Original Article (short paper)

Geographic distribution of Research Groups and their publications on diet and exercise interventions in cancer in the Brazilian territory

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Abstract — Aims: This study promoted a screening of the geographical distribution and scientific production of the Brazilian research groups on interventions with diet and/or exercise in cancer. **Methods**: A systematic search on the current basis of the Directory of Research Groups of the National Council for Scientific and Technological Development was done to collect information such as name of group; name of leader; unit of federation; institution; year of creation; number of researchers, students and technicians; and the group's knowledge sub-area. All leaders' curricula were accessed to screen their general publications on cancer and their specific publications on nutrition, exercise and cancer. The publications were classified according to the QUALIS (2015) criteria of the Coordination of Improvement of Higher Education Personnel in the Physical Education area. **Results:** The Southeast has the highest number of active groups, but the North has no registered groups. The Midwest concentrates the largest number of members in its research groups and the largest overall scientific production on cancer, but the Southeast presents the largest specific production on nutrition, physical exercise and cancer. Most of the specific publications were B2. **Conclusion:** Research groups and scientific contributions involving this knowledge field need to be encouraged and better distributed geographically throughout the Brazilian territory.

Keywords: cancer; interventions; exercise; diet; research groups;

Introduction

Cancer is a major concern in world health because of the high rate of morbidity and mortality. The latest global survey in 2012 reported about 14.1 million new cases of cancer[1]. In developed countries, such as the United States of America, the estimate for 2017 will be 1,688,780 cases, equivalent to more than 4,600 new diagnoses of cancer per day[2]. However, more than four in 10 cases of cancer occurring worldwide are in countries with a Human Development Index (HDI) classified as low or medium[1]. The estimate for Brazil, in the 2016-2017 biennium, points to the occurrence of about 600 thousand new cases of cancer[3].

The progression of the international and national incidence of cancer patients has been accompanied in recent years by innovations in treatments in this area, which contributes positively to the survival and control of these patients[4]. The treatments include multiple approaches, with combined or isolated interventions involving surgical methods, radiotherapy, chemotherapy, immunotherapy and hormone therapy. Despite the progression of the life expectancy of these patients, the side effects to the treatments are numerous and include early fatigue, sarcopenia, osteopenia, cardiovascular dysfunction, overweight, immunosuppression, systemic inflammation, sleep disorders and, consequently, decline in quality of life[5-11].

Eventually, much effort has been invested to investigate further complementary interventions that may counterbalance such effects. Currently, physical exercise and dietary interventions are presented as complementary strategies capable not only of minimizing the side effects of cancer treatments, but also of increasing the efficiency of patient recovery[12,13]. Although research on the subject is recent and in progress, it is necessary to stimulate the development of new studies. Behavioral aspects, such as physical activity, especially physical exercise, and improvement in eating habits, are primarily susceptible to future population interventions aimed at the theme.

In view of this, public actions are necessary to encourage and assist the research centers in the creation of study groups on dietary interventions and physical exercises in cancer, in order to increase the scientific knowledge in this area and to facilitate the population's access to the practice of these Interventions. Up to the present time, there is no record of survey on the research groups and the scientific productions existent on this subject in the national territory. This is why the present study was developed with the purpose of tracing the geographic distribution and scientific production of Brazilian research groups dedicated to studying therapeutic interventions in cancer, especially dietary interventions and physical exercise.

Methods

This study uses publicly available information and does not require registration and evaluation by an ethics committee

in research, in accordance with Article III.2-f of Resolution 466/12 and Article I.2 of Resolution 510/16 of the National Health Council (CONEP) of Brazil.

The tracking of the Brazilian research groups on interventions with diet and/or physical exercise in cancer (RGIDEC) and the survey of the scientific production of their leaders were carried out based on a systematic search in the Directory of Research Groups and in the Lattes Platform of the National Council of Scientific and Technological Development (CNPq) of Brazil, respectively. Only system-certified groups were considered, and only leaders' curricula that had been updated for at least the last three months preceding the search were considered. If the curriculum was not updated, the evaluation was directed to another leader in the same group or to another team representative.

