relevant costs to
form the benefit:cost ratio of the screening programme.

It is hoped that this Cost-Benefit analysis will provide a
sufficiently sound basis for making recommendations concerning
the future mass-screening at the CDJB. (The question of the
monetary value of good health will not be considered).

A. THE CLINIQUE DE DEPISTAGE JULES BORDET (C.D.J.B.)

Every year in Belgium some 2000 women die of breast cancer
and 250 die of cervical cancer. The probability that a woman
with cancer will be treated successfully depends primarily upon
how early the cancer is detected. Briefly, if the cancer is
found at an early, localised stage the prognostic is much more
favourable than if the cancer has started to spread beyond its
point of origin, eventually to other organs. Mass-Screening
increases the chances of catching a cancer early and in 1964 a
number of University screening centres were created, amongst
which the C.D.J.B.

During the period 1964-78, the C.D.J.B. received 111,663 visits from women aged essentially between 20 and 75, of which 48,666 were from women visiting for the first time (1st visits) and 62,997 from women having already visited at least once (Re-visits). Approximately 1/3 of these examinations took place at the woman's work. Since 1970, because of the low rate of detection of cancer amongst young women, only women over 30 are encouraged to visit the C.D.J.B.

During the examination, which lasts from 10 to 20 minutes and is free of charge to the visitor, a doctor examines the visitor's breasts, visually and by palpation, and her cervix, visually and tactiley, and taking a Papanicolaou smear-test.

The woman is examined briefly for other cancers, notably of the skin, thyroid and digestive system, and frequently non-cancerous anomalies are brought to light. The woman's personal and medical antecedents are also considered.

A small proportion of women, perhaps 1 in 8, are invited to submit to a supplementary examination of the breast (by X-ray mammography) or cervix (by colposcopy). A positive diagnosis of breast or cervical cancer, confirmed by biopsy, occurs in 4 out of 1000 visits. Between 1964 and 1978, 205 cancers of the breast and 190 cancers of the cervix were discovered. 96 cases of other sorts of cancer and a large number of non-cancerous anomalies were also discovered.
B. THE COSTS AND THE BENEFITS OF SCREENING AT THE C.D.J.B. 
(1964-78)

1. The costs

Fig. 1 gives the C.D.J.B.'s costs for 1978, a year for which detailed accounts are available. These costs are divided into 4 vertical categories (Consultations, Laboratory, Administration and Total), each of which are sub-divided into those costs related to breast screening and those related to cervical screening.

Seven horizontal categories are distinguished, concerning the Medical, Para-Medical and Administrative Personnel, Diverse Expenditures, Rent and Overheads, Mammographies and Colposcopies, and Time Lost. This latter estimates the economic value of the time spent in travel, waiting and examination (113 minutes), and represents 16 % of the total cost. Each hour "lost" is evaluated according to the average hourly gross wage-rate of women of different ages. The CDJB accounts cover only Personnel and Diverse Expenditures. The Rent and Overheads (heating etc.) are paid for by the U.L.B., and the cost of the mammographies and colposcopies is met by the belgian national health-insurance organisation, the INAMI.

Fig. 2 presents the total cost for the period 1964-78, together with the average cost per visit and per cancer discovered. The cost is divided between that related to first visits and that related to re-visits, and between that related to breast screening and that related to cervical screening.

Thus, the overall cost was 109 million FB 1971 (1 FB 1971 = 2 FB 1980). Each visit cost 977 FB 1971, of which 438 FB 1971 (45 %) concerned breast screening and 540 FB 1971 (55 %) concerned cervical screening.
Fig. 1: Detailed Costs for Mass-Screening at the CDJB 1978, in Thousands of FB. 1978

<table>
<thead>
<tr>
<th></th>
<th>Consultations</th>
<th>Laboratory</th>
<th>Administration</th>
<th>Total</th>
<th>% of Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Breast (1)</td>
<td>Cervix (2)</td>
<td>Cervix (4)</td>
<td></td>
<td>(11) = (10) x 100</td>
</tr>
<tr>
<td></td>
<td>(3) = (1)+(2)</td>
<td>(5)</td>
<td>(6)</td>
<td>(7) = (5)+(6)</td>
<td>(8) = (1)+(5)</td>
</tr>
<tr>
<td>1. Medical Personnel</td>
<td>1148</td>
<td>1147</td>
<td>2295</td>
<td>556</td>
<td>1148</td>
</tr>
<tr>
<td>2. Para-Medical Personnel</td>
<td>722</td>
<td>722</td>
<td>1444</td>
<td>1094</td>
<td>722</td>
</tr>
<tr>
<td>3. Administrative Personnel</td>
<td>503</td>
<td>1466</td>
<td>1466</td>
<td>2932</td>
<td>1466</td>
</tr>
<tr>
<td>4. Diverse Expenditures</td>
<td>118</td>
<td>251</td>
<td>369</td>
<td>128</td>
<td>281</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>399</td>
</tr>
<tr>
<td>5. Rent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>543</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Overheads</td>
</tr>
<tr>
<td>6. Mammographies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1370</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Colposcopies</td>
</tr>
<tr>
<td>7. Time Lost</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1300</td>
</tr>
<tr>
<td>TOTAL 1.- 7.</td>
<td>7313</td>
<td>8875</td>
<td>16188</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Fig. 2: Total Cost of Mass-Screening at the CDJB 1964-78, Cost per Visit, and Cost per Case of Cancer Discovered

<table>
<thead>
<tr>
<th></th>
<th>1st Visits</th>
<th>Re-Visits</th>
<th>All visits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Cost: Breast</strong></td>
<td>21,300,000</td>
<td>27,500,000</td>
<td>48,900,000 FB. 1971</td>
</tr>
<tr>
<td><strong>Cervix</strong></td>
<td>26,300,000</td>
<td>34,000,000</td>
<td>60,300,000 FB. 1971</td>
</tr>
<tr>
<td><strong>Breast + Cervix</strong></td>
<td>47,700,000</td>
<td>61,500,000</td>
<td>109,100,000 FB. 1971</td>
</tr>
</tbody>
</table>

| **Total Cost: Breast per visit** | 438 | 438 | 438 FB. 1971 |
| **Cervix** | 540 | 540 | 540 FB. 1971 |
| **Breast + Cervix** | 977 | 977 | 977 FB. 1971 |

| **Cost per Case of Cancer Discovered**: Breast | 174,000 | 324,000 | - FB. 1971 |
| **Cervix** | 183,000 | 629,000 | - FB. 1971 |

2. The benefits

As far as this article is concerned, the only benefits from mass-screening concern the savings in lives, years of life and their value that result from the discovery of breast and cervical cancers at an earlier, less fatal stage of development than that at which they would otherwise have been discovered.

