MAURITIUS RESEARCH COUNCIL

GENETIC EPIDEMIOLOGY OF BREAST CANCER IN MAURITIUS

Final Report

June 2003

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Genetic Epidemiology of Breast Cancer in Mauritius

(Updating)

An MRC funded project

Principal Investigator:
Dr G.Khittoo

June 2003

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- Our sincere thanks to all those who directly or indirectly helped in this project.

SUMMARY

This institution-based project was an attempt to revisit the data on breast cancer available at the Radiotherapy Unit at the Victoria General Hospital. This time we focussed on a longer window in time, spanning from 1990 to 2001 in contrast to our previous work which covered the 1994 to 1998 period. Our main objectives were to verify if the cancer trends reported for the 1994 to 1998 period would still hold true or if new trends would become apparent when different time segments were examined. This approach is viewed as a good exercise in epidemiology as it enables one to separate transient observations from more permanent ones. Using simple, well established statistical techniques, we were able to confirm that not only breast cancer is the most prevalent cancer in the Mauritian population but that over the most recent years it has been progressing at an accelerated pace. Examination of the incidence of breast cancer by age groups showed that from age 40 upwards there was a marked increase in the rate of breast cancer incidence. Interestingly there seemed to be a geographical gradient of breast cancer with a higher level recorded in the Western part of the island, diminishing towards the Eastern side. Comparison of the ages of menarche and menopause between a group of breast cancer patients and women not diagnosed with breast cancer revealed no notable difference. Although there were no significant difference of breast cancer among the four main ethnic groups namely General population, Chinese, Hindu and Muslim, the breast cancer incidence among the General population seemed to have risen putting it ahead of the Chinese population. The results of this study strongly suggest the need for more in depth population based studies for yet a clearer picture of the breast cancer scene in Mauritius.

INTRODUCTION

Breast cancer continues to be the focus of an impressive number of studies and yet it remains the most common and perhaps the most feared malignancy affecting women today. In a worldwide effort to find an acceptable cure, scientists are relentlessly seeking to understand the processes, molecular or other which drive normal breast cells into neoplastic growth. As we have entered the post genomic era, considerable effort are being deployed to seek for avenues to understand the pathogenesis of breast cancer at the molecular level. Thus molecular profiling and molecular signatures that have important prognostic values are being investigated (Van't Veer Lj, *et al.*, 2002). The expression of thousands of genes can now be monitored simultaneously with the use of DNA microarrays (Lenning *et al.*, 2001, Kallioniemi, 2002). These powerful technologies are helping to devise new and more reliable molecular markers to detect cancer, determine prognosis and monitor disease progression (Sidransky, 2002). Proteomics studies, part of which focuses on changing levels of active proteins inside tumour cells will enable doctors to assess changing levels of active proteins in order to determine if a given treatment is effective in a specific patient (http://cancer.gov) .The fact that there are only a limited number of known breast cancer susceptibility genes and that 10 to 20 percent of families at high risks for breast cancer have no linkage to BRCAI and BRCA2, implies that other breast cancer susceptible genes exist (Sakorafas and Tsiotou, 2000). Early detection of breast cancer is also among the frontiers being explored. Although mammography is being scrutinised and criticised, it remains an important imaging technique. Nevertheless mammography is being improved by modifications which include digital mammography coupled with computer aided technology for more accurate interpretation (Li *et al.*, 2002). Ultrasound is also gaining grounds in breast imaging (http://www.plesser.com). Attempts are being made to distinguish between genetic and non-genetic causes of cancer through the comparison of the patterns of cancer in monozygotic and dizygotic twins (Lichtenstein 2000). Several pilot studies are being conducted in aromatase inhibitors which act by blocking the synthesis of estrogens, resulting in the regression of breast carcinoma (Kuerer et *al.*, 2001). These are but a few examples of the tremendous efforts devoted to cancer research. Although no cure is yet

available, researchers have nevertheless unveiled promises and pitfalls (Sakorafas and Tsiotou, 2000). In view of the multifactorial nature of breast cancer, epidemiological studies remain a strong ally in the research for ways to curb the disease.

BREAST CANCER IN MAURITIUS

In March 2000 we submitted a report to the Mauritius Research Council (MRC) on the "Genetic Epidemiology of Breast Cancer". This MRC funded project provided a unique opportunity for us to examine the data available on breast cancer at the Radio Therapy Unit (RTU) at the Victoria Hospital in Quatre-Bornes. Analysis of the data collected at that institution enabled us to highlight some of the major trends in breast cancer during the period extending from 1994 to 1998. We were also able to identify a mutation in the breast cancer gene BRCA2 in members of a Mauritian family. In an effort to consolidate or complement the findings in our earlier report on the breast cancer situation in Mauritius, we have attempted to process data (collected at the RTU) which spans over a longer period of time, namely, from 1990 to 2001. It is hoped that our findings will enhance the appreciation of the breast cancer problem and perhaps stimulate more in depth studies of breast cancer in Mauritius.

MATERIALS AND METHODS

The methods of analysis employed are the standard statistical methods utilised in our previous report and described by Parkin and his colleagues (Parkin *et al.*, 1992)

RESULTS

ALL CANCER SITES

We revisited the RTU records and extracted data from the log book from the period extending from 1990 to 2001. The ten most cancers affecting the Mauritian population are shown in figures 1-3. As observed earlier, breast cancer is the dominating cancer even when both male and female populations are taken together. In fact the three highly prevalent cancers namely, cervical, lung and colon/rectum stay at the top when considered in all three different time frames. Interestingly prostate cancer seems to be rising steadily when one considers that it was absent in the ten most prevalent cancers between 1990 to 1995 but is listed as the ninth most prevalent cancer in the period from 1996 to 2001. The same applies for cancer of the mouth.