The search was performed by three different researchers during the month of January, 2017, without delimitation of time (years) as inclusion criterion. The third researcher had the function to perform the same research, but to manifest only in case of occurrence of non-consensual data among the other researchers. The data obtained through the survey were considered valid only when all researchers found the same results.

The descriptors used as inclusion criteria were: "cancer and physical exercise", "cancer and physical activity", "cancer and health", "cancer and prevention", "cancer and diet", "cancer and nutrition", and "cancer and rehabilitation". During the compilation of data were excluded the study groups that did not present specific research lines involving the theme, in order to select only the research groups that are dedicated to the study of the effects of diet and physical exercise in patients with cancer.

The information collected from this systematized survey comprised: name of group; name of leader; unit of federation; institution; year of creation; number of researchers, students and technicians; and the group's knowledge sub-area. If the group had more than one leader, only the first leader, in alphabetical sequence, was considered for analysis.

Then, the curricula of the selected group leaders were accessed in the Lattes Platform and their studies were classified based on the 1) year of creation of the group (prior and subsequent to the creation of the RGIDEC) and 2) nature of the publication (general publications about cancer and specific publications on nutrition, exercise and cancer). Initially, only articles whose titles contained the words "cancer", "neoplasia", "carcinoma" and/or "tumor", regardless of author order, were considered. This allowed the selection of the total production (general and specific) of articles on cancer. Then the articles initially selected by the keywords were analyzed by reading the abstract and when necessary, a complete reading of the publication was also done. Three different researchers analyzed and separately selected only publications that associated cancer with dietary interventions and/or exercise. This allowed the selection of specific scientific production on cancer, diet and exercise. Additionally, the specific publications were also classified according to the QUALIS criteria for the year 2015 of the area of Physical Education (area 21), based on the records of the Sucupira Platform of the Coordination of Improvement of Higher Education Personnel (CAPES).

The data were tabulated in the Excel application (Microsoft Corporation™, Redmond, WA, USA), version 2013, submitted to descriptive statistical analysis and presented in absolute and percentage values.

Results

Initially 27 RGIDECs were found and, after the analysis of the inclusion and exclusion criteria, 14 groups remained. Figure 1 shows the distribution of these groups throughout the national territory. The Southeast is the Brazilian region that has the highest concentration of the RGIDECs operating in the country, followed by the Midwest and Northeast. The South appears last and the North has no registered groups. The states of Goiás (GO) and São Paulo (SP) have the largest number of research groups on the subject. Four states have only one registered group (MA, Maranhão; MG, Minas Gerais; PR, Paraná; and RN, Rio Grande do Norte) and 20 states (AC, Acre; AL, Alagoas; AP, Amapá, AM, Amazonas; BA, Bahia; CE, Ceará; ES, Espírito Santo; MT, Mato Grosso; MS, Mato Grosso do Sul; PA, Pará; PB, Paraíba; PE, Pernambuco; PI, Piauí; RJ, Rio de Janeiro; RS, Rio Grande do Sul; RO, Rondônia; RR, Roraima; SC, Santa Catarina; SE, Sergipe; and TO, Tocantins) do not have RGIDEC registered at CNPq.

The progression of the number of RGIDECs created on national territory is illustrated in Figure 2. The first group was established in 1986, but the second group was created only eight years later. The period of greatest increase in the creation of new RGIDECs was the last seven years, when seven new groups were registered.

Table 1 shows the distribution by region and the total number of members involved in the RGIDEC. The Midwest has the largest number of members.

The leaders of the RGIDEC were distributed according to their highest academic title and situation in relation to the scientific productivity grant of CNPq, as shown in Table 2.

Figure 3 shows the general scientific production on cancer (n=188) (Fig 3A) and the specific scientific production on cancer and diet and exercise interventions (n=70) (Fig 3B) of the RGIDEC leaders from different Brazilian regions.

