CANCER IN AFRICA

WHAT DID WE LEARN IN THE LAST 50 YEARS?

Dr D. M. Parkin
HISTORY OF AFRICAN CANCER DATA

1900–1950  Case reports
1950’s       Case series (hospitals, pathology)
1960’s       the first registries
               Johannesburg 1953 (Higginson & Oettle)
               Capetown 1956  (Muir Grieve)
               Durban 1964   (Schonland and Bradshaw)
               Kampala 1954  (Davis, Templeton)
               Lourenco Marques 1956 (Prates)
               Ibadan 1960   (Edington)
               Bulawayo 1963 (Skinner)
1970’s       Black hole..........  
1980’s       Renaissance
### African Cancer registries in Cancer Incidence in Five Continents

<table>
<thead>
<tr>
<th>Volume</th>
<th>Period</th>
<th>Registries</th>
<th>Populations</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1950s</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>II</td>
<td>1956–67</td>
<td>4*</td>
<td>7</td>
</tr>
<tr>
<td>III</td>
<td>1968–72</td>
<td>2*</td>
<td>2</td>
</tr>
<tr>
<td>IV</td>
<td>1973–77</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>V</td>
<td>1978–82</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>VI</td>
<td>1983–87</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>VII</td>
<td>1988–92</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>VIII</td>
<td>1993–97</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

* One updates the entry in previous volumes
International Agency for Research on Cancer
World Health Organization

Cancer in Africa
Epidemiology and Prevention

Edited by D.M. Parkin, J. Ferlay, M. Hamdi-Chérif, F. Sitas,
J.O. Thomas, H. Wabinga, S.L. Whelan

IARC Scientific Publications No. 153
IARC Press
LYON 2002
AFRICA 2000
583,000 new cancer cases

- Breast: 9.4%
- Kaposi sarcoma: 10.8%
- Cervix: 11.4%
- Liver: 8.1%
- NHL: 4.7%
- Prostate: 4.4%
- Bladder: 4.0%
- Stomach: 4.0%
- Oesophagus: 3.9%
- Colon/Rectum: 3.5%
- Lung: 3.1%
- Colon/Rectum: 3.5%
- Oesophagus: 3.9%
- Bladder: 4.0%
- Stomach: 4.0%
- Prostate: 4.4%
- NHL: 4.7%
- Breast: 9.4%
- Kaposi sarcoma: 10.8%
- Cervix: 11.4%
- Liver: 8.1%
- NHL: 4.7%
- Prostate: 4.4%
- Bladder: 4.0%
- Stomach: 4.0%
- Oesophagus: 3.9%
- Colon/Rectum: 3.5%
- Lung: 3.1%
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MALES: 283,000 cases

- Prostate: 9.0%
- Liver: 11.2%
- Bladder: 6.1%
- Non-Hodgkin lymphoma: 5.8%
- Oesophagus: 5.4%
- Lung: 4.7%
- Stomach: 4.3%
- Colon/Rectum: 3.9%
- Kaposi sarcoma: 15.5%

FEMALES: 299,000 cases

- Breast: 18.3%
- Cervix uteri: 22.2%
- Kaposi sarcoma: 6.3%
- Liver: 5.1%
- Ovary: 4.1%
- Non-Hodgkin lymphoma: 3.7%
- Stomach: 3.7%
- Colon/Rectum: 3.1%
- Oesophagus: 2.4%

Colon/Rectum: 3.9%
Stomach: 4.3%
Lung: 4.7%
Oesophagus: 5.4%
Non-Hodgkin lymphoma: 5.8%
Bladder: 6.1%
Kaposi sarcoma: 15.5%

Colon/Rectum: 3.1%
Stomach: 4.3%
Lung: 4.7%
Oesophagus: 5.4%
Non-Hodgkin lymphoma: 5.8%
Bladder: 6.1%
Kaposi sarcoma: 6.3%
Age specific incidence of cancer of cervix uteri in Africa

*Algeria, Alger (1993-1996)
*Guinea, Conakry (1993-1997)
*Uganda, Kyadondo (1993-1997)
Trends in incidence of cervix cancer, Kampala, Uganda

Wabinga et al., 2000
Age specific incidence rates of breast cancer in Africa, and in black females in the USA