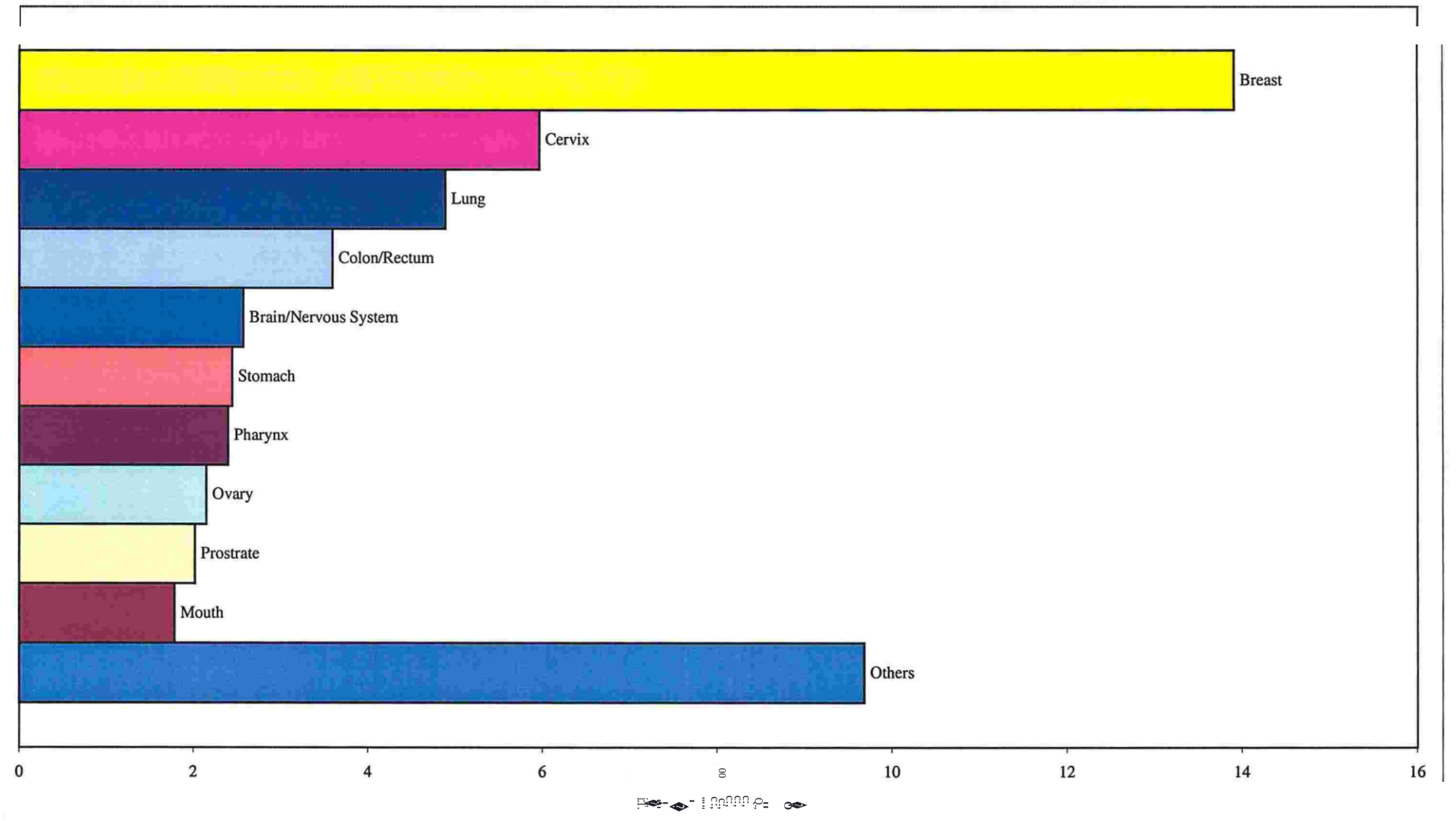
COMPARISON OF THE CANCER SITES AFFECTING FEMALES AND MALES

As we highlighted in our first report (March 2000), the pattern of distribution of cancers in women and men are quite different. Breast cancer remains the outstanding cancer in terms of prevalence. If one looks at breast cancer over the total 11 year period under study, there seems to have been an upsurge in the incidence of the cancer which almost reaches a figure of 27 from 1996 to 2001 compared to the 16.9 figure between during 1990 to 1995. Lung cancer, the foremost cancer affecting Mauritian men seems to be also rising among women especially over the more recent years. In general the cancers which do not affect the reproductive systems are at a higher incidence in men than in women (figures 4-9).

Breast
Cervix
Lung
Colon/Rectum
Brain/Nervous System
Pharynx
Stomach
Ovary
Mouth
Prostate
Others

Breast
Cervix
Lung
Colon/Rectum
Pharynx
Brain/Nervous System
Mouth
Stomach
Ovary
Urinary Bladder
Others
0
2
4
6
8
10
12
14
16

Figure 3: Incidence of the Ten Most Common Cancer Sites in the Mauritian Population (1996 - 2001)



Oesophagus

Lung
Pharynx
Mouth
Stomach
Brain/Nervous
Oesophagus
Non Hodgkin's Lymphoma
Others
0
2
4
6
14
16
18
20

Lung
Prostate
Pharynx
Sto
Brain/N
Oesophagus
Others

Breast
Cervix
Ovary
Colon/Rectum
Brain/Nervous
Lung
Stomach
Uterus
Endometrium
Others
25
30

Breast
Cervix
Ovary
Colon/Rectum
Brain/Nervous
Stomach
Lung
Uterus
Endometrium

Breast
Cervix
Ovary
Colon/Rectum
Brain/Nervous
Lung
Uterus
Endometrium
Stomach

INCIDENCE OF CANCER BY AGE GROUP

Breast cancer is rare among the younger age group below 30 years. Then for the next decade upwards breast cancer rates seem to be comparable among the different time frames (figures 10-12). However, from age 40 upwards there seems to be a marked increase in incidence of breast cancer during the period spanning from 1996 to 2001. The rate of increase in the older age groups seems to vary from an increase of 1.5 times to almost double in the age section of 60 and 64. This analysis also clearly shows a dramatic increase in breast cancer incidence during the more recent years.

GEOGRAPHY OF BREAST CANCER IN MAURITIUS

The figures 13-15 show the geographical distribution of breast cancer in the different districts of the island. Examination of figures 14 and 15 show that Plaines-Wilhems and Port-Louis are the districts with the highest number of breast cancer incidences in both time frames. However, the patterns of distribution seem to change in many other districts. For instance the breast cancer incidence in Pamplemousses appears to have doubled during the recent years, pushing it to the region having the third highest incidence of breast cancer. On the other hand the cancer incidence in Flacq presents the lowest rate of increase during the 1996 to 2001 period placing it as the district with the lowest breast cancer incidence for that period according to the records at the RTU. As shown in the maps (figures 13-15) there seems to be a clustering of breast cancer in the western half of the island.

INCIDENCE OF BREAST CANCER IN DIFFERENT ETHNIC GROUPS

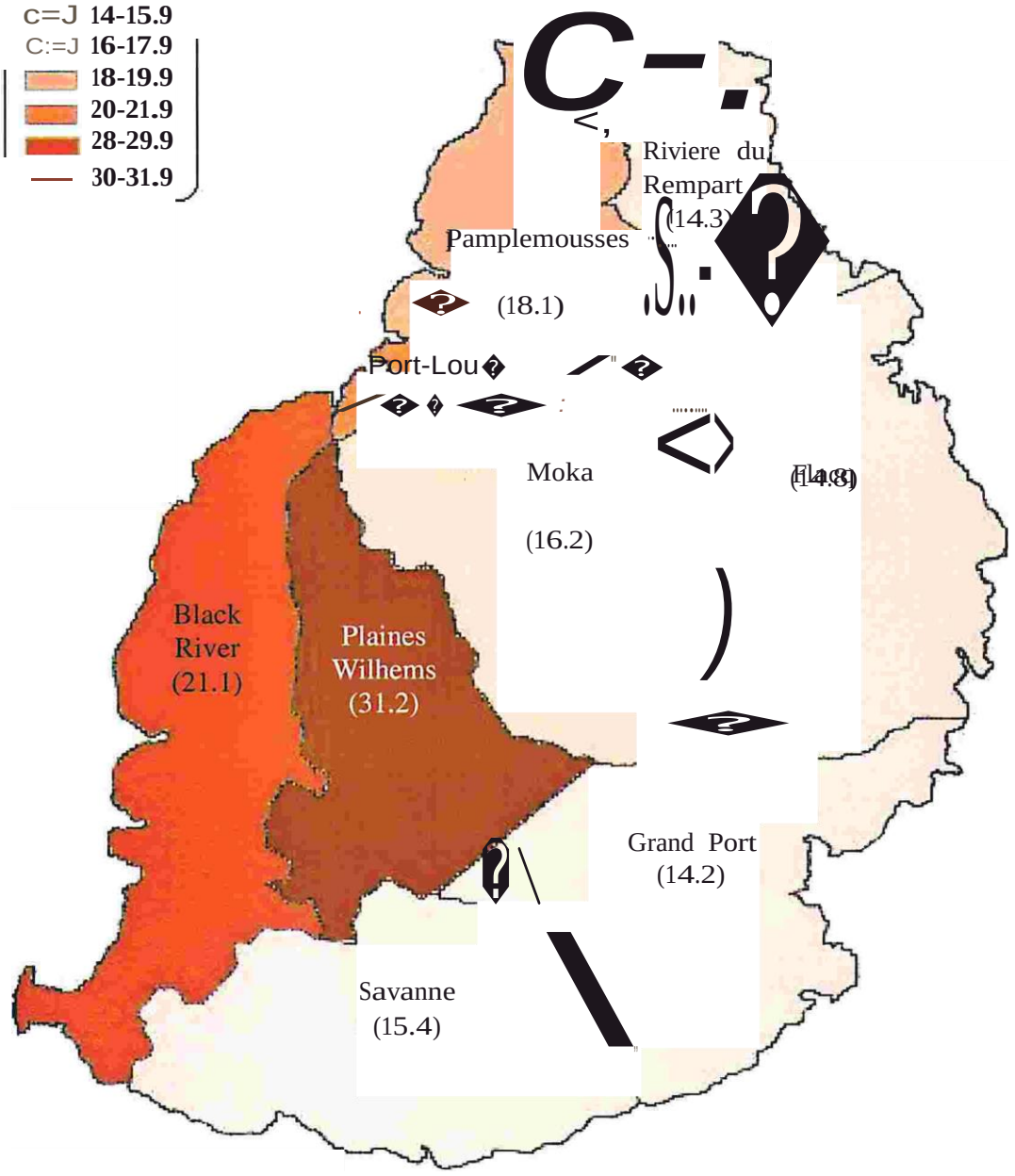
Since the time of our previous observations for the period spanning from 1994 to 1998, the breast cancer incidence shows definite signs of having been on the rise in all four ethnic groups considered (figures 16-18). The highest increase in incidence was noted in the General population. However, it is important to note that the difference in incidence