Regarding the total publications on cancer (Fig 3A), the Midwest presented the highest number of scientific articles (43.62%), followed by the Southeast (27.13%), South (20.21%) and Northeast (9.04%). Before the creation of the groups, when the number of publications was 40, the highest numbers of articles on the general theme were published by the Midwest (30%) and South (30%), followed by the Northeast (22.50%) and South (17.5%). But after the creation of the groups, when the number of publications increased to 148, the Midwest was the region with the highest production (47.3%), followed by the Southeast (29.73%), South (17.57%) and Northeast (5.41%).

Regarding the specific productions on cancer and interventions with diet and/or physical exercise (Fig 3B), the Southeast presented the highest total production (44.29%), followed by the South (37.14%), Midwest (14.29%) and Northeast (4.29%). Before the creation of the groups, when the number

of publications was only 8, the highest specific production was in the Southeast (50.0%), followed by the Midwest (37.5%), South (12.5%) and Northeast (0%). After the creation of the groups, when the number of publications rose to 62, the highest specific scientific production remained in the Southeast (43.55%), followed by the South (40.32%), Midwest (11.29%) and Northeast (4.84%).

The subareas of knowledge that concentrate most of the RGIDECs are Physical Education (n=3; 21.4%), Nutrition (n=3; 21.4%) and Public Health (n=3; 21.4%), followed by Physiology (n=2; 14.3%), Medicine (n=2; 14.3%) and Biochemistry (n=1; 7.1%).

The classification of production according to its QUALIS classification in the area of Physical Education showed that of the total of the specific articles found (n=70), 12 (17.14%) were A1, 9 (12.86%) A2, 8 (11.43%) B1, 24 (34.29%) B2, 5 (7.14%) B3, 3 (4.29%) B5, 2 (2.86%) C, and 7 (10.00%) had no QUALIS classification. The region with the highest number of QUALIS A articles, in relation to the total number of specific publications on cancer, nutrition and exercise in the country (n = 70), was the Southeast (n = 10, 14.29%), followed by the South (N = 6, 8.57%), Midwest (n = 4, 5.71%) and Northeast (n=1, 1.43%) regions. However, QUALIS B was the most frequent classification of the specific publications in all Brazilian regions [Southeast (n=15; 21.43%), South (n=19; 27.14%), Northeast (n=2; 2.857%) and Midwest (n=4; 5.71%)]. The only two QUALIS C publications were from the Southeast (n=1; 1.43%) and South (n=1; 1.43%). In addition, the highest number of publications without QUALIS classification was from the Southeast (n=5; 7.14%), followed by the Midwest (n=2; 2.86%).

