Pattern of cancer mortality in some Brazilian HBRAs

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Abstract. Among residents of Brazilian High Background Radiation Areas, there is great concern about radiation-related health effects and there is also a common certitude that cancer incidence is higher in those areas than in other Brazilian areas with normal background radiation. This paper aims to present an overview of Brazilian High Background Radiation Areas and evaluate whether cancer mortality among residents from Poços de Caldas, Araxá, and Guaraí is higher than would be expected when applying mortality rate of their respective States. Results show that cancer mortality from the Brazilian HBRAs, Poços de Caldas, and Guaraí is higher than would be expected for their respective reference population. On the other hand, cancer mortality for the Araxá population is lower than would be expected. © 2004 Elsevier B.V. All rights reserved.

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1. Introduction

Some Brazilian locations have been globally recognized as High Background Radiation Areas (HBRAs); included among these are Poços de Caldas, Araxá, and Tapira, all located in Minas Gerais State and Guaraí, located in Espirito Santo State [1,2]. As a consequence of this recognition, residents of those areas have great concern about radiation-related health effects. There is a common sense among these populations that cancer incidence is higher than in other Brazilian areas with normal background radiation. Nevertheless, no previous cancer statistics have been shown to support this hypothesis and, until the present time, no health effect study had been conducted in Brazilian HBRAs. Most of the data concerning natural radiation exposure in those areas were obtained during...
the late 1970s. Recently new assessments were performed at Poços de Caldas [3] and Guarapari [4]. Those results indicated that the great urbanization process in Guarapari changed the radiation exposure pattern; the external radiation exposure is at present lower than that in the past. The radiation level in Guarapari can be considered normal, except in the hot spots on the beaches and in the fishing village of Meaípe [4]. At Poços de Caldas, it was shown that only rural areas could be considered as high natural background radiation areas. The radiation dose in urban areas can be considered normal.

Therefore, this paper aims to assess whether there is an excess of cancer mortality among residents from Poços de Caldas, Araxá, and Guarapari in comparison with a reference population. The State of Minas Gerais was used as the standard population for Poços de Caldas and Araxá, and the Espirito Santo State for Guarapari.

2. Methodology

Mortality data on cancer and all other causes of death were examined for Poços de Caldas, Araxá, and Guarapari as well as for the States of Minas Gerais and Espirito Santo, which were used as reference areas. Mortality data from 1991 to 2000, obtained from the Brazilian National Mortality System, were evaluated for both sexes and for the following age intervals: <1, 1–4, 5–9, 10–14, 15–19, 20–29, 30–39, 40–49, 50–59, 60–69, 70–79, and 80 and over. Standardized mortality ratios (SMRs) for every city were estimated as the ratio of deaths observed to those expected. Expected numbers of death for the cities of Poços de Caldas and Araxá were obtained by multiplying the sex and age group stratum’s population by different cancer sex–age-specific death rates for the Minas Gerais State. The expected numbers of deaths for Guarapari City were obtained by applying cancer sex-age-specific death rates for Espirito Santo State.

3. Results

Table 1 presents the observed and expected numbers of deaths for selected cancer and all causes of death for cities of Araxá and Poços de Caldas, respectively, using the specific general mortality for Minas Gerais State as the standard population. For the Araxá population, mortality for all causes of death was significantly higher than expected from the reference population (SMR=118, CI=115–121). Nevertheless, total cancer did not
Table 2
Standardized mortality ratios for Guarapari City, both genders, 1991–2000

<table>
<thead>
<tr>
<th>International classification of diseases</th>
<th>Cause of death</th>
<th>Obs</th>
<th>SMR 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICD-9</td>
<td>ICD-10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>001–999</td>
<td>A00–Z99</td>
<td>All causes</td>
<td>3942</td>
</tr>
<tr>
<td>140–239</td>
<td>C00–D48</td>
<td>All cancer sites</td>
<td>468</td>
</tr>
<tr>
<td>150</td>
<td>C15</td>
<td>Esophagus</td>
<td>42</td>
</tr>
<tr>
<td>151</td>
<td>C16</td>
<td>Stomach</td>
<td>90</td>
</tr>
<tr>
<td>161</td>
<td>C32</td>
<td>Larynx</td>
<td>9</td>
</tr>
<tr>
<td>162</td>
<td>C33–C34</td>
<td>Lung</td>
<td>77</td>
</tr>
<tr>
<td>174</td>
<td>C50</td>
<td>Female breast</td>
<td>28</td>
</tr>
<tr>
<td>185</td>
<td>C61</td>
<td>Prostate</td>
<td>48</td>
</tr>
<tr>
<td>204–208</td>
<td>C91–C95</td>
<td>All leukemias</td>
<td>19</td>
</tr>
</tbody>
</table>

exceed the expectation and no statistically significant excess was observed for any selected cancer sites.

For Poços de Caldas, mortality for all causes and all cancers were significantly higher than expected. Among single cancer sites, stomach, lung, breast, and leukemia showed statistically significant excess. Larynx and prostate showed nonsignificant excesses ranging from 20% to 26%, whereas esophagus cancer was below the expectation. Among leukemia subtypes, lymphocytic and myelocytic leukemia presented a nonstatistically significant excess (SMR=120, CI=60–215 and SMR=123, CI=74–193, respectively), whereas for cellular type not specified, statistically significant excess was observed (SMR=242, CI=146–378).

Table 2 presents the standardized mortality ratio for the Guarapari population, using the specific general mortality for Espirito Santo State. Mortality for all causes was significantly lower than expected (SMR=95, CI=92–98), whereas a nonsignificant excess of 9% was observed for all cancer mortality. Among single cancer sites, high statistically significant SMRs were observed for esophagus, stomach, lung, and prostate cancer. Mortality from leukemia was close to the rate expected, whereas larynx and breast cancer were slightly higher than expected, although not statistically significant.

4. Discussion

Studies of geographical variation need to be interpreted with caution because many factors other than environmental exposure can contribute to such variation in the recorded frequency of disease or death. Mortality data can be affected by varying qualities of cause of death certification and differences in survival among regions. The imprecision of the available data can also conduce to a dilution effect and biases the results. Genetic and ethnic factors may confound geographical variations, and migration patterns may also affect geographical comparisons if there are substantial inward or outward movements.

Despite the higher cancer mortality observed for some cancer sites in the Poços de Caldas population, the estimated doses from natural radiation at Poços de Caldas indicated that only the rural population would be highly exposed. For the Guarapari population, the higher cancer mortality cannot be related to the radiation exposure, based on the fact that radiation levels in Guarapari city can be considered normal, with high spots only at the beaches, and levels are not significant concerning chronic public exposure.
The observed excess cancer mortality in Poços de Caldas and Guarapari HBRAs must be seen as the result of a very preliminary study, and further analysis should include other important variables, such as socioeconomic status, smoking, and dietary habits, as well as other aspects of environmental exposure such as pesticide use in agricultural activities (mainly for Poços de Caldas). Quality of cause of death certification in those regions must be also assessed.

5. Conclusion

This report represents the first time that cancer mortality has been assessed for Brazilian HBRAs. It was observed that cancer mortality for Poços de Caldas and Guarapari is higher than would be expected for their respective reference populations, Minas Gerais State and Espirito Santo State, respectively. On the other hand, cancer mortality for the Araxá population is lower than would be expected.

Nevertheless, natural radiation levels at those regions cannot be associated with this excess cancer mortality. Other aspects of environmental exposure must be investigated in a more consistent study.

References