JƎAO 18 98
178--08
6L--9L
-0L
69--99
179--09
69--99
179--09
617--917
1717--017
68--98
178--08
Sa-sz
20--24
6♦--♦9

15-19
20-24
25-29
30-34
35-39
40-44
45-49
50-54
55-59
60-64
65-69
70-74
75-79
80-84
85 and above
0
20
40
60
80
100
120
140
160
180
200

Incidence Rate per 100000 Women
0
10
20
30
40
50
60
70
80
90
15-19
20-24
25-29
30-34
35-39
40-44
45-49
50-54
55-59
60-64
65-69
70-74
75-79
80-84
85 and Older

Figure 13: Geographical distribution of breast cancer in Mauritius (1990-2001)



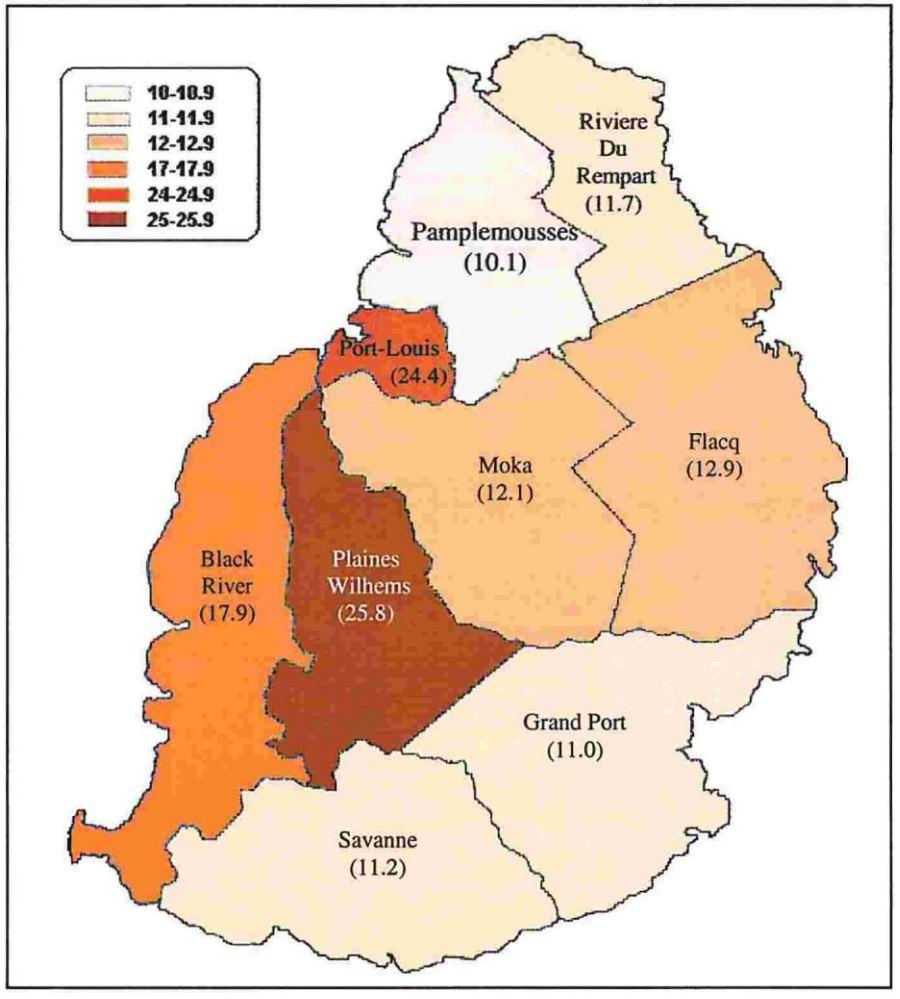


Figure 14: Incidence of Rate of Breast Cancer in the Districts of Mauritius 1990-1995

