

Evaluation of eating habits and practice of physical activity in colorectal cancer patients in the active phase of treatment

Avaliação dos hábitos alimentares e prática de atividade física em pacientes com câncer colorretal na fase ativa do tratamento

Evaluación de hábitos alimentarios y práctica de actividad física en pacientes con cáncer colorrectal en fase activa de tratamiento

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Abstract

Colorectal cancer is one of the most prevalent in men and women, and its development is associated with several risk factors, such as a sedentary lifestyle, obesity, alcohol consumption, and eating habits. This study aimed to present the results of applying the questionnaire on eating habits and physical activity from the *Food Guide: how to have a healthy diet* in the first chemotherapy session, after signing the consent form, and eight weeks after the first application. All patients with colorectal cancer under active treatment from July to December 2022 were invited to participate in the study. The Ethics Committee approved this project. During the research, patients underwent a new monitoring model that included the use of a chatbot and wearable device for eight weeks. The model aimed to ensure greater patient engagement with their treatment through interactions about symptoms and adverse effects, eating habits, and physical activity practice. As a result, there was a statistical reduction in the consumption of alcoholic beverages and fast foods and a statistical increase in fruit consumption. In addition, the findings indicate that the model contributed to a greater practice of physical activity by patients. For future work, we suggest applying this model to patients with other types of cancer to assess and extend the benefits of the model in different contexts of cancer treatment.

Keywords: Eating habits; Colorectal cancer; Physical activity; Internet of things; Machine learning.

Resumo

O câncer colorretal é um dos mais prevalentes em homens e mulheres, e seu desenvolvimento está associado a diversos fatores de risco, como sedentarismo, obesidade, consumo de álcool e hábitos alimentares. O objetivo deste estudo foi apresentar os resultados da aplicação do questionário *Guia Alimentar: como ter uma alimentação saudável* sobre hábitos

alimentares e atividade física na primeira sessão de quimioterapia, após a assinatura do termo de consentimento, e oito semanas após a primeira aplicação. Todos os pacientes com câncer colorretal em tratamento ativo no período de julho a dezembro de 2022 foram convidados a participar do estudo. Este projeto foi aprovado pelo Comitê de Ética. Durante o estudo, os pacientes foram submetidos a um novo modelo de monitoramento que incluiu o uso de um chatbot e um wearable device por um período de 8 semanas. O modelo visava garantir maior engajamento do paciente com seu tratamento por meio de interações sobre sintomas e efeitos adversos, hábitos alimentares e prática de atividade física. Como resultado, houve redução estatística no consumo de bebidas alcoólicas e fast foods e aumento estatístico no consumo de frutas. Além disso, os resultados indicam que o modelo contribuiu para uma maior prática de atividade física pelos pacientes. Para trabalhos futuros, sugerimos a aplicação deste modelo a pacientes com outros tipos de câncer para avaliar e estender os benefícios do modelo em diferentes contextos de tratamento do câncer.

Palavras-chave: Hábitos alimentares; Câncer colorretal; Exercício físico; Internet das coisas; Aprendizado de máquina.

Resumen

El cáncer colorrectal es uno de los más prevalentes en hombres y mujeres, y su desarrollo está asociado a varios factores de riesgo, como el sedentarismo, la obesidad, el consumo de alcohol y los hábitos alimentarios. El objetivo de este estudio fue presentar los resultados de la aplicación del cuestionario sobre hábitos alimentarios y actividad física direccionada por el *Guía Alimentaria: cómo tener una alimentación saludable* en la primera sesión de quimioterapia, previa firma del formulario de consentimiento informado, ya las ocho semanas de la primera aplicación. Se invitó a participar en el estudio a todos los pacientes con cáncer colorrectal en tratamiento activo de julio a diciembre de 2022. Este proyecto fue aprobado por el Comité de Ética. Durante el estudio, los pacientes se sometieron a un nuevo modelo de monitoreo que incluyó el uso de un chatbot y un dispositivo portátil durante un período de 8 semanas. El modelo pretendía garantizar un mayor compromiso del paciente con su tratamiento a través de interacciones sobre síntomas y efectos adversos, hábitos alimentarios y práctica de actividad física. Como resultado, hubo una reducción estadística en el consumo de bebidas alcohólicas y comidas rápidas y un aumento estadístico en el consumo de frutas. Además, los hallazgos indican que el modelo contribuyó para una mayor práctica de actividad física por parte de los pacientes. Para trabajos futuros, sugerimos aplicar este modelo a pacientes con otros tipos de cáncer para evaluar y extender los beneficios del modelo en otros contextos de tratamiento del cáncer.