Mauritius: Breast cancer mortality
UGANDA, Kampala. Breast cancer incidence

Wabinga et al., 2000
Incidence of Liver cancer: ASR [World]-Male [All ages]
HEPATOCELLULAR CARCINOMA

AETIOLOGICAL ASSOCIATIONS

HEPATITIS B VIRUS
HEPATITIS C VIRUS
AFLATOXIN
ALCOHOL
SMOKING
OTHER: diet
arsenic
thorotrast
iron overload
steroid hormones
Prevalence of HBsAg carriers worldwide (%)

- HBsAg < 1
- 1 < HBsAg < 2
- 2 < HBsAg < 5
- 5 < HBsAg < 10
- HBsAg > 10
Global prevalence of Hepatitis C
Based on published data, update 1999
AFLATOXIN & LIVER CANCER

Epidemiological evidence

• Correlation studies
  Aflatoxin in foodstuffs
  Aflatoxin in urine
  Aflatoxin – albumin adducts (blood)

• Case control studies

• Cohort studies

Molecular data

GC : TA transversion at codon 249 of p53
EVALUATING EXPOSURE TO AFLATOXIN

1. Assumed - from measurements in food items
   Alpert et al, 1971 (Uganda); Peers & Linsell, 1973 (Kenya); Peers et al, 1976, 1987 (Swaziland); Van Rensberg et al, 1985, 1990 (South Africa); Omer, 1998 (Sudan)

2. Estimated - from dietary questionnaire plus measures in food items

3. Urinary metabolites
   AUTRUP et al. 1987, (Kenya)

4. Adducts in blood (albumin, haemoglobin)
Combined effects of HBsAg positivity and presence of urinary aflatoxin biomarkers \(^a\) on risk of hepatocellular carcinoma in Shanghai

<table>
<thead>
<tr>
<th>HBsAg</th>
<th>Aflatoxin negative</th>
<th></th>
<th>Aflatoxin positive</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cases (^a)</td>
<td>Controls</td>
<td>RR (^b) (95% CL)</td>
<td>Cases</td>
</tr>
<tr>
<td>Negative</td>
<td>5</td>
<td>134</td>
<td>1.0</td>
<td>13</td>
</tr>
<tr>
<td>Positive</td>
<td>9</td>
<td>24</td>
<td>7.3 (2.2, 24.4)</td>
<td>23</td>
</tr>
</tbody>
</table>

\(^a\) AFB\(_1\), AFP\(_1\), AFM\(_1\) and AFB\(_1\) - N\(^7\) - Gua

\(^b\) Adjusted for cigarette smoking

*From Qian et al (1994)*
Prevalence of 249\textsuperscript{Ser} p53 mutation – Aflatoxin Exposure

Incidences of Hepatocellular Carcinoma

(Total number of cases: ~ 1000)
PREVENTION OF LIVER CANCER

**Vaccination**
- Hepatitis B
- [ Hepatitis C]

**Aflatoxin**
- Reduce exposure
- Detoxication (GST inducers)

SCREENING
Annual crude rate 1964-79, of primary liver cancer among Mozambique gold miners in South Africa (Bradshaw et al, 1982)
BURKITT LYMPHOMA IN AFRICA
(International Incidence of Childhood Cancer Vol. II)

<table>
<thead>
<tr>
<th>Location</th>
<th>Age adj. rates (per 10^6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kampala, Uganda</td>
<td>36.1</td>
</tr>
<tr>
<td>Blantyre, Malawi</td>
<td>35.8</td>
</tr>
<tr>
<td>Ibadan, Nigeria</td>
<td>18.0</td>
</tr>
<tr>
<td>Harare, Zimbabwe</td>
<td>2.4</td>
</tr>
<tr>
<td>Namibia</td>
<td>1.9</td>
</tr>
<tr>
<td>Bamako, Mali</td>
<td>1.7</td>
</tr>
<tr>
<td>US. White</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Age adj. rates (per 10^6)
Distribution of Burkitt lymphoma in Africa (from Haddow, 1963)
Burkitt lymphoma

- **African type (endemic)**
  - Africa, Papua New Guinea
  - malaria, undernourishment, EBV