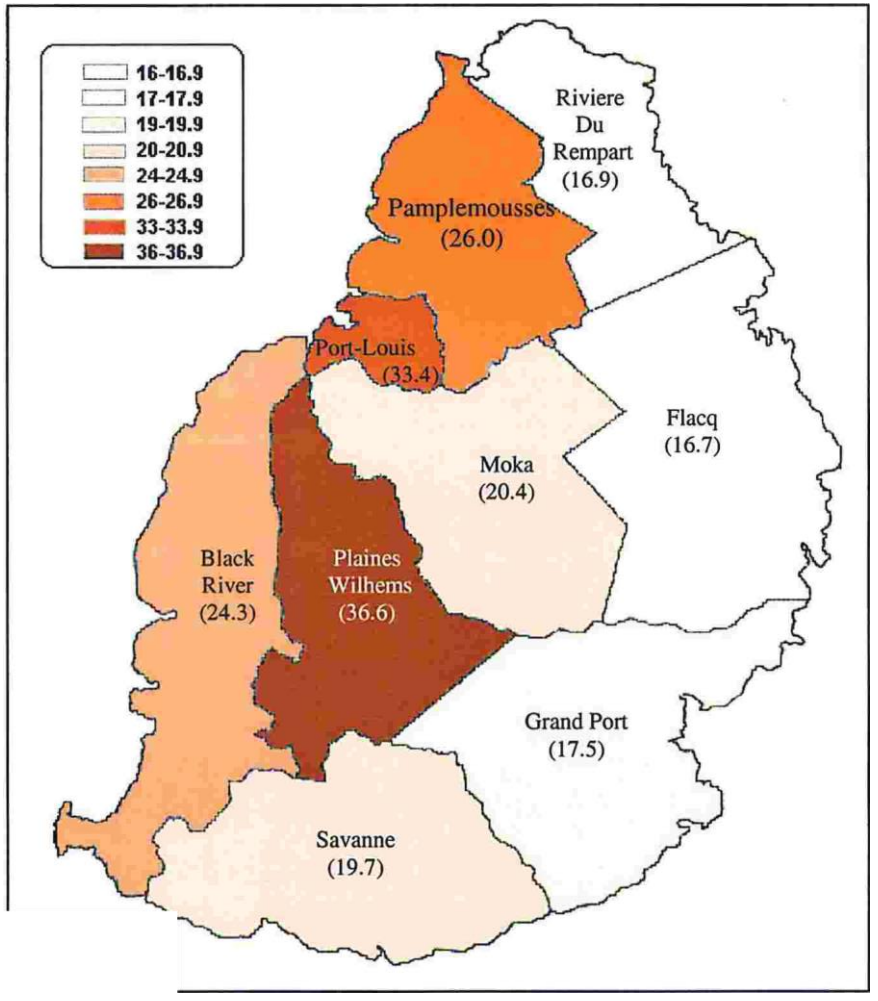


Figure 15: Incidence of Rate of Breast Cancer in the Districts of Mauritius 1996-2001

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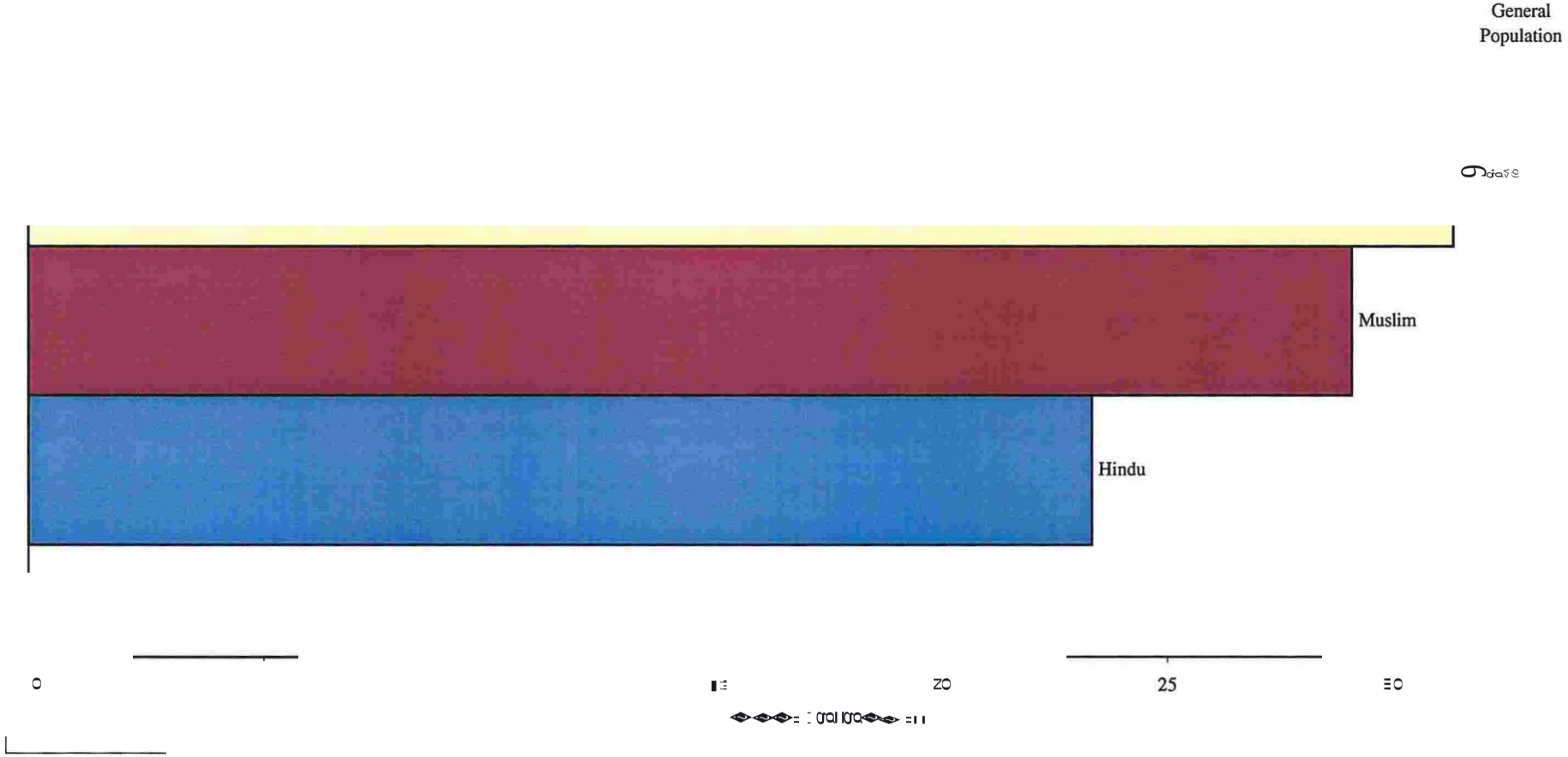
Figure 18: Incidence of Breast Cancer



among all ethnic groups was not found significant when analysed by the Chi-square test. The lowest rate among the Hindu population is most likely due to the largest size of the population as we noted in our previous MRC report.

HORMONAL INFLUENCE

Studies have revealed that the hormonal milieu affects breast cancer risk. In this study we compared the age at menarche in 300 breast cancer patients with Mauritian women (matched for age) without diagnosed breast cancer. We also compared the onset of menopause among 300 breast cancer patients with 300 Mauritian women not suffering from breast cancer and matched for age. The results are shown in figures 19 and 20. Inspection of these figures reveals that menarche is not particularly at a lower age among breast cancer patients compared to women with diagnosed breast cancer. In fact there seem to be more examples when menarche is at a higher age among breast cancer patients. Similarly, figure 20 indicates that the pattern of menopause among breast cancer patients is not significantly different from that of women without diagnosed breast cancer.

paMa!AJa1u1 sa1ewa.:1 J0 JaqwnN

Number of females interviewed
140
120
100
80
60
40
20
0
66-69
60-64
55-59
50-54
45-49
40-44
35-39
30-34
25-29
20-24
15-19

DISCUSSION

A few years ago we completed a project on the genetic epidemiology of breast cancer in Mauritius. In that Institution-Based study we analysed data collected from the records of the RTU covering the period from 1994 to 1998. Although several interesting trends were revealed, many more questions were raised. In an attempt to get a more complete picture of the breast cancer scene in Mauritius we have now processed additional data obtained at the RTU. Although this study is an institution-based one, the fact that over 70% of breast cancer cases are referred to the RTU (personal communication, Dr H. Mustun in charge of the RTU during our study of 1994-1998) the observations are very likely to reflect trends of the actual breast cancer situation on the island. The period of investigation now spans from 1990 to 2001. This extended period of analysis confirmed the fact that the incidence of breast cancer has been steadily rising over the years to become the most prevalent cancer among the Mauritian population.