Palabras clave: Hábitos alimentarios; Cáncer colorrectal; Ejercicio físico; Internet de las cosas; Aprendizaje automático.

1. Introduction

Colorectal cancer (CRC) is the third most common cancer and the fourth most common cause of cancer-related death. The risk of developing CRC is associated with personal characteristics such as age, gender, history of chronic diseases, and lifestyle factors such as consumption of carbohydrate-rich and lipid-rich foods and low intake of fruits, vegetables, and fiber-rich foods (Mármol et al., 2017).

This disease is influenced by several factors, including age (being ≥ 50 years one of the main risk factors), overweight, obesity, and unhealthy dietary habits such as low intake of fruits, vegetables, and fiber-rich foods, as high consumption of processed and red meats (Queiroz, Carneiro, et al., 2022), (Wilde et al., 2019). Furthermore, genetic factors, exposure to ionizing radiation, family history, previous presence of intestinal, ovarian, uterine, or breast cancer, smoking, and excessive alcohol consumption also play a significant role in the growth and development of this tumor (Calle & Kaaks, 2004).

There are protective factors that are associated with a lower incidence of CRC, such as regular physical activity and a diet rich in fruits, vegetables, fiber, folate, calcium, dairy products, vitamin D, and vitamin B6, as well as intake of magnesium, fish, and garlic (Thanikachalam & Khan, 2019). In addition, physical activity plays an essential role as a protective factor, as it reduces body fat and therefore has a beneficial effect on the risk of CRC, possibly by decreasing insulin resistance and inflammation - both associated with the development of CRC. Other mechanisms by which physical activity may reduce the risk of CRC include stimulating digestion and reducing transit time through the intestine, although robust data to support this mechanism in humans are limited (AICR & WCRF, 2018; WCRF, 2023).

Given current technological advances, chatbots have the potential to play an increasingly important role in health and medical care, assisting physicians during a consultation, supporting patients in changing behavior, or helping in their own homes. Patients can, for example, receive advice and information provided by chatbots and describe their current symptoms, even if they

are away from the medical care center (Wolters et al., 2016). Similarly, patients can use chatbots to check symptoms and monitor their mental health (Hoermann et al., 2017; Miner et al., 2016). Ly et al. (Ly et al., 2017) assessed the efficacy and compliance of a smartphone application designed to teach strategies from optimistic psychology aimed at enhancing happiness and decreasing negative symptoms.

IoT has emerged as a promising tool in healthcare and has the potential to reduce costs, improve user experience and patient monitoring, and increase the quality of life (Costa et al., 2018), (Gralha et al., 2022). Personalized interventions combined with IoT have contributed to improving the quality of life and mitigating symptoms and adverse effects in cancer patients undergoing treatment (Queiroz et al., 2021). The use of wearable devices demonstrated that the better clinical condition and quality of sleep of the patient were associated with improvement in the practice of physical activity (Chung et al., 2019), (Nyrop et al., 2018), (Queiroz et al., 2021). A higher number of steps was associated with reduced chemotherapy-related symptoms such as fatigue, anxiety, and distress data (Chung et al., 2019), (Nyrop et al., 2018).

Thus, this study aimed to develop and evaluate a tool for monitoring patients with CRC during the active phase of treatment using the Internet of Things and Artificial Intelligence techniques. The model aimed to ensure greater patient engagement with their treatment through interactions about symptoms and adverse effects, eating habits, and physical activity practice. This study presents the results of applying a questionnaire on eating habits and physical activity from the Food Guide: how to have a healthy diet – Ministry of Health (Brazil, 2013) before and after the intervention and is part of an ongoing broader study.

2. Methodology

2.1 Study type

A prospective clinical study aims to evaluate the benefits of the SMT (Smart Monitoring Tool) model to patients regarding eating habits and physical activity practice. The study population was CRC patients undergoing active treatment at the Sinop Cancer Center (Cecans) in Sinop, Mato Grosso, Brazil. Data were collected from July 2022 to December 2022 at Cecans. This study is part of a broader study that evaluated the benefits of the model by comparing patients who used the SMT model with patients who followed the traditional model adopted by the clinic. The questionnaire was applied in person in the field during chemotherapy sessions and data collection was based on a quantitative approach (Pereira et al., 2018). Patients were instructed to choose one of the available options in each question, when available, inform the amount of consumption or answer yes/no.