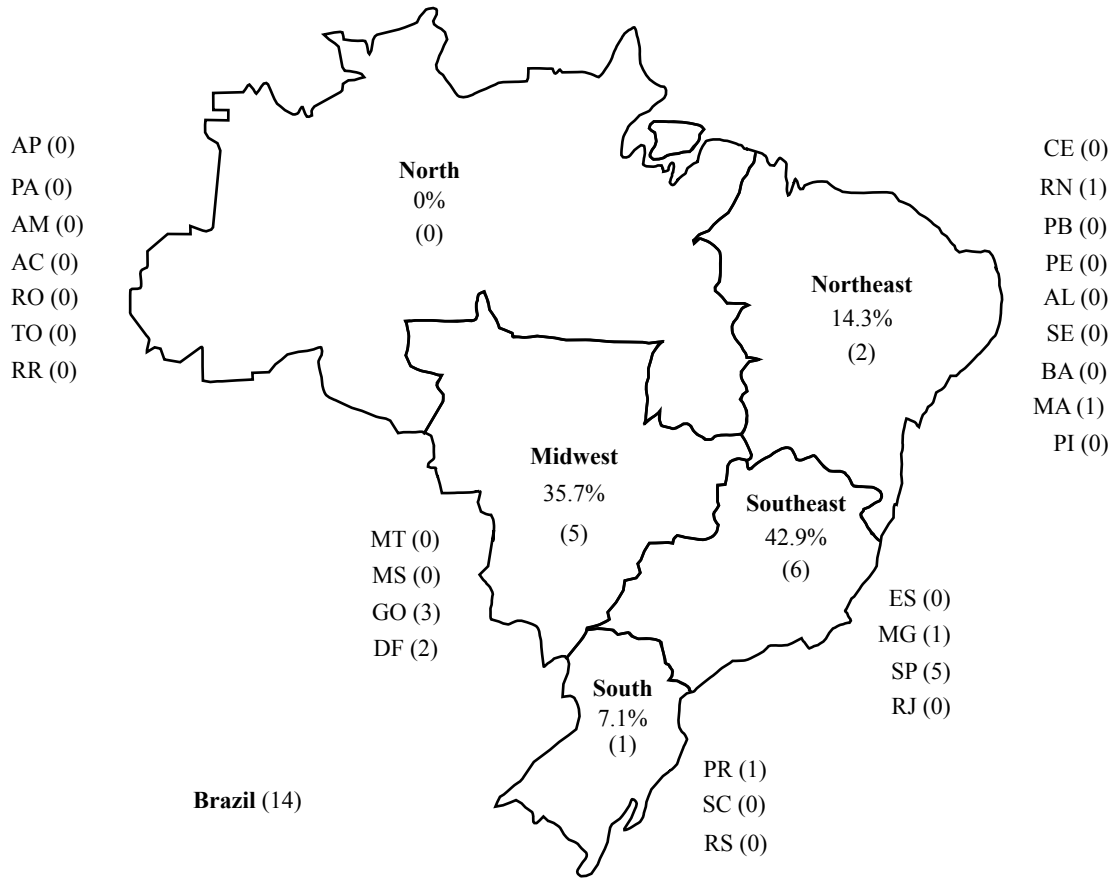

Figure 1. Geographic distribution in January 2017 of the Brazilian research groups on dietary interventions and physical exercise in cancer by region (in percentage) and federation state (in frequency).

Table 1. Number and percentage of members of the research groups on diet and exercise interventions in cancer, by category, in January 2017

Region	Researchers	Students	Technicians	Total Members
Midwest	96 (44.86%)	79 (33.06%)	2 (33.33%)	177 (38.56%)
North	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Northeast	22 (10.28%)	50 (20.92%)	0 (0%)	72 (15.68%)

South	16 (7.48%)	36 (15.06%)	0 (0%)	52 (11.32%)
Southeast	80 (37.38%)	74 (30.96%)	4 (66.67%)	158 (34.42%)
Total*	214 (46.62%)	239 (52.07%)	6 (1.31%)	459 (100%)