Part of the increase in the incidence of breast cancer could certainly be due to improved detection methods and a higher level of awareness as suggested being the case in many other countries. However, as we mentioned in our previous report one cannot rule out other important factors as the environment, the aging population or genetic factors. Whatever the reasons for the recent upsurge in breast cancer, the situation is serious and must be fully addressed. It would be important to look into mortality rates to evaluate the impact on the population. For instance in the USA, where in spite of the several technological advances, breast cancer is among the leading cause of cancer related deaths (Parker 1997). Interestingly, the geographical gradient we observed previously (Khittoo 2000) still persists with a marked higher incidence in the western half of the island **(figure 13).** Comparison of the breast cancer incidence in the three time frames revealed that although the distribution remains higher in the western half of the island there are several fluctuations in the breast cancer incidence among the districts. For example in the earlier report, we showed that the Port-Louis district had the highest breast cancer incidence. This picture seems to be changing as Port-Louis has moved to the second place behind Plaines-Wilhems, whereas Pamplemousses has recently moved from the

region of lowest cancer incidence to become the district with the third highest breast cancer incidence. It would seem therefore that breast cancer incidence is dynamic or unstable and it would be interesting to monitor the progress of breast cancer in the coming years to see if the divide between eastern and western part of the island still persists and why?

ETHNIC DIMENSION OF BREAST CANCER

The prevalence of breast cancer has been shown to vary among ethnic groups (Chaudru *et al.*, 2002), on the other hand studies in migration patterns have shown that the environment is also important (Ziegler *et al.*, 1993). Examination of the distribution among the four major ethnic groups in Mauritius showed that from 1990 to 1995 the incidence among the Chinese population was the highest **(figure 17)** but in the recent years incidence of breast cancer in the General population has surpassed that of the Chinese population. Although the discrepancy in rates among the different ethnic groups could be attributable to some extent, to the population size of each ethnic group, the rise in incidence in the general population must be looked into. Again we note the dynamic or unstable nature of breast cancer incidence among different population groups inferring that there are indeed many factors known or unknown, which influence the incidence of breast cancer in a population.

HORMONAL MILIEU

The hormonal environment as influenced by early menarche or late menopause has been shown to increase breast cancer risk. It has been hypothesised that the longer exposure of breast cells to high level of estradiol and progesterone increase the risk for breast cancer by boosting the mitotic rate of breast cancer epithelial cells (Pike *et al.*, 1993; Key, 1999). In this preliminary study described here, we did not detect a marked tendency for breast cancer patients to have early menarche or late menopause as reported in other studies (Pike *et al.*, 1993; Key, 1999). In fact there seemed to be a few breast cancer patients whose age at menarche was unusually high. This could be viewed as a possible

hormonal dysfunction but more in depth investigation is warranted to establish if in Mauritius, the ages at menarche or menopause among breast cancer patients are relevant to the disease.

CONCLUSION AND RECOMMENDATIONS

This study provided an opportunity to examine the breast cancer situation in Mauritius over a longer span of time. In epidemiological analysis of data over different time windows is an important exercise as it enables the verification whether observations made at a certain point in time are stable. It is only then that one can identify or confirm if identified trends are lasting ones or just part of transient phenomena. Indeed in this study it was revealed that the breast cancer prevalence has recently been increasing at an accelerated pace. Interestingly the breast cancer gradient that we observed earlier (Khittoo 2000) still persists and the fact that Pamplemousses has also shown a significant mcrease in breast cancer incidence over the recent period, make the breast cancer gradient more marked. This geographical distribution should be closely examined in order to determine if this observation is an artefact due to methods of recording and analysis of the data or if we are witnessing real environmental determinants in action.

We have already made several recommendations and elaborated on risk factors at length in our previous report (Khittoo 2000). These recommendations and comments are still valid today and are supported by the findings in this new report and the current scientific literature. We should perhaps reiterate that if we are to understand the nature of breast cancer among Mauritian women to the level achieved in industrialised nations, we need to mobilise the resources to conduct more population based studies coupled with molecular aspects of the disease: the majority of scientists working on breast cancer seem to agree that this is a good approach if we are to finally be able to find a viable solution for curbing the disease.

REFERENCES

1. Chaudru V, Laing A, Dunston GM, et al. Genetic Epidemiology 2002; 22: 285-297.

2. Kallioniemi A; Molecular Signatures of Breast Cancer-Predicting the Future. N Engl J Med 2002; 347: 2067-2068.

3. Key T. Serum oestradiol and breast cancer risk. Endocrine-Related Cancer 1999; 6:175-180.

4. Khittoo G. Final report submitted to MRC, 2000.

5. Kuerer HM, Buzdar AU, Singletary SE. Biologic basis and evolving role of aromatase inhibitors in the management of invasive carcinoma of the breast. Journal of Surgical Oncology 2001; 77:139-147.

6. Li L, Clark RA, Thomas J. Computer-aided diagnosis of masses with full-field digital mammography. Acad Radiol 2002; 9:4–12.

7. Lichtenstein P, Holm NV, Verkasalo PK, Iliadou A, Kaprio J, Koskenvuo M, Pukkala E, Skytthe A, Hemminki K. Environmental and heritable factors in the causation of cancer--analyses of cohorts of twins from Sweden, Denmark, and Finland. N Engl J Med. 2000; 343(2):78-85.

8. Lenning PE, Serlie T, Perou CM, Brown PO, Botstein D, Berresen-Dale AL: Microarrays in primary breast cancer lessons from chemotherapy studies. Endocrine-Related Cancer 2001; 8: 259-263.

9. Parker SL, Tong T, Bolden S, Wingo PA. Cancer statistics 1997. CA Cancer J Clin 1997; 47: 5-27.

10. Parkin DM, Muir CS, Whelan SL, Gao J, Powell: Cancer Incidence in Five Continents. IARC Scientific Publication No. 120. International Agency for research on Cancer Lyon, 1992.

11. Pike, M. C., Spicer, D. V., Dahmoush, L. and Press, M. F., 1993, Estrogens, progestogens, normal breast cell proliferation and breast cancer risk. Epidemiological Review, 15, 17–21.

12. Sakorafas GH and Tsiotou AG: Genetic predisposition to breast cancer; a surgical perspective: British Journal of Surgery 2000, 87: 149-162.

13. Sidransky D; Emerging molecular markers of cancer. Nature reviews 2002; 2: 210-219.

14. Van't Veer Lj, Dai H, van de Vijver MJ, et al: Gene expression profiling predicts clinical outcome of breast cancer. Nature 2002;415:530-536.

15. Ziegler RG, Hoover RN, Pike MC et al: Migration patterns and breast cancer risk in Asian-American women. J Natl Cancer Inst 1993; 85: 1819-1827

Web Sites:

http://www.plesser.com/pdf/TechnologyBreastCancer.pdf

http://cancer.gov/cancerinfo/digestpage/proteomics

APPENDJXI

APPENDIX I

	1990-1995	1996-2001	1990-2001
Lung	6.4	7.4	6.9
Pharynx	3.3	3.8	3.6
Prostate	2.4	4.0	3.2
Colon/Rectum	2.6	3.8	3.2
Stomach	2.3	3.4	2.8
Mouth	2.8	2.6	2.7
Brain/Nervous System	2.2	2.6	2.4
Urinary Bladder	2.3	2.2	2.2
Non Hodgkin's Lymphoma	1.2	2.0	1.6
Oesophagus	1.4	1.9	1.6
Others	14.6	18.6	16.6

Table 1: Incidence for the Ten most common Cancer Sites in the Mauritian Men

	1990-1995	1996-2001	1990-2001
Breast	16.9	26.9	21.9
Cervix	12.3	11.7	12.0
Ovary	3.7	4.3	4.0
Colon/Rectum	2.1	3.4	2.7
Brain/Nervous System	1.9	2.5	2.2
Lung	1.3	2.3	1.8
Stomach	1.6	1.5	1.5
Uterus	1.0	2.0	1.5
Non Hodgkin's Lymphoma	1.0	1.4	1.2
Endometrium	0.7	1.6	1.2
Others	16.6	20.6	18.6