- **non-African (sporadic)**
  - elsewhere
Burkitt lymphoma
(1980’s; proportion of cases in age-groups)

**Africa**

- Uganda
- Nigeria

**White populations**

- SEER-w
- E & W
- Australia

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Burkitt lymphoma
(1980’s; proportion of cases in age-groups)

Asia

Middle East

Burkitt lymphoma (1980’s; proportion of cases in age-groups)
Burkitt lymphoma

- Epstein-Barr virus
  - identified in 1964 in African-type BL
  - present in over 95% of BL in Africa, 50% South America, 5-15% Western countries

- majority of BL carry translocations affecting c-myc protooncogene, which plays a significant role in cellular growth regulation.
CHROMOSOMAL ABNORMALITIES IN B.L.

Breakpoint on long arm of chromosome 8q

Involves c-myc gene in 90% tumours in the USA
25% tumours in Africa

Translocations:

- t (8; 14) 75%
- t (8; 22) 16%
- t (8; 2) 9%
The evidence linking risk of BL to malaria infection (Morrow, 1985)

- The incidence of BL correlates within and between countries with the incidence of malaria and with parasitaemia rates.
- The age of peak levels of antimalarial antibodies (5–8 years) same as age of peak incidence of BL.
- Individuals living in urban areas where malarial transmission rates are lower also have a lower incidence of BL.
- In regions where death rates due to malaria have declined, BL incidence has also declined.
- The age of BL cases among immigrants from malaria-free areas to malarious areas is higher than that of the original inhabitants.
- There is an inverse relationship between the age at onset of BL and the intensity of infection with *Plasmodium falciparum*.
- There is a reduced incidence of BL in individuals with sickle-cell trait, which also protects against malaria.
- There is some evidence for seasonal variation and for time-space clustering of BL cases.
Trends in the incidence rate (three-year moving average) of Burkitt lymphoma in East Africa
(data from Geser et al., 1989)
Mortality from Prostate cancer: ASR (World) (All ages)
### PROSTATE

#### SEER INCIDENCE Rates Among Men, 1988-1992

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>180.6</td>
</tr>
<tr>
<td>Chinese</td>
<td>46.0</td>
</tr>
<tr>
<td>Filipino</td>
<td>69.8</td>
</tr>
<tr>
<td>Hawaiian</td>
<td>57.2</td>
</tr>
<tr>
<td>Japanese</td>
<td>88.0</td>
</tr>
<tr>
<td>Korean</td>
<td>24.2</td>
</tr>
<tr>
<td>Vietnamese</td>
<td>40.0</td>
</tr>
<tr>
<td>White</td>
<td>134.7</td>
</tr>
</tbody>
</table>
Age specific incidence of prostate cancer

- Uganda, Kyadondo (1993-1997)
- USA, SEER: Black (1993-1997)
PROSTATE CANCER

Genetic Mechanisms:

Polymorphisms of

5 alpha reductase (SRD 5 A2)
Androgen receptor gene
Vitamin D receptor gene
Mauritius: Prostate cancer mortality 1964-1998, (3-year moving average)
Trends in incidence of prostate cancer, Kampala, Uganda

Wabinga et al., 2000
**Schistosomiasis & Bladder Cancer**

*Schistosoma haematobium* : sufficient evidence (group 1) - IARC Monograph 61 (1994)

- **Clinical observations**
  the two diseases appear to frequently co-exist in the same individual, and the bladder cancers are of squamous cell origin, rather than transitional cell carcinomas.

- **Descriptive studies**
  correlation between the two diseases in different populations.

- **Case-control studies**
  compare infection with *Schistosoma haematobium* in bladder cancer cases and controls.
Zimbabwe, Harare: African
Zimbabwe, Bulawayo: African
UK, England and Wales
US, SEER: Black
France (8 regs)
Kuwait: Kuwaititis
Latin America Caribbean
Mali, Bamako
Japan (6 regs)
India (6 regs)
Uganda, Kyadondo
Algeria, Setif

World Standardised Rate (0-85+), per 100,000

CI5VII (IARC 1997)
Global distribution of schistosomiasis due to *Schistosoma haematobium*
Bladder, Transitional cell Carcinoma
Bladder, Squamous cell Carcinoma
Bladder, Sarcoma
Bladder, Unspec. Carcinoma
Bladder, Adenocarcinoma
Bladder, Unspec. morphology
Bladder, Other morphology