Certain minor benefits are considered in Goss (1982), concerning:

- The discovery of Non-Cancerous anomalies during mass-screening.
- The discovery of cancers other than of the breast or cervix during mass-screening.
- The replacement of mammectomies by tumorectomies as a result of early-detection by mass-screening, causing a certain number of breasts to be preserved relatively intact.

- The replacement of hysterectomies by conisations as a result of early-detection by mass-screening, causing a certain number of uteri to be preserved.

- The reduction in treatment costs as a result of early-detection by mass-screening.

Mass-screening may also have some negative effects. For example it increases the number of in situ cervical cancers detected and treated that would not have become invasive even in the absence of treatment and thus increases the amount of unnecessary surgery.

Breast screening may increase the number of operations to remove benign lesions (Miller 1978). Miller also points out the possibility of an early diagnosis only increasing the period of anxiety, and of mass-screening leading to false reassurance.

Similarly a large number of screened women may suffer anxiety while waiting to see if the screening is negative or not. As the results of the cervical smear are not communicated if negative, and as a number of women are recalled for supplementary examinations which eventually prove negative, this period of anxiety may be prolonged.

Finally X-ray mammographies may induce cancer as well as detect it (Bailar 1976, Eddy 1980a), though this effect is less important for the screening performed at the CDJB, as only 7% of visitors are given mammographies.

The estimation of the benefit of mass-screening is both
controversial and complex, involving many "ifs" and "butts". For a complete discussion of how the benefits presented in this article were estimated, the reader is referred to Goss (1982).

Briefly, the benefit was estimated by considering what would have happened to those women whose cancer was discovered at the CDJB had the CDJB not existed. When diagnosed, cancers may be classified into five different stages of development, stages 0 to IV, stage 0 being the least advanced, least fatal stage, and stage IV being the most advanced, most fatal stage. The distribution of the cancers discovered during mass-screening at the CDJB amongst these 5 stages is known, and is called the screened stage-distribution.

Without screening it is assumed that these women would have had their cancers discovered on average at a more advanced stage-distribution, the "had-they-not-been-screened" stage-distribution, corresponding to the stage-distribution of those cancers not discovered at mass-screening centres (i.e. amongst the population in general, the vast majority of cancers in Belgium not being discovered at screening centres).

Thus, knowing the stage-related survival curves, comparing the screened and the "had-they-not-been-screened" stage-distributions enables one to estimate the net benefit of screening, in terms of lives saved.

Knowing the ages of the women in question, and taking into account the delay between the moment their cancer was discovered at screening and the moment they would have died had they not been screened one may estimate the number of years of life saved.

Figs. 3 and 4 show that for breast and cervical cancer, more cases of cancer and more cases of cancer per 1000 visits are found
during the first visit than during subsequent visits (Re-visits). On the other hand the stage-distributions for both breast and cervical cancer are more favourable for the cases found during re-visits. To what extent is the improvement in the quality of the cases found during re-visits counterbalanced by the lower number of cases found per visit? The answer is given in figures 4 and 5, which present the estimated benefit in terms of the number of premature deaths avoided and the number of years of life saved.

Thus, in spite of there being less cases of breast cancer found during re-visits than during 1st visits (85 versus 123, see fig. 3), more premature deaths are avoided (10.3 versus 4.2, see fig. 4) and more years of life saved (255 versus 107, see fig. 5) during re-visits, as a result of the improvement in the stage-distributions.

The opposite is true for cervical cancer. Less cases of cervical cancer were found during re-visits than during 1st visits (54 versus 144, see fig. 3), but also less premature deaths were avoided (7.7 versus 16.6, see fig. 4) and less years of life were saved (161 versus 412, see fig. 5).

Examining the marginal totals in figs. 4 and 5, it is seen that cervical screening avoids more premature deaths and saves more years of life than breast screening. Similarly first visits gave a greater benefit than re-visits.

These results however do not take into account the number of visits in each category of screening, nor the difference in cost between breast screening (438 FB 1971 per visit) and cervical screening (540 FB 1971 per visit, see fig. 2). These two factors are taken into account when one calculates the cost per life saved and the cost per year of life saved (see figs. 7 and 8),
which is a cost-effectiveness analysis.

Thus, looking at the marginal totals for fig. 8, it is seen that cervical screening is more cost-effective than breast screening (105,000 FB 1971 per year of life saved versus 135,000 FB 1971), and first visits are more cost-effective than re-visits (92,000 FB 1971 per year of life saved versus 148,000 FB 1971). More particularly, the most cost-effective category concerned a first cervical screening (64,000 FB 1971 per year of life saved), followed by breast re-screening (108,000 FB 1971 per year of life saved), breast first screening (200,000 FB 1971 per year of life saved) and lastly cervical re-screening (212,000 FB 1971 per year of life saved).

Figs. 3-8: Parameters relevant to the cost-effectiveness analysis of the screening performed at the CDJB 1964-78
(1 FB 1971 = 1.95 FB 1980)

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**Fig. 3:** The No. of Cases of Cancer Discovered

<table>
<thead>
<tr>
<th></th>
<th>1st visits</th>
<th>Re-visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast</td>
<td>123</td>
<td>85</td>
</tr>
<tr>
<td>Cervix</td>
<td>144</td>
<td>54</td>
</tr>
</tbody>
</table>

**Fig. 4:** The No. of Cancer Discovered per 1000 visits

<table>
<thead>
<tr>
<th></th>
<th>1st visits</th>
<th>Re-visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast</td>
<td>2.53</td>
<td>1.35</td>
</tr>
<tr>
<td>Cervix</td>
<td>2.96</td>
<td>0.85</td>
</tr>
</tbody>
</table>
Fig. 5: The No. of Premature Deaths Avoided

<table>
<thead>
<tr>
<th></th>
<th>1st visits</th>
<th>Re-visit</th>
<th>All visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast</td>
<td>4.2</td>
<td>10.3</td>
<td>14.5</td>
</tr>
<tr>
<td>Cervix</td>
<td>16.6</td>
<td>7.7</td>
<td>24.3</td>
</tr>
<tr>
<td>Both cancers</td>
<td>20.7</td>
<td>18.1</td>
<td>38.8</td>
</tr>
</tbody>
</table>