2.2 Inclusion and exclusion criteria

Inclusion criteria were CRC patients; aged over 18 years; under active cancer treatment; staging from I to IV; Patients must have smartphone skills. Exclusion criteria were patients with restrictions to exercise due to severe cardiovascular, pulmonary, or renal diseases, have cognitive impairment that prevents using smartphones or are unable to give verbal consent.

2.3 Intervention

Patients who met the inclusion criteria were invited to participate in the research during the 1st chemotherapy session. Patients who agreed to participate signed the Informed Consent Form. Patients were asked to answer a questionnaire containing 18 questions about eating habits and physical activity from the Food Guide: how to have a healthy diet – Ministry of Health (Brazil, 2013). The questionnaire was applied in the 1st chemotherapy session and eight weeks after the first application. In the first application, patients were instructed to self-report their eating habits and physical activity before the cancer diagnosis. And in the second application, patients were asked to self-report their conduct after participating in the research.

2.4 Data analysis

The influence of the SMT model on the patient's eating habits and physical activity was evaluated. Statistical analysis: data were presented as mean \pm standard deviation (SD) or in percentage (%). The results were statistically evaluated by the Student's *t* test, the Wilcoxon test, or the chi-square test (χ^2) using the GraphPad Prism 7 Program. The minimum acceptable significance level was $p < 0.05$.

2.5 Ethical aspects

Ethical aspects are considered following Resolution 466/12 of the Ministry of Health, which establishes ethical standards governing research involving human beings. The execution of the project was authorized by Cecans and by the physician responsible for the Oncology Wing and approved by the Ethics Committee in Research with Human Beings (CAAE 48258421.7.0000.5344).

3. Results and Discussion

In total, 19 patients were invited to the intervention group. Unfortunately, four patients did not accept to participate because they did not have technological skills or were not interested in participating, and two patients withdrew during the research due to complications resulting from the treatment. In addition, the mean age of these patients was 58.2 years old, and most patients (83.3%) were over 50 years old. Finally, 13 patients completed the study in the intervention group. All patients had private health insurance or underwent treatment privately.

3.1 Clinical and epidemiological profile of intervention group of CRC patients

According to the epidemiological data, body weight mean, and height median were 73.8 kg and 1.68m, respectively. The body mass index mean was 26.1 kg/m², with 5 (38.5%) patients with a BMI between 20kg/m² and 25kg/m², considered regular/eutrophic, and 8 (61.5%) patients over 25kg/m², classified as overweight/obese. The data corroborate the literature, showing that overweight/obese patients are at greater risk of developing CRC (Loosen et al., 2022), (INCA, 2022). The oximetry means, and temperature median were 97.0 % and 36.4°C, respectively. Regarding blood pressure, the mean systolic blood pressure was 123.8 (SD 16.1) mmHg, and the median diastolic was 80 (80 - 80) mmHg. All these data were within the reference parameters considered normal.

The mean age was 49.7 years old. Most patients were between 25 and 44 years old (46.2%), were married (92.3%), women (61.5%), and Hispanic (53.8%). Furthermore, most patients live in Sinop-MT (38.5%) and Sorriso-MT (15.4%). Studies have associated the risk of developing CRC with personal characteristics, such as male sex, elderly, and high consumption of carbohydrates and lipids and low consumption of fruits and vegetables (Thanikachalam & Khan, 2019), (Mármol et al., 2017), (WCRF, 2023), (AICR & WCRF, 2018), (Loosen et al., 2022), (INCA, 2022). The study also observed an increase in the incidence of CRC in young people, and the causes are still under discussion. They may be related to eating habits, lifestyle, and genetic factors (Wilde et al., 2019), (Thanikachalam & Khan, 2019).

According to the clinical data, most patients were diagnosed with stage 3 (69.2%), had a family history (69.2%), and had surgery and chemotherapy as indicated type of treatment (76.9%), with adjuvant chemotherapy (69.2%). The mFolfox6 protocol (69.2%) was the most recommended. All patients presented adenocarcinoma-type CRC (100.0%). Most had affected lymph nodes (76.9%), were diagnosed with primary cancer (92.3%), and did not have metastasis (92.3%). Studies have shown that, due to the characteristics of CRC, patients typically discover the disease at a more advanced stage, consequently, the staging will be greater, and the clinical prognosis will be more critical (Queiroz, Alegranci, et al., 2022; Schult et al., 2021). Screening through colonoscopy is one of the methods that can contribute to discovering this type of cancer at an early stage (Bai et al.,

2022). Family history is also one of the risk factors. Individuals with first-degree relatives diagnosed with CRC have a two to four times higher risk than the general population (Bai et al., 2022).