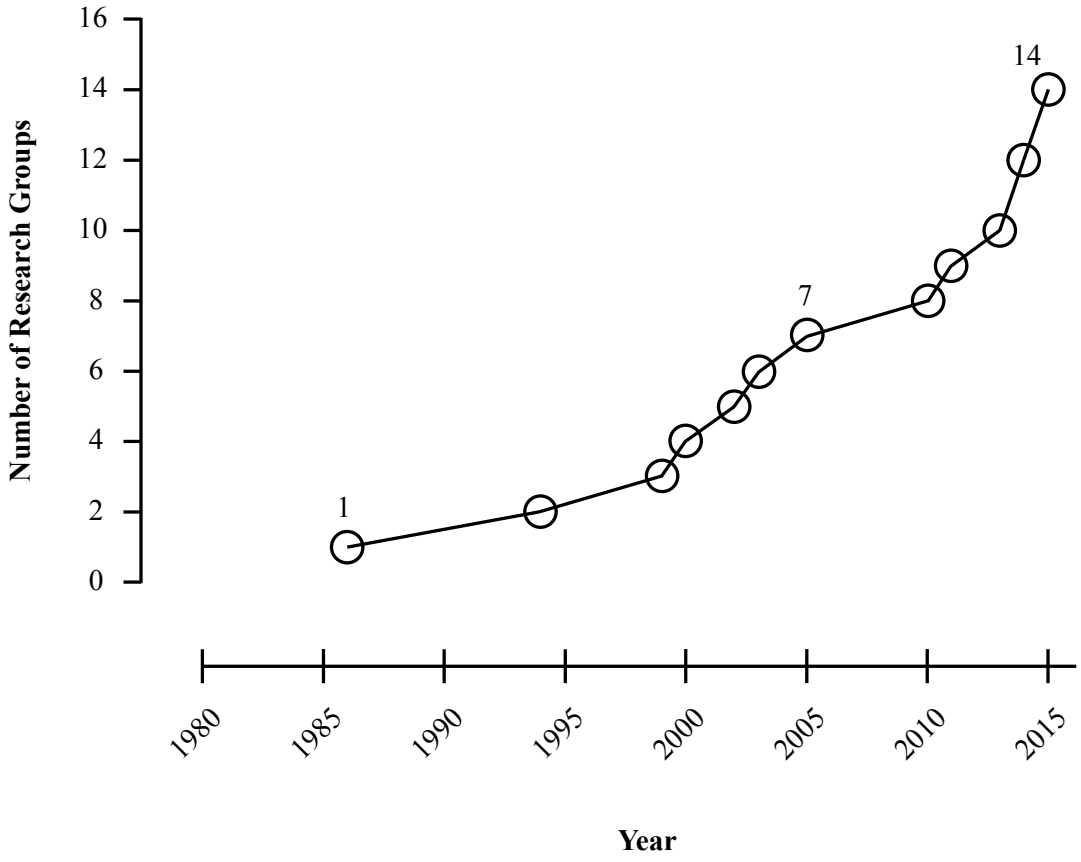

Figure 2. Evolution of the number of Brazilian research groups on interventions with diet and physical exercise in cancer. Source: Directory of Research Groups of the National Council for Scientific and Technological Development (CNPq).

Table 2. Distribution of academic titles of the research group leaders by Brazilian region

Region	MSc Without Productivity Grant	DSc Without Productivity Grant	DSc With Productivity Grant	Total
Midwest	0 (0.0%)	3 (50%)	2 (28.57%)	5 (35.71%)
North	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Northeast	1 (100%)	0 (0%)	1 (14.28%)	2 (14.29%)
South	0 (0%)	0 (0%)	1 (14.28%)	1 (7.14%)
Southeast	0 (0%)	3 (50%)	3 (42.86%)	6 (42.86%)
Total*	1 (7.14%)	6 (42.86%)	7 (50%)	14 (100%)

* Values given as frequency and percentage values in relation to total members.