Fig. 6: The No. of Years of Life Saved

<table>
<thead>
<tr>
<th></th>
<th>1st visits</th>
<th>Re-visit</th>
<th>All visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast</td>
<td>107</td>
<td>255</td>
<td>362</td>
</tr>
<tr>
<td>Cervix</td>
<td>412</td>
<td>161</td>
<td>572</td>
</tr>
<tr>
<td>Both cancers</td>
<td>519</td>
<td>415</td>
<td>934</td>
</tr>
</tbody>
</table>

Fig. 7: The Cost per Life Saved, in millions of FB 1971

<table>
<thead>
<tr>
<th></th>
<th>1st visits</th>
<th>Re-visit</th>
<th>All visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast</td>
<td>5.1</td>
<td>2.7</td>
<td>3.4</td>
</tr>
<tr>
<td>Cervix</td>
<td>1.6</td>
<td>4.4</td>
<td>2.4</td>
</tr>
<tr>
<td>Both cancers</td>
<td>2.3</td>
<td>3.4</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Fig. 8: The Cost per Year of Life Saved, in thousands of FB 1971

<table>
<thead>
<tr>
<th></th>
<th>1st visits</th>
<th>Re-visit</th>
<th>All visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast</td>
<td>200</td>
<td>108</td>
<td>135</td>
</tr>
<tr>
<td>Cervix</td>
<td>64</td>
<td>212</td>
<td>105</td>
</tr>
<tr>
<td>Both cancers</td>
<td>92</td>
<td>148</td>
<td>117</td>
</tr>
</tbody>
</table>

However these values do not distinguish between the 20th year of life of a woman and the 90th year of life of a woman. Are they equal in value? Nor do they distinguish between a year of life saved now, i.e. a short-term benefit, and a year of life saved 10 or 20 years from now, i.e. a long-term benefit. Finally these values do not enable us to decide whether or not to continue with mass-screening.

Is a woman's life worth more or less than 1.6 million FB 1971, as with first cervical screenings (1 FB 1971 = 2 FB 1980)? Is 5.1 million FB 1971 too much to pay for a woman's life, as with first breast screenings?
To answer these questions it is necessary to introduce the
notion of the economic value of human life.

C. THE ECONOMIC VALUE OF AN AVERAGE WOMAN’S LIFE IN BELGIUM

Since 1930, when Dublin and Lotka published the first major
work on "The money value of man", no two authors seem to have
proceeded in exactly the same manner in setting a value on human
life (see Reynolds (1956), Abraham & Thedié (1960), Fromm (1965),
Dawson (1967, 1970), Akehurst & Culyer (1974), Ghosh, Lees and
Seal (1975), Usher (1975), Dreze (1962), Schelling (1968), Mishan
Raffia (1969), Pliskin, Shepard & Weinstein (1975) and Weinstein
et al. (1980).

Two papers by Mishan (1971) and Jones Lee (1976) review the
important previous publications and attempt to put some order
into the existing state of affairs in defining a solid theore-
tical basis for adopting one approach. The approach used in this
study is based more particularly on Jones-Lee's analysis.

1. The Losses Resulting From Premature Deaths

The benefit accruing from many public health projects,
including mass-screening for cancer, is generally a reduction in
the risk of premature death for a certain population, in this
study the screened population. Some premature deaths will be
avoided but it is not known in advance whose.

Jones-Lee distinguishes three losses resulting from premature
deaths:

1) Real Resource Costs involved with premature death; this
   concerns, for example, legal and medical expenses relating
to premature deaths from different causes.
2) Loss of net output; an adult’s output or economic production on average exceeds his or her consumption, and his or her premature death deprives society of the net output corresponding to the years of life lost.

3) Non-economic losses; this concerns for example the emotional loss to the family of the deceased person.

The value of the life of an unidentified person (woman in this study) of a given age is the sum of these three losses that would result from her premature death, as evaluated for an average woman of that age.

Jones-Lee argues that 1) and 2) may be evaluated directly, but that a well-founded estimate for 3) would have to result from many years of theoretical and practical work along the lines that he and Mihan advocate. Substitute evaluations for 3) are therefore used in this study.

The evaluation of each of these component losses is discussed in detail below.

a) Real Resource Costs Involved with Premature Death

These costs may depend to a great extent upon the cause of the premature death. In the case of a road accident death they include vehicle damage, damage to other physical objects, police and ambulance costs, administration and legal costs, medical expenses and funeral expenses, and the overall total may be relatively important. In the case of death from breast or cervical cancer they are essentially limited to medical and funeral expenses. The importance of the medical expenses is significantly limited in the case of a premature death from breast or cervical cancer avoided by mass-screening, due to the fact that the mass-screened
patient must also undergo medical treatment.

One must thus only consider the difference between the medical expenses of a woman with breast or cervical cancer discovered by mass-screening who survives, and the medical expenses of a woman with a breast or cervical cancer not discovered by mass-screening who does not survive.

As it is intended to derive a value for the average woman’s life that is independent of the cause of death, this difference in medical expenses that is specific to premature deaths avoided by mass-screening will not be included in the evaluation of women’s lives in this chapter, but is treated elsewhere (see Goss (1982)).

The only real resource costs common to all premature deaths are funeral expenses. In 1971 these amounted to about 20,000 FB for an average funeral, an amount negligible in comparison to the hundreds of thousands or the millions of FB relating to the losses 2) and 3) as described below. Furthermore, a person whose premature death is avoided now will have to be buried anyway at the end of their natural lifetime. Therefore the funeral costs really incurred by a premature death in 1971 would be 20,000 FB 1971 minus the discounted costs of the funeral that would have taken place at the end of the person’s natural lifespan.

For these reasons the real resource costs relating to a premature death from breast or cervical cancer will not be considered in the evaluation of the average woman’s life in this chapter.

b) The Loss of Gross and Net Output

For the moment, the average woman’s gross output will be
considered for three categories of women.
- unemployed women under 60 years of age, not gainfully employed
- women 60 years of age and over
- employed women under 60 years of age.

It is evident that unemployed women are not idle, even though
their production is not measured or included in the calculation
of the G.N.P..

The most recent major study of the belgian woman's time budget
is that of Javeau (1966). His estimation of the time spent by
unemployed women on household chores gives a total of 8 hours 2
minutes per workday and 4 h 27' per Sunday, making a total of
52 h 39' per week, or 52,65 h. per week.

The value placed on housework performed by unemployed women is
a subject of controversy, and in this study we will follow the
opinion that this work should be evaluated at the same hourly
rate as that of a hired household help or "daily". In 1971, the
base year for this study, the average wage-rate for a daily in
the region of Brussels was 55 FB/hour (estimated from local en-
quiry).