3.2 Evaluation of eating habits and practice of physical activity

The meals most consumed by patients before the intervention were breakfast (84.6%), lunch (92.3%), and dinner (100.0%), as seen in Table 1. Moreover, a minority of patients self-reported consuming morning snacks (38.5%) and afternoon snacks (46.2%), and supper (7.7%). After the intervention, it was observed, based on the patient's self-report, higher consumption of breakfast (92.3%), morning snack (46.2%), afternoon snack (69.2%), and lunch (100%). Studies report that one of the symptoms of cancer and the adverse effects of treatment with antineoplastic drugs is decreased food intake and lack of appetite, which can lead to anorexia (Lazarus & Bays, 2022), (Ferioli et al., 2018). However, our results indicate that patients improve their eating habits by eating more frequently during the day. The amount of water consumed before or after the intervention was very similar. No statistical differences were identified. However, a statistical decrease in alcohol consumption ($p=0.0472$) was observed. Before the intervention, most patients self-reported alcohol consumption (76.9%), and after the intervention, only 30.8% reported alcohol consumption. The diagnosis, medical advice, and participation in the study may have contributed to this relevant reduction in consumption. Several studies have shown an association between alcohol consumption and CRC incidence (Thanikachalam & Khan, 2019), (Ghazaleh Dashti et al., 2017).

Table 1 - Analysis of the regular consumption of each type of meal, the daily number of glasses of water, and the frequency of alcoholic beverages. Data were extracted before and after the intervention.

Variable	Before the intervention	After the intervention	<i>p</i>
n (%)	13 (100.0 %)	13 (100.0)	
Breakfast[#]	n (%)	n (%)	
Yes	11 (84.6)	12 (92.3)	>0.9999
No	2 (15.4)	1 (7.7)	
Morning snack[#]	n (%)	n (%)	
Yes	5 (38.5)	6 (46.2)	>0.9999
No	8 (61.5)	7 (53.8)	
Lunch[#]	n (%)	n (%)	
Yes	12 (92.3)	13 (100)	>0.9999
No	1 (7.7)	0 (0.0)	
Afternoon Snack[#]	n (%)	n (%)	
Yes	6 (46.2)	9 (69.2)	0.4283
No	7 (53.8)	4 (30.8)	
Dinner[#]	n (%)	n (%)	
Yes	13 (100.00)	13 (100.0)	>0.9999
No	0 (0.0)	0 (0.0)	
Supper[#]	n (%)	n (%)	
Yes	1 (7.7)	0 (0.0)	>0.9999
No	12 (92.3)	13 (100.0)	
Water (cups/day)	n (%)	n (%)	
< 4	1 (7.7)	1 (7.7)	0.9684
4 to 5	4 (30.8)	3 (23.1)	
6 to 8	4 (30.8)	4 (30.8)	
≥ 8	4 (30.8)	5 (38.5)	

Alcoholic beverage[#]	n (%)	n (%)	
Yes	10 (76.9)	4 (30.8)	0.0472*
No	3 (23.1)	9 (69.2)	
Alcoholic beverage	n (%)	n (%)	
Non-consumption	3 (23.1)	9 (69.2)	0.0458*
Occasionally	5 (38.5)	3 (23.1)	
Weekly/Daily	5 (38.5)	1 (7.7)	

Results are expressed as the number of individuals and percentage (n (%)). Statistical analysis: Chi-square test and [#]Fisher test. *p<0.05.
 Source: Elaborated by the authors.

Table 2 shows that before the intervention, most patients self-reported consumption of fruits (69.2%), vegetables (92.3%), and grains (84.6%). Most reported eating one or less fruit daily (53.8%), and two or more tablespoons of grains daily (61.5%). Moreover, after the intervention, there was a statistical increase in fruit consumption (p=0.0297), where 100% self-reported fruit consumption. The application of the questionnaire during the intervention may have contributed to the improvement in fruit consumption, as patients were encouraged to reflect on their current behavior. Fruit consumption is a crucial factor in primary cancer prevention. Consumption has been associated with a lower mortality rate for cancer survivors (Hurtado-Barroso et al., 2020). Most reported eating two or more fruits a day (61.6%), eating vegetables (84.6%), and grains (92.3%).