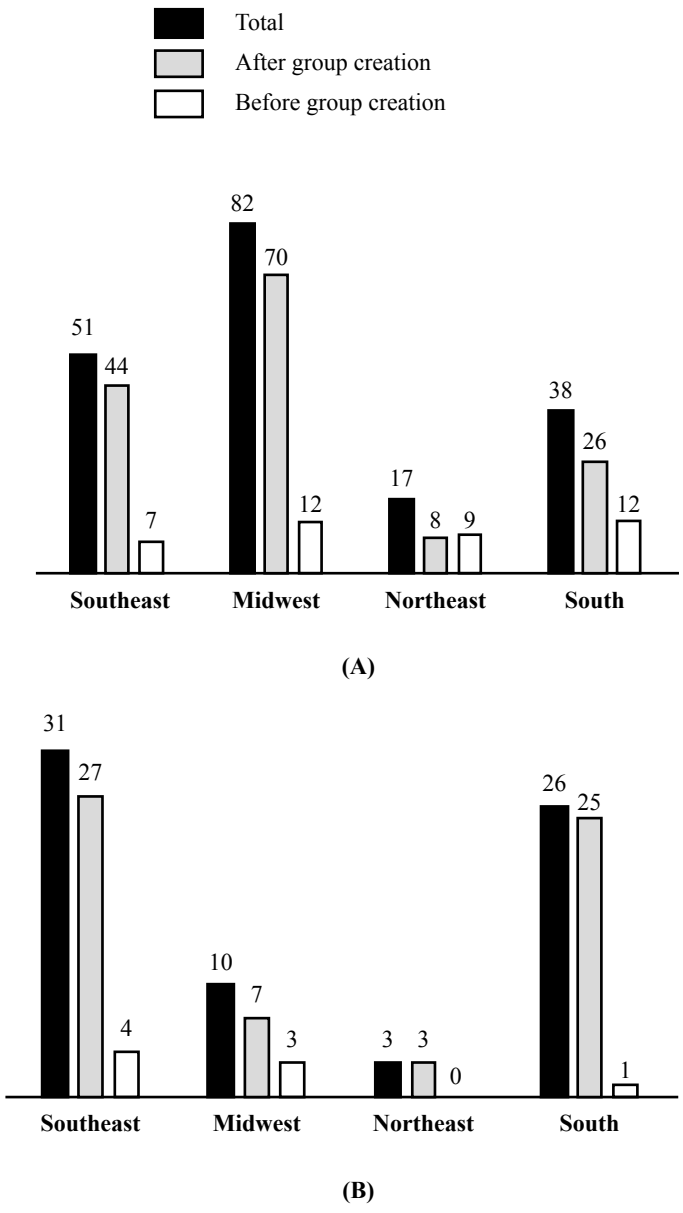

Figure 3. A) General scientific production on cancer of RGIDEC leaders from different Brazilian regions until January 2017. B) Specific scientific production on cancer and intervention with exercise and/or diet of RGIDEC leaders from different Brazilian regions until January 2017. There were no study groups in the northern region of Brazil.

Discussion

Given the benefits of diet and physical exercise during the treatment of cancer[12,13] it is important to disseminate the knowledge of these areas of study throughout the national territory. The results indicate that the majority of the groups focused on this issue have arisen in the last seven years and are concentrated predominantly in the Southeast, particularly in the state of São Paulo, followed by the Midwest, where Goiás is the state with the highest amount of RGIDECs. The Midwestern region leads the overall scientific literature on cancer, but the Southeastern Region had the highest specific scientific literature on the subject cancer and diet and/or exercise.

Anyway, the results of this study show that the creation of RGIDECs could directly influence the general scientific literature on cancer and also the specific production on interventions with diet and/or exercise in cancer, with increases of 3.7 and 7.75 times, respectively, in the number of papers published after the creation of the groups, although the total number of published articles is still modest. In addition, the basic training of the leaders and professionals involved in the groups can directly influence the types of research that are developed. Thus, the fact that the Southeast has a larger number of research groups in the area investigated here would mean that it has a greater potential for qualification of professionals and, consequently, a greater investigative contribution in the area of intervention

with nutrition and physical exercise in cancer, as it was shown in this study.

Another interesting point that deserves to be highlighted is the QUALIS classification of publications in the area of Physical Education. The QUALIS classification is made by the advisory committees of each evaluation area, following criteria previously defined by the scientific area and approved by the Technical and Scientific Council of Higher Education (CTCES), in order to reflect the relative importance of the different journals for a given area. In addition to the small number of specific publications at the national level in the area of Physical Education, the quality indicated by QUALIS classification still has much to improve. Although most of the articles have been published in international journals, the QUALIS classification of the journals where the most expressive number of publications (34.29%) was inserted was B2. Viewed from this perspective, this does not seem very good, but considering the insertion of a higher percentage (41.43%) of the publications in higher QUALIS classifications (A1, A2 and B1, in this order), the scenario seems to be better.

Despite the importance of applying metric analyzes in the evaluation of publications in the area, this is not the major concern of the present study, but rather the need to link diet and exercise interventions as complementary strategies in the treatment of cancer. Indeed, the origin of this concern with the need for research groups and specific scientific production on the subject is not merely the generation of knowledge, but the need to prepare the different Brazilian regions to confront the epidemiological expansion of cancer.

Estimates from the National Cancer Institute (INCA) report that if there are no effective interventions against the cancer incidence in the country, the progression of new cases will reach 26 million and the number of deaths to 17 million per year in 2030[3]. The economic repercussion would also be tragic for the country, since between 2000 and 2007, the Ministry of Health's expenses with cancer increased fivefold, from about 80 to 460 million dollars[14].