Thus one year's housework by an unemployed woman under 60 is
evaluated by multiplying this hourly wage-rate by the number of
hours worked per year, counting 50 full weeks per year giving :

Value of one year's housework =
55 x 50 x 52,65 = 144,787.5 FB 1971

In this study all women over 60 years of age shall be consi-
dered as being unemployed, their only production therefore con-
cerning the housework they perform.
As these women age, their production in terms of housework diminishes. To establish an accurate estimate of the production as a function of age would be beyond the scope of this study, and the following approximation will be used. The number of hours of housework will be assumed to diminish linearly with age from 52 h 39' per week (see above) at the age of 60, to zero at the age of 89. The value placed on these hours of housework will be the same as for unemployed women under 60 years of age, i.e. 55 FB 1971/Hour.

In a year, the average employed woman’s gross output is given by the sum of:

1) Her gross output relating to her employment, as given by her gross earnings plus patronal social security (ONSS) contributions.

2) Her gross output relating to the housework she performs outside the period of her employment, not all employed women performing a full year’s work in a given year (52.65 h. housework per unemployed week, evaluated at 55 FB 1971/hour, as for unemployed women under 60).

3) Her gross output relating to the housework she performs during the period of employment (23.18 h per working week, from Javeau (1966), evaluated at 55 FB 1971/hour).

The Office National des Pensions pour Travailleurs Salariés (ONPTS) publishes the total of the earnings of all Belgian women having exercised a paid profession for at least one day in the year in question, together with the number of days worked, for each year of age, and for the two professional categories "ouvrières" and "employées".

The earnings concern gross earnings, not including patronal
ONSS contributions. The gross output is measured by the gross earnings, patronal ONSS contributions included, these latter being estimated as being a fraction (0.262 for "ouvrières" and 0.163 for "employées" of the gross earnings (patronal ONSS contributions excluded). The derivation of the two coefficients 0.262 + 0.163 is explained in Goss (1982).

The total output of independent workers ("indépendantes") is not known. The average output of "employées", "ouvrières" and "indépendantes" combined is estimated in this study as being 10% higher than the average output for "employées" and "ouvrières" combined, as calculated from the ONPTS statistics.

The average woman’s gross yearly output is calculated for women of each year of age on the basis of 1971 figures, chosen as being central to the 1964-1978 screening period. The average gross output of women under 60 years of age is taken as being the combined average output of both employed and unemployed women, weighted according to the number of women with a breast or cervical cancer discovered at the CDJB that were employed at the time of their first visit, and to the number that were unemployed, being 191 and 132 respectively.

From this average gross yearly output for women of different ages in calculated the average hourly output, on the basis of 8 hours per day and 260 days per year. This average hourly output is used to evaluate the time lost in relation to the 111,663 visits to the CDJB (1964-1978).

The average woman’s total discounted gross lifetime output (TDGLO) may thus be calculated for a woman aged $a_0$ from the following parameters:
\[ V_a = \text{The average gross yearly output for a woman aged } a \]

(see above)

\[ p_a = \text{The probability of a woman aged } a \text{ surviving to age } a + \frac{1}{2} \]

\[ g = \text{The future rate of growth of the GNP per person per year} \]

\[ i = \text{The discount rate} \]

It is assumed that the average woman aged \( a_o \) now will produce in \( j \) years' time what the average woman now aged \( a_o + j \) produces, adjusting for future growth of production per person and discounting.

Thus the Total Discounted Gross Lifetime Output (TDGLO) of a woman aged \( a_o \), assuming that the output for women aged 90 and over is zero, is given by:

\[
\text{TDGLO} \quad a_o = \sum_{a=a_o}^{89} V_a \cdot p_a \cdot \left( \frac{1 + g}{1 + i} \right)^{a - a_o}
\]

The principal value of \( g \) used in this study, 2.8 %, is based on the 1979 publication of the OCDE's study group "Interfutures".

The principal value of \( i \) used in this study, 4.18 %, is based on the work of Kirschen et al. (1975).

In order to appreciate the sensitivity of the life values obtained to the values of \( g \) and \( i \) chosen, a second value of \( g \), 0 %, and two other values of \( i \), 7 % and 10 %, will also be used.

Up until this point, the discussion has concerned the estimation of the average woman’s total discounted gross lifetime output.

Part of this output is consumed by the woman herself. The rest constitutes the women's net output, reduced according to her
consumption of other people’s output (principally her husband’s). This net output is what is lost for society if the woman dies prematurely. However, as will be seen, her total consumption will constitute part of the non-economic loss to society, the woman herself included, that would result from her premature death, and will therefore be included in the calculation of her total discounted life value.

Thus as both constituents of her total discounted gross lifetime output, namely her net output and her personal consumption, are included in the estimation of her total discounted life value, it is not necessary in this study to calculate them separately. Details of how the separation might be made are given in Goss (1982).

c) The Non-Economic Losses Resulting From a Woman’s Premature Death

As remarked earlier, a well-founded estimate for these losses would have to result from many years of theoretical and practical work along the lines advocated by Jones-Lee & Mishan. For example, the **ex ante** willingness to pay for a reduction in the probability of dying does not necessarily correspond to the **ex post** willingness to pay. Nor is the willingness to pay necessarily linearly proportional to the magnitude of the reduction of the probability of dying. Therefore substitute estimations will have to be used in this study.

Three categories of people suffer non-economically from a woman’s premature death:

- The woman herself
- Those that know the woman (principally her family)
- Those that don’t know the woman.
The non-economic losses relating to these three categories of people are discussed below.

- The non-Economic Losses Suffered by Women As a Result of Their Own Premature Death

In this study the value of a woman's life is being considered in relation to mass-screening for cancer.

Money is being spent to avoid future deaths and society has to decide whether the losses avoided by mass-screening for cancer are worth the expenditure. As the women whose future deaths are in question are part of the society that has to decide whether to carry out mass-screening, it is logical to consider the value they themselves place on their own life as being part of the loss society would suffer if they died prematurely.

One may approach the problem of estimating the loss suffered by women with their own death in the following manner. The pleasures and non-pleasures of life may be divided into the following four categories:

i) Pleasures associated with economic consumption
ii) Non-Pleasures associated with economic consumption
iii) Pleasures not associated with economic consumption
iv) Displeasures not associated with economic consumption.

For example, certain expenditures are associated more or less entirely with pleasure, such as buying a new dress while the old ones are still wearable, or taking a holiday abroad. These expenditures would be placed in the category of pleasures associated with economic consumption (i)). Other expenditures are more associated with the avoidance of displeasure, such as
heating to avoid being cold. These expenditures make up the
cost of keeping oneself alive in minimum sufficient comfort,
in the context of the belgian society, and would be placed in
the category of non-pleasures associated with economic con-
sumption (ii)).