Table 2: Incidence for the Ten most common Cancer Sites in the Mauritian Women

	1990-1995	1996-2001	1990-2001
15-19	0.6	0.3	0.5
20-24	1.8	0.3	1.1
25-29	3.7	2.3	3.0
30-34	14.5	14.6	14.6
35-39	32.0	33.2	32.6
40-44	33.2	47.4	40.3
45-49	48.2	68.7	58.4
50-54	54.7	82.6	68.7
55-59	45.2	80.8	63.0
60-64	44.4	88.5	66.5
65-69	39.1	70.0	54.5
70-74	51.7	76.5	64.1
75-79	54.2	80.3	67.2
80-84	43.7	75.4	68.2
85 and above	33.4	54.4	43.9

Table 3: Incidence of Breast Cancer by age group

	1990-1995	1996-2001	1990-2001
Plaines Wilhems	25.8	36.6	31.2
Port Louis	24.4	33.4	28.9
Black River	17.9	24.3	21.1
Pamplemousses	10.1	26.0	18.1
Moka	12.1	20.4	16.2
Savanne	11.2	19.7	15.4
Flacq	12.9	16.7	14.8
Riv. Du Rempart	11.7	16.9	14.3
Grand port	11	17.5	14.2

Table 4: Incidence Rate of Breast Cancer in the Districts of Mauritius

	1990-1995	1996-2001	1990-2001
Chinese	27.3	31.3	29.3
General Population	19.7	31.8	25.7
Muslim	17.4	29.1	23.2
Hindu	16.4	23.4	19.9

Table 5: Incidence of Breast Cancer in the different Ethnic Groups of Mauritius

	1990-1995	1996-2001	1990-2001
Quatre Bornes	12.9	20.2	16.5
B.Bassin/R.Hill	31.0	13.9	22.5
Curepipe	7.8	15.8	11.8
Vacoas/Phoenix	10.5	12	11.3
Port Louis	9.0	13.5	11.3

Table 6: Incidence Rates of Breast Cancer in Major Towns of Mauritius

APPENDIX II

CHAPTER TWENTY-TWO

Breast cancer in Mauritian women: An institution-based study

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22.1 ABSTRACT

Analysis of data collected for a five year period spanning from 1994 to 1998 at the Radio Therapy Unit of Mauritius confirmed that breast cancer is the leading cancer affecting Mauritian women. The age adjusted incidence of breast cancer indicated that breast cancer increased with old age as already shown in several developed countries. Surprisingly, in a small territory like Mauritius there seems to be a significant difference among the distribution of breast cancer across the island with a higher incidence rate in highly urbanized areas. Comparison of breast cancer incidence among the four major ethnic groups in the island showed no significant difference in the distribution of cancer in the different communities, supporting the notion of a strong environmental influence on the prevalence of breast cancer.

22.2 INTRODUCTION

In spite of the significant advances and groundbreaking discoveries witnessed in cancer research over the past three decades, breast cancer remains a major challenge facing public health today. Indeed, breast cancer is the third most frequent cancer in the world after lung and stomach cancers. Recent epidemiological studies confirm that breast cancer is by far the most important cancer affecting women across the world, reaching up to 21% of all new cancers (Chu *et al* 1996, Parkin *et al* 1999). About one in 12 women in the western developed countries develop breast cancer compared to an average of 2.2% in developing countries (Parkin *et al* 1999).

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Edited by Theeshan Bahorun and Ameenah Gurib-Fakim

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Although the major advances made in the early detection and treatment have brought some relief to breast cancer patients, the etiology of the disease remains uncertain. Several risk factors which have been invoked for breast cancer include increasing age, a family history of breast cancer, diet, especially one rich in fat, consumption of alcohol, age at first child birth, menarche and menopause (Parkin 1999). Nevertheless no single factor seems to act alone and a number of epidemiological studies have shown that there is a genetic predisposition to breast cancer (Peto *et al* 1996). However, only a small proportion (5 to 10%) of breast cancer cases can be attributed to inherited susceptibility.

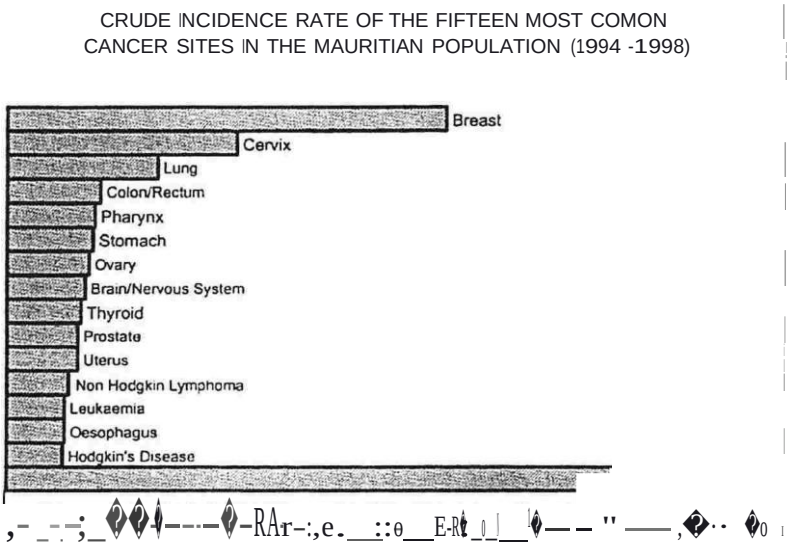

Figure 22.1 Fifteen most prevalent cancer sites in the Mauritian population.

The two most important genes conferring dominant susceptibility are the two tumour suppressor genes BRCA1 and BRCA2 (Hall *et al* 1990, Miki *et al* 1996, Bertwistle and Ashworth 1999). In addition to these two genes, numerous molecular alterations have been found in breast cancer. These include mutations in the tumour suppressor gene p53 and genes involved in the metabolism of oestrogens (Feigelson *et al* 1998). How these breast cancer susceptible genes interact with environment factors remains a major challenge (Rahman and Stratton 1998). Nevertheless, the fact that several studies of migrants show a convergence towards local cancer rates, excludes genetic susceptibility as an explanation for the difference in incidence of breast cancer among different populations. It is therefore not surprising that cancer epidemiologists have concluded that most cancers can possibly be avoided by a suitable choice of lifestyle and environment (Peto *et al* 2001).

In Mauritius, the cancer situation is poorly understood largely because there have been very few studies in the field conducted on the island and the fact that a national cancer registry has only

become available very recently. In an attempt to help understand how breast cancer is affecting the Mauritian population we have initiated an institution-based study of breast cancer in the Victoria general hospital, the major hospital of the island which also houses the only Radio Therapy Unit (RTU). An estimated figure of about 80% of breast cancer patients in Mauritius attends this unique department at some point for diagnosis or treatment. It is therefore expected that an epidemiological study on breast cancer at the RTU will provide an accurate picture of breast cancer in the Mauritian population. Here we present the results obtained in this institution-based study of breast cancer affecting Mauritian women.