Crude rate (0-85+), per 100,000

CI5VII (IARC 1997)
BLADDER CANCER CASES: BULAWAYO 1963-1977

447 Males

179 Females

- Squamous
- Transitional
- Other
- Unspecified
<table>
<thead>
<tr>
<th>Study</th>
<th>Cases / Controls</th>
<th>Infection</th>
<th>O.R.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mustacci &amp; Shimkin (1958)</td>
<td>48 / 940</td>
<td>Eggs in urine</td>
<td>2.1</td>
</tr>
<tr>
<td>[Egypt]</td>
<td></td>
<td>(hospital)</td>
<td></td>
</tr>
<tr>
<td>Gelfand et al (1967)</td>
<td>33 / 33</td>
<td>Bladder calcification</td>
<td>15.0 (2.9-33.2)</td>
</tr>
<tr>
<td>[Rhodesia]</td>
<td></td>
<td>(hospital)</td>
<td></td>
</tr>
<tr>
<td>Elem &amp; Purohit (1983)</td>
<td>50 / 50</td>
<td>Bladder calcification</td>
<td>3.8 (1.4-10)</td>
</tr>
<tr>
<td>[Zambia]</td>
<td></td>
<td>(necropsies)</td>
<td></td>
</tr>
<tr>
<td>Digested eggs</td>
<td></td>
<td></td>
<td>14.0 (4.6-43)</td>
</tr>
<tr>
<td>Vizcaino et al (1994)</td>
<td>300 / 2078 (males)</td>
<td>Past history</td>
<td>3.9 (2.9-5.2)</td>
</tr>
<tr>
<td>[Zimbabwe]</td>
<td></td>
<td>(registry)</td>
<td></td>
</tr>
<tr>
<td>(self-report)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bedwani et al (1998)</td>
<td>190 / 187</td>
<td>Past history</td>
<td>1.7 (1.0-2.9)*</td>
</tr>
<tr>
<td>[Egypt]</td>
<td></td>
<td>(hospital)</td>
<td></td>
</tr>
<tr>
<td>(self-report)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* only 18% cases were SCC (Bedwani et al, 1997)
SCHISTOSOMIASIS & BLADDER CANCER
Mechanisms of carcinogenesis

- Inflammation/cell proliferation
- Metabolic changes.
- Immunological changes
- Secondary infection
- Viruses
- \( \beta \)-glucuronidase
- Genetic damage in schistosomiasis patients
Bladder cancer and S. haematobium in Africa

<table>
<thead>
<tr>
<th>AREA</th>
<th>PREVALENCE</th>
<th>CASES (2000)</th>
<th>AF(%)*</th>
<th>CASES due to S. haem.</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Africa</td>
<td>29.2</td>
<td>4268</td>
<td>54</td>
<td>2305</td>
</tr>
<tr>
<td>Middle Africa</td>
<td>30.3</td>
<td>699</td>
<td>55</td>
<td>384</td>
</tr>
<tr>
<td>Northern Africa</td>
<td>11.3</td>
<td>16381</td>
<td>31</td>
<td>5078</td>
</tr>
<tr>
<td>Southern Africa</td>
<td>10.2</td>
<td>1893</td>
<td>29</td>
<td>549</td>
</tr>
<tr>
<td>Western Africa</td>
<td>32.6</td>
<td>2807</td>
<td>57</td>
<td>1600</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>26048</td>
<td>38.1</td>
<td>9916</td>
</tr>
</tbody>
</table>

* Assuming relative risk = 5

* Assuming relative risk = 5
Stomach cancer: ASR (World)-Male (All ages)
### Population seroprevalence of *H. pylori* antibodies in African adults