Some pleasures cost nothing, such as a beautiful day or
feeling good, and would be placed in the category of pleasures
not associated with economic consumption (iii)). Life also
counts many displeasures, such as exams, the non-financial as-
pects of illness, unhappiness or monotony, and these would be
placed in the category of displeasures not associated with
economic consumption (iv)).

The net non-economic pleasure of life is given by subtracting
the displeasures not associated with economic consumption from
the pleasures not associated with economic consumption (i.e.
(iii) - (iv)).

The total net pleasure of life is given by the sum of the
pleasures associated with economic consumption and the net non-
economic pleasures of life (i.e. (i) + (iii) - (iv)).

It is of course open to debate and entirely subjective as to
whether the total net pleasure of life is positive (1). The fact
that most people do not commit suicide, while not necessarily
implying that the total net pleasure of life is positive, sug-
gests that, on average, it is not more negative than a certain
threshold value after which suicide is preferable to living.

Assuming that the total net pleasure of life is on average

(1) "Is life worth living ? It depends on the liver" (N. Coward).
positive, the question then becomes "How Positive?".

Consider the assumption that the net non-economic pleasure of life is equal in value to the non-pleasures associated with economic consumption (i.e. \( (iii) - (iv) = (ii) \)). This may be an overestimation (a housewife for example has more than her share of drudgery) or it may be an underestimation. It has, however, the advantage of making the total net pleasure of life a quantity that one may estimate directly. Following this assumption the total net pleasure of life is given by the sum of the pleasures associated with economic consumption and the non-pleasures associated with economic consumption, this latter quantity replacing the net non-economic pleasures of life (i.e. \( (i) + (iii) - (iv) = (i) + (ii) \)).

The total net pleasure of life is thus given by the total economic consumption of the average woman, discounted to make future years comparable with present years. This discounting, placing relatively less value on future years than on present years, corresponds to the general human attitude towards life, as witnessed by the number of people who smoke, drink, drive a car, cross the road or perform any other dangerous activity and as witnessed by the smallness of the number of people who take sufficient physical exercise outside working hours or who perform any other activity destined to increase their healthy lifespan (perhaps one in ten women offered the possibility of mass-screening take it up).

As well as these advantages, the total discounted lifetime consumption has another property that would seem necessary for an estimator of the total net lifetime pleasure of life, namely having a value that decreases with increasing age of the woman under consideration, and thus placing less value on the total net
lifetime pleasure as the number of years left to live decreases.

For these reasons the assumption \((iii) - (iv) = (ii)\) will be followed in this study.

- The Non-Economic Loss Suffered by Those that Know the Deceased Woman

An appropriate estimator for this quantity should take into account the consideration that the death of a younger woman generally causes a greater loss to those that know her than the death of an older woman. As a woman ages the number of years she has left to live diminishes and therefore the number of years of family relationship or other relationships she has left to offer diminishes. Furthermore her children leave home and become less dependent and her contemporaries start to die, and therefore the number of people that care about her diminishes.

Qualitatively therefore, the total discounted gross lifetime output would be an appropriate estimator as it diminishes suitably with the increasing age of the woman in question. Quantitatively therefore, a fixed fraction of the total actualised gross lifetime output would provide a roughly suitable estimator for the non-economic loss suffered by those that know the deceased woman. This fraction will be chosen based on the compensation awarded by courts and insurance companies to the family of deceased married adults.

In the early 70's the sums awarded varied from 100,000 - 200,000 FB for the marital partner and 75,000 - 125,000 FB for the children (Butoyi, 1979), or, taking the mid-range values, 250,000 FB in all. This value of 250,000 FB will be used to fix the value of the non-economic loss suffered by those that
know a deceased woman of average age. The average age will be taken as the average age estimated for women with breast or cervical cancer discovered at the CDJB (1964-1978), being ~ 47 years.

The total discounted gross lifetime output for a woman of 47 years of age, estimated as discussed in section 5.22.1, is ~ 3,347,000 FB 1971.

250,000 FB 1971 is approximately 7.5% of this sum. Thus the value placed on the non-economic loss suffered by those that know a deceased woman of any age will be taken as being 7.5% of her total discounted gross lifetime output.

- The Non-Economic Loss Suffered by Those that Do Not Know the Deceased Woman

The idea put forward by Dawson (1967) in a different context would seem appropriate here. Society, through social security services, is prepared to support non-productive invalids.

This is done on an anonymous basis, in as much as the taxpayer does not know the invalid whose life he is paying to support. The amount payed to support invalids would provide an estimate of the value individuals place on the lives of people they don’t know.

In 1971, invalids received 1.9% of the Gross National Income (see Goss, 1982), and thus the non-economic loss suffered by those that do not know the deceased woman will be estimated at 1.9% of the woman’s total discounted gross lifetime output.

2. Total Discounted Life Values

The component values of the total discounted life value, as
discussed in C.1., may be briefly summarised as follows:

\[
\begin{align*}
\text{i) Economic loss to Society (Net production)} & \quad \% \\
\text{ii) Non-Economic loss to the woman herself} & \quad 91.4 \\
\text{iii) Non-Economic loss to those that know the woman} & \quad 6.9 \\
\text{iv) Non-Economic loss to those that don't know the} & \quad 1.7 \\
\text{woman} & \quad \hphantom{1.7} \\
\hline
\text{100.0} & \quad \% \\
\end{align*}
\]

Fig. 9 presents the life-values obtained for women of different ages using the principal values of the annual rate of growth of the GNP per person, \( g = 2.8 \% \), and the discount rate, \( i = 4.18 \% \).

The average hourly output and the total actualised life values, both for the principal values of \( g \) and \( i \) and for three other combinations of values of \( g \) and \( i \), are presented in graphical form as a function of the age of the woman in fig. 10.

**Fig. 9: Total Discounted Life Values (a)**

<table>
<thead>
<tr>
<th>Age</th>
<th>Average Hourly Gross Output (FB 1971)</th>
<th>Total Actualised Life Value (Millions of FB 1971)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>77</td>
<td>7.0</td>
</tr>
<tr>
<td>30</td>
<td>84</td>
<td>5.9</td>
</tr>
<tr>
<td>40</td>
<td>84</td>
<td>4.6</td>
</tr>
<tr>
<td>50</td>
<td>82</td>
<td>3.2</td>
</tr>
<tr>
<td>60</td>
<td>55</td>
<td>1.7</td>
</tr>
<tr>
<td>70</td>
<td>36</td>
<td>0.7</td>
</tr>
<tr>
<td>80</td>
<td>17</td>
<td>0.2</td>
</tr>
</tbody>
</table>

(a) Using a rate of growth of GNP per person per year of 2.8 % and a discount rate of 4.18 % (1 FB 1971 = 2 FB 1980).
Fig. 10: Total discounted life value and average hourly gross output as function of age.