22.3 MATERIALS AND METHODS

22.3.1 Analysis of the prevalence of breast cancer in Mauritius

Data from the medical records available at the Radio Therapy Unit at Victoria General Hospital were compiled and analysed to compare the incidence of breast cancer with those of other cancers using standard statistical methods outlined in Cancer of the Five Continents (Parkin *et al* 1992). As these records represent a large majority of cancer cases in Mauritius it was felt that we would be able to obtain a general picture of the trends in the breast cancer situation in Mauritius and at the same time put breast cancer in proper perspective with the other forms of cancers that were prevalent in Mauritius during the period of study (1994-1998).

22.4 RESULTS AND DISCUSSION

22.4.1 Comparison of breast cancer with the other leading cancers

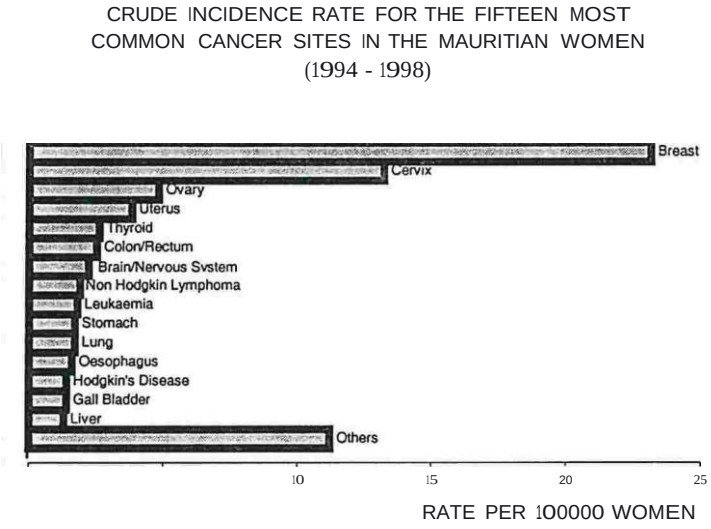

Figure 22.2 Fifteen most prevalent cancer sites in Mauritian women.

Although our main focus was the breast cancer situation on the island, examination of the different cancers affecting the Mauritian population enabled us to get a better perspective of the prevalence of breast cancer in Mauritius.

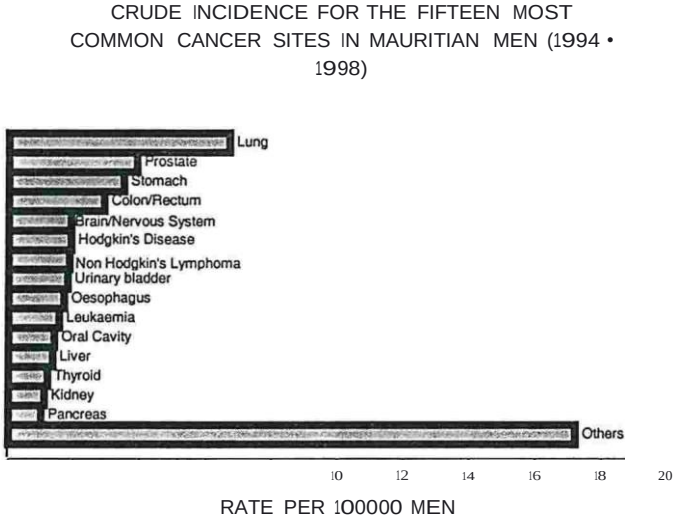

Figure 22.3 Fifteen most prevalent cancer sites in Mauritian men.

Data logged for the past five years (1994-1998) in the record books kept at the RTU were analysed using simple statistical methods to examine frequencies and distributions of various cancers with a hope to identify existing trends

Figure 22.1 shows the 15 most prevalent cancers affecting the combined female and male population. Breast cancer is by far the most prevalent of all cancers in Mauritius. At first sight the pattern of distribution of cancer in Mauritius looks different from those emanating from observations in Western Europe and North America where lung cancer is the dominant one. Furthermore, the pattern of cancer on the island is also different from recent data (Parkin 1999) which show that lung cancer and stomach cancer are the two most prevalent cancer worldwide. However, if we compare the frequency of the leading cancers in different countries with our data we find that a majority of the top cancers (up to 8 out of 10) in Mauritius are also present among the ten most prevalent cancers affecting the industrialised nations.

22.4.2 Comparison of the cancer sites affecting females and males

Inspection of Figures 22.2 and 22.3 (where data for females and males are presented separately) reveals a totally different picture from that of the total population (Figure 22.1), confirming that cancers do not affect Mauritian women and men the same way. For instance, lung cancer, the most prevalent cancer affecting men is not listed among the top 10 cancers affecting women. As expected breast cancer is the dominating cancer (31.3% of all cancers among women).

Stomach cancer is surprisingly low among Mauritian women (1.8% compared to 6.8% in men). This is in sharp contrast with the world wide figures (Parkin *et al* 1999) which show that stomach cancer is at a high of 9.8% among women and 18.0% among men.

Breast cancer incidence by age groups

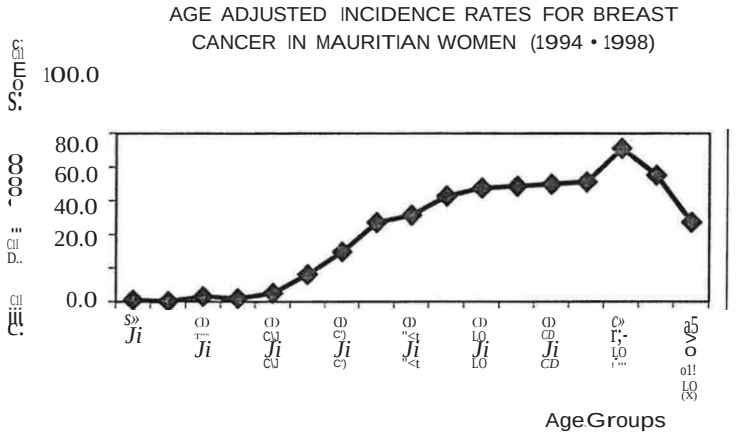

Figure 22.4 Prevalence of breast cancer among women of different age groups.

The incidence of breast cancer among Mauritian women was found to increase with age reaching a peak in the age group of 75 to 79.

When all the number of breast cancer cases obtained for the period 1994 to 1998 were compared it seemed that breast cancer was more prevalent in the 40 to 44 age segment. However when the incidence rates were adjusted for the female population in each age segment, a different picture emerged as shown in Figure 22.4. The graph shows a steady rise in breast cancer incidence with a peak at the age segment from 75 to 79. This illustrates the importance of age adjusted incidence and indicates that the higher number of breast cancer cases for the 40 to 44 age segment is simply a reflection of a larger population in that age group. At the same time the pattern obtained in age adjusted breast cancer incidence among Mauritian women is very similar to those obtained in industrialised countries (Parkin *et al* 1999).

22.4.3 Geography of breast cancer in Mauritius

Cancer rates are known to vary from one geographical rates to another (Ziegler *et al* 1993, Sturgeon *et al* 1995). In spite of its small size Mauritius seems to have different distributions of number of breast cancers and rates in its nine different districts, with a markedly higher prevalence in the western section of the island. The results shown in Figure22.5 indicate that Port-Louis (in the North West area) is the district with the highest breast cancer incidence leaving Flacq (in the Eastern area of Mauritius) as the region of least incidence of breast cancer. The reasons for the differences of breast cancer incidence in urban areas and other regions of a small territory like Mauritius remain obscure and needs further investigation. It is also not clear why the geography of breast cancer is very different from that of all cancer sites.