This sharp increase in spending in such a short time is predictable since the price of chemotherapy drugs for cancer treatment can reach US$125,000 for a single treatment[15]. That is why access to the most modern cancer drugs in developing countries has so far been limited. In addition, comorbidities linked to oncological treatments can still boost spending, since public health actions do not expand their services in post-treatment care and thus, expenses with diagnosed patients are unavoidable. However, small behavioral interventions, such as improvement in eating habits and insertion in a physical exercise program, can minimize the economic, social and health problems caused by cancer and its treatments.

With adequate nutrient intake there is an improvement in metabolic health and generation of a protective state against cancer and its recurrence[16,17]. Appropriate nutritional strategies can reduce DNA damage, potentiate cytotoxicity against tumor cells, and optimize anti-inflammatory activity[16]. Several phytochemicals have anticancer and antiangiogenic properties, such as isothiocyanates (cruciferous vegetables), which modulate the enzymatic systems responsible for neutralizing carcinogenic substances[16], and resveratrol, found in the red grapes, which has pro-apoptotic activity against cells isolated from a wide variety of tumors[18].

In addition, controlled and well-applied physical exercise may be able to reduce the required amount of drugs used during adjuvant chemotherapeutic treatment. Patients with different types of cancer submitted to adjuvant chemotherapy who underwent combined physical exercises (aerobic + resisted exercises), with intensity varying from moderate to high, had a reduction in the side effects generated by the treatment, such as a lower rate of decline in cardiorespiratory fitness, decrease in recovery time and early return to normal life, and reduction in the readjustment need of the chemotherapeutic drugs doses[19]. Other studies have demonstrated that physical exercise after treatment may be effective in protecting against recurrence of cancer[20,21], being a common situation for these patients.

The mechanisms promoted by physical exercise to protect against recurrence of cancer and complications of the side effects of oncological treatments are not yet well known, but the improvement of body composition is one of the main investigated aspects[22,23]. The increase in lean mass and muscle strength provides an anti-inflammatory and protective environment against other types of diseases and even against recurrence of cancer and/or onset of other types of cancer[22-24].

Thus, the benefits of nutritional and physical exercise strategies in oncology treatment should be investigated more thoroughly in order to establish what types of physical exercises and diets are most effective for each type of staging and/or cancer type of the patient, not only because these complementary interventions constitute easier access resources that can effectively promote increase in the patient's survival and improved life quality, but also because they will contribute to reduction in public health expenditures from relatively low financial investments compared to other strategies.

This study shows that only 14 Brazilian research groups registered in the directory of research groups of CNPq have a specific study/research line on diet and exercise interventions in cancer. Consequently, the production of knowledge and generation of information on the subject is still limited. In addition, to date, RGIDECs are concentrated in specific regions of the country, especially the Southeast. This is probably due to the greater concentration of technological resources and potential sources of funding, as well as the consolidated status of the scientific research in many southeastern universities.

A possible strategy for the decentralization of scientific research on the subject in Brazil would be the more homogenous distribution of resources throughout the national territory, which makes a lot of sense, since cancer is a chronic non-transmissible disease that is in process of epidemiological expansion, affecting people of different ethnicities, sex, economic classes and geographic regions. Although cancer research groups generally need bolder infrastructures and greater financial resources, the resources for studying interventions with diet and physical exercise usually require more modest infrastructures and less bulky financial resources. Ideally, these studies should be done in the patients' natural environments, ie, throughout the national territory, taking into account the great diversity of nutritional and physical activity patterns existing in the different regions

of the country. In addition, it is important to highlight that the existence of these groups, although requiring the participation of trained professionals in the areas of Oncology, Nutrition and Exercise, will also contribute to the multidisciplinary training of these professionals in their own regions.

It should be noted that although the findings of this research are restricted to the applied methodology, it describes the current research scenario on the subject throughout the Brazilian territory.

Conclusion

Research groups and their studies on dietary and physical exercise interventions as a contribution to cancer treatments in Brazil need to be more geographically spread throughout the national territory, since cancer is a disease that is present, and increasingly, in all states and federal district, following an international trend.

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