This figure presents the average hourly gross output and the total discounted life values for women, both using the principal values for the rate of growth of GNP per person (g) and for the discount rate (i), and for three other combinations of values of g and i, as a function of the age of the woman.
3. Sensitivity of the total discounted life values with respect to the values of the rate of growth of GNP/person (g), and the discount rate (i) chosen.

The total discounted life values are highly dependent upon the choice of g and i. Six combinations of g and i were chosen to investigate this dependence, from two values of g (0.0 % and 2.8 %) and 3 values of i (4.18 %, 7 %, 10 %). Note that 10 % is the value officially used in Great Britain, 7 % is a value frequently used in other countries, and 4.18 % is the value based upon the effect of diverting investments from other economic sectors (see Kirschen et al., 1975).

The effect of g and i is a combined one, depending upon the ratio \[
\frac{1 + \frac{g}{100}}{1 + \frac{i}{100}}.
\]

Two pairs of combinations of g and i give virtually the same ratio, these being (0.0, 4.18) and (2.8, 7.0), and (0.0, 7.0) and (2.8, 10.0). Thus only 4 of these six combinations are significantly different from each other, being represented in fig. 11.

The values of g and i chosen will affect the discounted value, as estimated now, of a person’s future output. For a person whose present output is valued at 1 FB, figure 11 gives, for different combinations of values of g and i, the discounted value, as estimated now, of the same person’s future output 10, 20, 30 and 40 years in the future, together with the corresponding halving-time, i.e. the number of years after which the future output, as estimated now, of a person whose present output is valued at 1 FB, is valued at 0.5 FB (Any effect of age on the person’s output is ignored here).
Fig. 11: Discounted value, as estimated now, of the future output (10-40 years from now) for a person whose present output is valued at 1 FB

<table>
<thead>
<tr>
<th>Combinations of g and i</th>
<th>10 years</th>
<th>20 years</th>
<th>30 years</th>
<th>40 years</th>
<th>Halving-time</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2.8, 4.18)</td>
<td>0.88</td>
<td>0.77</td>
<td>0.68</td>
<td>0.59</td>
<td>~53 yrs</td>
</tr>
<tr>
<td>(2.8, 7.0),(0.0, 4.18)</td>
<td>0.67</td>
<td>0.44</td>
<td>0.30</td>
<td>0.21</td>
<td>~17 yrs</td>
</tr>
<tr>
<td>(2.8, 10.0),(0.0, 7.0)</td>
<td>0.51</td>
<td>0.26</td>
<td>0.15</td>
<td>0.08</td>
<td>~10 yrs</td>
</tr>
<tr>
<td>(0.0, 10.0)</td>
<td>0.39</td>
<td>0.15</td>
<td>0.06</td>
<td>0.02</td>
<td>~7 yrs</td>
</tr>
</tbody>
</table>

The life-values shown in figs. 9 and 10 decrease with age because the expected number of years left to live decreases with age. More particularly, the number of years before the 60th year of age decreases with age, and, as shown by the average hourly gross output, these years of life are valued more highly than those after the 60th year of age. This effect is however, counter-balanced by the discount rate which reduces the most the value of the years furthest away (see fig. 11). Thus the greater the discount rate, the less the difference between the life-values of women in the 20-55 age-range. This is illustrated by the progressive flattening of the 20-55 year fraction of the life-value curves with increasing discount rates (fig. 10).

More independently of the discount rate, the life-value decreases rapidly after 55, due to the rapidly decreasing gross output attributed to women over 60 with increasing age.

The first part of the fig. 12 expresses the total discounted life values for the different combinations of g and i as a % of the values given by the principal combination (2.8 %, 4.18 %). It is clear that an increase in i has a much greater effect on the life values of younger women than of older women. For example, increasing the value of i from 4.18 % to 10 % reduces
the total discounted life value of a woman aged 20 from 100% to 43%, whereas, for a woman aged 60, this reduction is only from 100% to 73%.

The second part of the fig. 12 gives the % decrease of the life values, as shown in the first part, per 1% absolute increase in i. Thus, for a woman aged 20, for each 1% absolute increase in i in the range 4.18 + 7.0, the life value decreases by 13%, with respect to the principal value.

Note that, as \( \frac{1.0}{1.10} = \frac{1.028}{1.1308} \), the combination (0.0, 10.0) gives the same values as the combination (2.8, 13.08) and thus the difference between the two versions (2.8, 4.18) and (0.0, 10.0) is equivalent to an increase in i from 4.18 to 13.08%.

This second part of the fig. 12 again shows that the effect of an increase in i is greater the younger the woman, though less for the last increment range (10% + 13.08%) than for the first increment range (4.18 + 7.0%). The first 1% increment in general has more effect than the last increment of 1%, this difference being greater the younger the woman.

Fig. 12: Life values, as a % of the values given by the combination of g and i (2.8, 4.18), for the different combinations of g and i:

| Age | (2.8, 7.0) | (2.8, 10.0) | (0.0, 10.0) | % decrease of the life value per 1% absolute increase of i, for the different combinations of g and i:
|-----|------------|-------------|-------------|-------------------------------------------------
| 20  | 62         | 43          | 33          | (2.8, 7.0) | (2.8, 10.0) | (0.0, 10.0) |
| 30  | 67         | 49          | 39          | 13.5       | 9.8         | 7.5         |
| 40  | 73         | 57          | 46          | 11.7       | 8.8         | 6.9         |
| 50  | 79         | 65          | 55          | 9.6        | 7.4         | 6.1         |
| 60  | 85         | 73          | 64          | 7.4        | 6.0         | 5.1         |
| 70  | 91         | 82          | 76          | 5.3        | 4.6         | 4.0         |
| 80  | 97         | 93          | 90          | 3.2        | 3.1         | 2.7         |
4. The Total Value of the Lives Lost in Belgium from Breast and Cervical Cancer in 1976

The latest national statistics from the I.N.S. giving the number of deaths, by age-group, from breast and cervical cancer in women cover the year 1976. Based on the total discounted life-values described in fig. 9, the economic loss related to the 2049 deaths from breast cancer in 1976 and the 249 deaths from cervical cancer are given in figure 13. Thus with \((g, i) = (2.8 \%, 4.18 \%)\), ~3,141 millions of FB 1971 were lost due to deaths from breast cancer in 1976, and ~336 millions of FB 1971 due to deaths from cervical cancer.