22.4.4 Ethnic dimension of breast cancer

The Mauritian population can be divided into at least four major ethnic groups including Indo-Mauritian (of Indian origin, about 69%), General Population (of African ancestry, about 28%), Sino-Mauritian (of Chinese origin, about 3%) and European descent (less than 1%). However the demographic statistics compiled by the Mauritian statistical office no longer provide the population size of the different ethnic groups (since 1972). As breast cancer is known to vary among ethnic groups (Parkin 1999) we have attempted to compare its incidence among the different major local ethnic groups. Because it is essential to know the population size to calculate incidence, it was necessary to make a projection of the current population of the ethnic components based on the data available back in 1972.

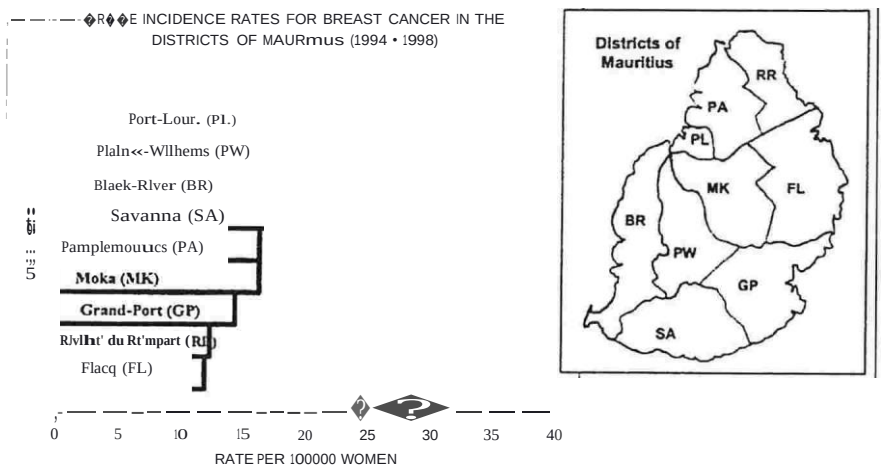

Figure 22.5 Geographical distribution of breast cancer in Mauritius.
The crude incidence rates of breast cancer were shown to vary in different areas of the island. Higher prevalence of breast cancer was encountered in more urbanised regions.

The incidence of breast cancer among the different ethnic groups is shown in Figure 22.6. For the purpose of this study Muslims was separated from Inda-Mauritian because of different lifestyles especially in food habits. A chi-square test when applied to our results showed that there was no significant difference (at $a = 0.05$) in the proportions of cancer in the different communities, confirming the notion that sharing the same environment leads to a convergence of cancer rates among different ethnic groups (Peto *et al* 2001).

22.5 CONCLUSION

This institution-based study clearly shows that breast cancer is a major health concern that warrants a nation wide investigation. More detailed epidemiological data obtained would certainly clarify trends of this important disease. The multi-ethnic composition of the Mauritian population could be a useful model for cancer studies. A mutation has been identified in a

Mauritian family of Indian origin (Khittoo *et al,* 2001) which indicates that in depth studies are mandatory in order to obtain the complete picture of the breast cancer in Mauritius.

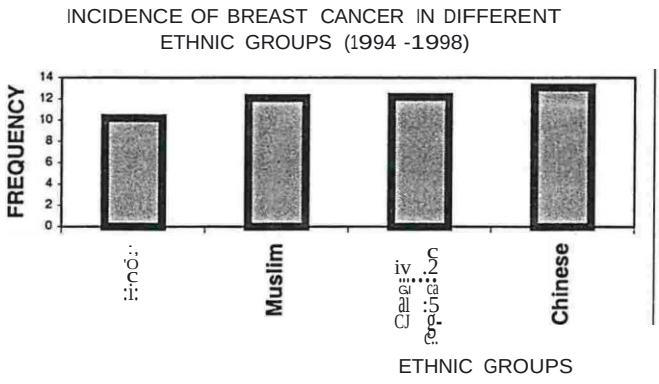

Figure 22 6 Ethnic dimension of breast cancer in Mauritius.
The data collected at the radio Therapy Unit showed that there was no significant difference in the distribution of breast cancer incidence in the major ethnic groups in Mauritius.

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REFERENCES

Bertwistle, D and Ashworth, A. (1999). The pathology of familial breast cancer: How do the functions of BRCA1 and BRCA2 relate to breast tumour pathology? *Breast Cancer Research* 141-7.

Chu, K. C., Tarone, R. E., Kessler, L. G., Ries, L.A., Hankey, B. F., Miller, B. A and Edwards, B. K. (1996). Recent trends in U.S. breast cancer incidence, survival, and mortality rates. *Journal of the National Cancer Institute* 88 1571-1579.

Feigelson, H.S., Ross, R.K., Yu, M.C., Coetzee, G.A., Reichardt, J.K.V and Henderson, B.E. (1998). Sex steroid and genetic susceptibility to breast and prostate cancer. *Drug Metabolism Reviews.* 30 421-434.

Hall, J.M., Lee, M.K., Newman, B., Morrow, J.E., Anderson, L.A., Huey, Band King, M.C. (1990). Linkage analysis of early onset familial breast cancer to chromosome 17q21. *Science* 250 1684-1689.

Khittoo, G., Manning, A., Mustun, H., Appadoo, J., Venkatasamy, S., Fagoonee, I., Ghadirian, P and Tonin, P. N. (2001). Mutation analysis of a Mauritian heredity breast cancer family reveals the *BRCA2* 6503delTT mutation previously found to recur in different ethnic populations. *Human Heredity* 52 55-58.

Miki, Y., Katagiri, T., Kasumi, F., Yoshimoto, T and Nakamura, Y. (1996). Mutation analysis in the *BRCA2* gene in primary breast cancers. *Nature Genetics* 13 245-247.

Parkin, D.M. (1999). Breast cancer in Europe: Epidemiology and forecasts. International Agency for Research on Cancer (IARC) Scientific publications. Lyon, France.

Parkin, D.M., Muir, C.S., Whelan, S.L., Gao, Y.T., Ferlay, J and Powell, J. (1992). Cancer Incidence in Five Continents. IARC Scientific publications No. 120. International Agency for Research on Cancer, Lyon.

Parkin, D.M., Pisani, P and Ferlay, J. (1999). Estimates of the worldwide incidence of twenty• five major cancers in 1990. *International Journal of Cancer* 80 827-841.

Peto, J. (2001). Cancer epidemiology in the last century and the next decade. *Nature* 411 390-395.

Peto, J., Easton, D.F., Matthews, F.E., Ford, D and Swerdlow, A.J. (1996). Cancer mortality in relatives of women with breast cancer: The OPCS study. *International Journal of Cancer* 65 275-283.

Rahman, N and Stratton, M.R. (1998). The genetics of breast cancer susceptibility. *Annual Review of Genetics* 32 95-121.

Sturgeon, S. R., Schairer, C., Gail, M., McAdams, M., Brinton, L. A and Hoover, R. N. (1995). Geographic variation in mortality from breast cancer among white women in the United States. *Journal of the National Cancer Institute* 87 1846-1853.

Ziegler, R. G., Hoover, R. N., Pike, M. C., Hildesheim, A., Nomura, A. M., West, D. W., Wu, Williams, A.H., Kolonel, L. N., Horn Ross, P. L., Rosenthal, J. F and Hyer, M. B. (1993). Migration patterns and breast cancer risk in Asian-American women. *Journal of the National Cancer Institute* 85 1819-1827.