<table>
<thead>
<tr>
<th>Country</th>
<th>Study Authors</th>
<th>Year</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ivory Coast</td>
<td>Megraud et al., 1989</td>
<td>1989</td>
<td>71%</td>
</tr>
<tr>
<td>Algeria</td>
<td>Megraud et al., 1989</td>
<td>1989</td>
<td>79%</td>
</tr>
<tr>
<td>Nigeria</td>
<td>Holcombe et al., 1989</td>
<td>1989</td>
<td>85%</td>
</tr>
<tr>
<td>Zaire (DRC)</td>
<td>Glupzynski et al., 1989</td>
<td>1989</td>
<td>79%</td>
</tr>
<tr>
<td>South Africa</td>
<td>Sitas et al., 1997</td>
<td>1997</td>
<td>86%</td>
</tr>
<tr>
<td>South Africa</td>
<td>Sathar et al., 1994</td>
<td>1994</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Africans</td>
<td></td>
<td>93%</td>
</tr>
<tr>
<td></td>
<td>Indians</td>
<td></td>
<td>83%</td>
</tr>
<tr>
<td></td>
<td>Mixed race</td>
<td></td>
<td>81%</td>
</tr>
<tr>
<td></td>
<td>Whites</td>
<td></td>
<td>42%</td>
</tr>
</tbody>
</table>
Trends in oesophagus cancer incidence, Kampala, Uganda (Wabinga et al, 2000)
Trends in mortality from cancer of the oesophagus, males (above) and females (below).

SOUTH AFRICA 1949-1979 (Bradshaw and Harington, 1985)
Annual crude rate 1964-79, of oesophageal cancer among Mozambique and Transkeian gold miners in South Africa (Bradshaw et al, 1982)
Spread of HIV in sub-Saharan Africa, 1984 to 1999

Estimated percentage of adults (15–49) infected with HIV:

- 20.0% – 36.0%
- 10.0% – 20.0%
- 5.0% – 10.0%
- 1.0% – 5.0%
- 0.0% – 1.0%
- Trend data unavailable
- Outside region
Trends in Kaposi Sarcoma, Kampala Cancer Registry

Age standardized rate (per 100,000)

<table>
<thead>
<tr>
<th>Year</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960-66</td>
<td>3.2</td>
<td>0.1</td>
</tr>
<tr>
<td>1967-71</td>
<td>3.7</td>
<td>0.2</td>
</tr>
<tr>
<td>1991-94</td>
<td>39.3</td>
<td>17.9</td>
</tr>
<tr>
<td>1995-97</td>
<td>39.3</td>
<td>21.8</td>
</tr>
</tbody>
</table>

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Kaposi’s sarcoma in East Africa

![Bar chart showing the distribution of Kaposi's sarcoma by gender and country in East Africa. The chart indicates a higher prevalence among males compared to females, with Zimbabwe showing the highest male-to-female ratio.](chart.png)
Uganda, Kyadondo County (1993-1997)
CANCER IS NOT RARE IN AFRICA

Cumulative incidence of cancer (excluding Kaposi sarcoma and non-melanoma skin cancer) in women, 0–64 years of age, 1993–97 (Parkin et al., 2002)

<table>
<thead>
<tr>
<th>Location</th>
<th>Cumulative incidence (0–64 years) %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uganda, Kampala</td>
<td>11.3</td>
</tr>
<tr>
<td>Harare, Zimbabwe</td>
<td>12.6</td>
</tr>
<tr>
<td>England</td>
<td>15.2</td>
</tr>
<tr>
<td>France*</td>
<td>14.0</td>
</tr>
<tr>
<td>Sweden</td>
<td>14.4</td>
</tr>
</tbody>
</table>

* 9 cancer registries
Radiotherapy Services in Africa

From Levin et al., 1999
Population Growth and Aging: 2000-2050

<table>
<thead>
<tr>
<th>Region</th>
<th>2000</th>
<th>2020</th>
<th>2050</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Elderly</td>
</tr>
<tr>
<td></td>
<td>(%)</td>
<td>(%)</td>
<td>(%)</td>
<td>(%)</td>
</tr>
<tr>
<td>EUROPE</td>
<td>729</td>
<td>712</td>
<td>628</td>
<td>-14</td>
</tr>
<tr>
<td>AFRICA</td>
<td>784</td>
<td>1187</td>
<td>1766</td>
<td>+125</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+466</td>
</tr>
</tbody>
</table>
Increase in cancer numbers: by region

Africa

Asia

Europe

2000 2010 2020 2050

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