It is recalled that the life-values used to obtain the values in fig. 13 are based on life-tables that include the effect of breast and cervical cancer on the average life-expectancy for a given age. This effect should ideally be excluded here, and the values obtained in fig. 13 are therefore slight under-estimations.

Fig. 13: Loss in millions of FB 1971 due to the deaths of women in 1976 from breast and cervical cancer

<table>
<thead>
<tr>
<th>((g, i))</th>
<th>Breast</th>
<th>Cervix</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2.8, 4.18)</td>
<td>3141</td>
<td>336</td>
</tr>
<tr>
<td>(2.8, 7.0)</td>
<td>2529</td>
<td>275</td>
</tr>
<tr>
<td>(2.8, 10.0)</td>
<td>2109</td>
<td>232</td>
</tr>
<tr>
<td>(0.0, 10.0)</td>
<td>1819</td>
<td>202</td>
</tr>
</tbody>
</table>

D. THE COST-BENEFIT ANALYSIS

Applying the economic values of women’s lives obtained in Section C to the number of lives saved obtained in Section B one may estimate the benefit of mass-screening in FB (see fig. 14).
The cost-effectiveness analysis (see figs. 7–8) may be criticised as the values obtained for the cost per life and year of life do not distinguish between different years of life, in that they consider as equivalent the twentieth year of a woman aged twenty now, the 99th year of a woman aged 20 now, the 99th year of a woman aged 99 now, and all years in between these extremes.

This is not the case for the figures presented in fig. 14, giving the economic value, in millions of FB 1971, placed on the years of life saved. As discussed in Section C, this analysis places a linearly decreasing value on the years of life after the sixtieth year, and a geometrically decreasing value the further a given year of life lies in the future. Thus, for example, overall, the average discounted value placed on the years of life saved of women whose breast or cervical cancer was diagnosed during her 1st visit at 30–34 years of age was approximately 112,000 FB 1971 per year, as opposed to 52,000 FB 1971 per year for women aged 65–69 at diagnosis.

Thus returning to fig. 14, the value of the years of life saved was greatest for cervical first-screening, followed by breast re-screening, cervical re-screening and breast first-screening in that order. Overall, cervical screening gave a greater benefit in FB than breast screening, and first-screening a greater benefit than re-screening. Finally the total estimated benefit for the CDJB’s screening 1964–78 was 88.9 millions of FB 1971.

This brings us to the last step in the analysis. A simple consideration of the benefit in FB does not take into account the number of visits and the cost per visit in the different screening categories. It is thus necessary to compare the benefits in FB for the different categories with their related costs, forming the benefit : cost ratios given in fig. 15.
This gives the overall benefit:cost ratio for the CDJB’s 1964-78 screening programme as 0.81. Thus, grosso modo, the CDJB’s activity has represented a small loss.

The category with the highest benefit:cost ratio was cervical first-screening (1.50) followed by breast re-screening (0.91), breast first-screening (0.50) and cervical re-screening (0.40).

The results presented in figs 14 and 15 were calculated using a discount rate \((i)\) of 4.8\% and a rate of growth of GNP per person \((g)\) of 2.8\%.

The estimated value of a woman’s life is highly sensitive to the choice of the values of \(g\) and \(i\).

With the principal values \((g, i) = (2.8\%, 4.18\%)\), the overall benefit:cost ratio was 0.81. These figures drop to 0.55 (see fig. 16) if one increases \(i\) to 7\%. Thus instead of appearing to have made a small, relatively acceptable loss, the CDJB’s 1964-78...
screening programme would appear to have made a heavy, inaccep-
table loss. Further increasing \( i \) and decreasing \( g \) reinforces this
change of appreciation (see figs. 16a, 16b).

The benefit:cost ratio of cervical screening is slightly
more sensitive to an increase in \( i \) than that of breast screening.
Increasing \( i \) from 4.18% to 7% reduces the breast-screening
benefit:cost ratio (all visits) to 71% of the value obtained
with \( i = 4.18 \), and the cervical-screening benefit:cost ratio
(all visits) to 66%.
This difference is due to the greater effect of \( i \) on the value
of the years of life of younger women and on the years of life
further in the future.

Fig. 16 : Benefit : Cost Ratios with \( (g,i) = (2.8\%, 7.0\%) \)

<table>
<thead>
<tr>
<th></th>
<th>1st visits</th>
<th>Re-visits</th>
<th>All visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast</td>
<td>0.37</td>
<td>0.64</td>
<td>0.52</td>
</tr>
<tr>
<td>Cervix</td>
<td>1.00</td>
<td>0.25</td>
<td>0.58</td>
</tr>
<tr>
<td>Both Cancers</td>
<td>0.72</td>
<td>0.43</td>
<td>0.55</td>
</tr>
</tbody>
</table>

(As a % of
fig. 15)

<table>
<thead>
<tr>
<th></th>
<th>1st visits</th>
<th>Re-visits</th>
<th>All visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast</td>
<td>74</td>
<td>70</td>
<td>71</td>
</tr>
<tr>
<td>Cervix</td>
<td>67</td>
<td>63</td>
<td>66</td>
</tr>
<tr>
<td>Both Cancers</td>
<td>69</td>
<td>68</td>
<td>68</td>
</tr>
</tbody>
</table>

Fig. 16a : Benefit : Cost Ratios with \( (g,i) = (2.8\%, 10.0\%) \)

<table>
<thead>
<tr>
<th></th>
<th>1st visits</th>
<th>Re-visits</th>
<th>All visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast</td>
<td>0.28</td>
<td>0.47</td>
<td>0.39</td>
</tr>
<tr>
<td>Cervix</td>
<td>0.69</td>
<td>0.16</td>
<td>0.39</td>
</tr>
<tr>
<td>Both Cancers</td>
<td>0.51</td>
<td>0.30</td>
<td>0.39</td>
</tr>
</tbody>
</table>

(As a % of
fig. 15)

<table>
<thead>
<tr>
<th></th>
<th>1st visits</th>
<th>Re-visits</th>
<th>All visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast</td>
<td>56</td>
<td>52</td>
<td>53</td>
</tr>
<tr>
<td>Cervix</td>
<td>46</td>
<td>40</td>
<td>44</td>
</tr>
<tr>
<td>Both Cancers</td>
<td>49</td>
<td>48</td>
<td>48</td>
</tr>
</tbody>
</table>
Fig. 16b: Benefit: Cost Ratios with \((g_i) = (0.0\%, 10.0\%)\)

<table>
<thead>
<tr>
<th></th>
<th>1st visits</th>
<th>Re-visits</th>
<th>All visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast</td>
<td>0.22</td>
<td>0.36</td>
<td>0.30</td>
</tr>
<tr>
<td>Cervix</td>
<td>0.50</td>
<td>0.11</td>
<td>0.28</td>
</tr>
<tr>
<td>Both Cancers</td>
<td>0.37</td>
<td>0.22</td>
<td>0.29</td>
</tr>
</tbody>
</table>

(As a % of Fig. 15)

<table>
<thead>
<tr>
<th></th>
<th>1st visits</th>
<th>Re-visits</th>
<th>All visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast</td>
<td>44</td>
<td>40</td>
<td>41</td>
</tr>
<tr>
<td>Cervix</td>
<td>33</td>
<td>28</td>
<td>32</td>
</tr>
<tr>
<td>Both Cancers</td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
</tbody>
</table>

**FINAL CONCLUSIONS**

The conclusions are sufficiently clear, in spite of the inevitable element of uncertainty. During the period 1964-78, the CDJB’s overall screening programme did not give a net benefit. However, accepting a 4.18\% discount rate, the loss was only small (benefit:cost ratio = 0.8) and relatively acceptable, especially considering that certain minor benefits were not taken into account.

The principal consequence of this result is that an effort should be made to improve the benefit:cost ratio. One way of achieving this would be by restricting the CDJB’s future screening.

Certain screening categories for certain age-groups were much more profitable than others. By discontinuing those whose benefit:cost ratio was less than 0.85 it would be possible to continue screening with a net benefit.

Taking into account:
- The future changes in the % of those cervical cancers
discovered outside screening centres, that are diagnosed at stage 0.

- The fact that screening for cervical cancer alone during a visit would cost more than the cervical cancer's share of the cost of screening when screening for both breast and cervical cancers during the same visit.

it would thus be recommended to continue a first breast screening for the 45-54 age-group and a first cervical screening for the 35-59 age-group accepting a 4.18% discount rate and 2.8% annual rate of growth of GNP per person.

The overall benefit:cost ratio would become 1.23, which compares favourably with that of 0.81 for the 1964-78 overall screening.

It would be recommended to discontinue all other first screenings and to discontinue re-screening every two years. Re-screening would only be considered for those women who, after an interval sufficiently long (10 years?) after their first screening, still fall into the age-groups recommended for continued first screening (if these latter are restricted to the 45-54 age-groups, then no re-screening at all would be recommended on the basis of a 10 year interval).

Many countries, it should be noted, use discount rates higher than that of 4.18%. Applying these to the CDJB would reduce the overall benefit:cost ratio for the 1964-78 period and would further restrict the categories and age-groups recommended to the point of virtually rejecting all screening.

A second possible way of improving the overall benefit:cost ratio would concern decreasing the unit cost per visit, by means
of a thorough cost-productivity analysis.
A significant reduction in the unit cost per visit would improve
the benefit:cost ratios of all screening categories and age-
groups, providing of course no corresponding reduction in the
benefits would ensue.

Were one to reject the principal a fixed and finite value for
the life of the average woman of a given age, then the cost-
benefit analysis is of course invalid. Nevertheless similar con-
clusions would still be drawn from this study on the basis of a
cost-effectiveness analysis (i.e. the cost per year of life saved).
The same categories and age-groups recommended would appear by
and large less costly than those not recommended, though it would
be more difficult to decide at what point screening becomes too
costly.

In order to be fully justified, the CDJB screening programme
should ideally have a cost per life saved which compares favour-
ably with that of other life-saving projects.

However, the cost per life saved is not known for most public
projects involving savings in human lives. Thus it is not as yet
possible to make a decision concerning the CDJB’s future scree-
ning programme on the basis of such ideal comparisons between
different projects.

Once one accepts the principal of fixing a finite value for
human life, then cost-benefit analysis of life-saving projects
become possible.

The actual value placed on human life is of course highly
controversial. Nevertheless the bases of the calculation of the
values used in this analysis are clearly enough defined to enable
the interested parties to judge the acceptability of the values
used, for example as concerns the lesser values placed on older lives.

Cost-benefit analyses present a considerable advantage over the more primitive cost-effectiveness analysis. In this context they enable one to decide which screening categories and age-groups do not satisfy the basic economic criterion of having a benefit:cost ratio greater than unity. (The 0.85 cut-off value used to establish the recommendations for future screening was set deliberately lower than unity in order to compensate for the minor benefits not taken into account).

Ideally the benefit:cost ratios of the recommended screening categories and age-groups should not only be greater than unity, but also greater than those of other life-saving projects competing for public funds. There is more than one way to skin a cat and there are many ways of saving lives. Furthermore, logically, benefit : cost ratios for projects concerning human lives should also be compared with projects which do not concern human lives.

However, for the present, the benefit:cost ratios for most projects concerning human lives are unknown. Moreover the values placed on human lives are not wholly agreed on. Thus, as with the cost-effectiveness analysis, it is not yet possible to make a decision concerning the CDJB's future screening on the basis of such ideal comparisons between different projects.

Finally, summing up, this study recommends a thorough cost-productivity analysis and a restricted screening programme. How restricted would depend upon the degree of caution of the persons who will decide the CDJB's future programme. A cautious doctor would reason that, if in doubt, apply the highest value for a woman's life and continue screening unless it is absolutely clear
that it is not worthwhile.

A cautious accountant or ministerial official would reason that, if in doubt, screening should only continue if it is absolutely clear that the benefits exceed the costs, and preferably that the benefit:cost ratio is greater than that of other projects competing for public funds. As always in such matters there is a certain political element, as for example the pressure of public opinion, and the final decision would have to strike a just balance between the different points of view.

Contents:

Introduction
A. The Clinique de Dépistage Jules Bordet (1964-78)
B. The Cost and the Benefits of Screening at the C.D.J.B. (1964-78)
C. The Economic Value of an Average Woman’s Life in Belgium.
D. The Cost-Benefit Analysis
Final Conclusions.

BIBLIOGRAPHY


SOMMAIRE


On estime le bénéfice à 39 vies ou 934 années de vie. La valeur économique des vies de femmes d'âges différents en Belgique est évaluée en prenant en considération la perte de la production nette et trois catégories de pertes non-économiques qui résultent d'une mort précoce.

L'application de ces valeurs économiques donne un rapport coût:bénéfice global de 0.8. Certaines suggestions sont faites en vue d'améliorer ce rapport.