Table 2 - Analysis of patients' behavior before and after the intervention regarding consuming fruits, vegetables, and grains.

Variable	Before the intervention	After the intervention	p
n (%)	13 (100.0 %)	13 (100.0)	
Fruits[#]	n (%)	n (%)	
Yes	9 (69.2)	13 (100.0)	0.0297*
No	4 (30.8)	0 (0.0)	
Fruits (unit/slice/glass of natural juice)/day	n (%)	n (%)	
≤ 1	7 (53.8)	5 (38.5)	0.7338
2	3 (23.1)	4 (30.8)	
≥ 3	3 (23.1)	4 (30.8)	
Vegetables[#]	n (%)	n (%)	
Yes	12 (92.3)	11 (84.6)	>0.9999
No	1 (7.7)	2 (15.4)	
Vegetables (tablespoons/day)	n (%)	n (%)	
≤ 3	5 (38.5)	5 (38.5)	0.6198
4 to 5	4 (30.8)	5 (38.5)	
6 to 7	4 (30.8)	2 (15.4)	
≥ 8	0 (0.0)	1 (7.7)	
Grain Consumption[#]	n (%)	n (%)	
Yes	11 (84.6)	12 (92.3)	>0.9999
No	2 (15.4)	1 (7.7)	
Grains (tablespoons/day)	n (%)	n (%)	
Non-consumption	2 (15.4)	1 (7.7)	0.8810
< 5 times a week	1 (7.7)	2 (15.4)	
≤ 1 tablespoon/day	2 (15.4)	2 (15.4)	
≥ 2 tablespoons/day	8 (61.5)	8 (61.5)	

Results are expressed in number of individuals and percentage (n (%)). Statistical analysis: chi-square test (X²) and [#]Fisher test. *p<0.05.
 Source: Elaborated by the authors.

Table 3 shows that, before and after the intervention, most patients self-reported consuming pasta, carbohydrates, cereals (before and after: 100%), and bread (before and after: 76.9%). Furthermore, before the intervention, 38.5% reported rarely consuming sweets and sugary drinks, and 23.1% reported rarely consuming fast food, sausages, and fried food. However, after the intervention, most patients reported rarely consuming fast food, sausages, and fried food (61.5%). This is essential data since consuming processed meats, such as hamburgers, sausages, and bacon, contributes to increased cancer risk (Wilde et al., 2019).

Table 3 - Analysis of pasta, carbohydrates, cereals, industrialized beverages, fast food, and sweets consumption by patients before and after the intervention.

Variable	Before the intervention	After the intervention	<i>p</i>
n (%)	13 (100.0 %)	13 (100.0)	
Pasta, carbohydrates, and cereals #	n (%)	n (%)	
Yes	13 (100)	13 (100.0)	>0.9999
No	0 (0.0)	0 (0.0)	
Pasta, carbohydrates, and cereals (tablespoons/day)&	3.0 (2.5 – 4.5)	4 (3.0 – 5.0)	0.8828
Bread #	n (%)	n (%)	
Yes	10 (76.9)	10 (76.9)	>0.9999
No	3 (23.1)	3 (23.1)	
Bread (units or slices)/day&	1.0 (0.5 – 2.0)	1.0 (0.5 – 2.0)	0.8125
Simple Cake#	n (%)	n (%)	
Yes	1 (7.7)	3 (23.1)	0.5930
No	12 (92.3)	10 (76.9)	
Simple cakes (slices/day) &	0.0 (0.0 - 0.0)	0.0 (0.0 – 0.5)	>0.9999
Simple Biscuits#	n (%)	n (%)	
Yes	4 (30.8)	1 (7.7)	0.3217
No	9 (69.2)	12 (92.3)	
Simple biscuits (units /day) &	0.0 (0.0 – 2.5)	0.0 (0.0 – 0.0)	0.4375
Fast Food and Sausages and Fried Food	n (%)	n (%)	
Rarely	3 (23.1)	8 (61.5)	0.1588
Daily	1 (7.7)	0 (0.0)	
< 2 times a week	5 (38.5)	4 (30.8)	
2-3 times a week	4 (30.8)	1 (7.7)	
Sweets and Sugary Drinks	n (%)	n (%)	
Rarely	5 (38.5)	5 (38.5)	0.4801
Daily	1 (7.7)	1 (7.7)	
< 2 times a week	2 (15.4)	5 (38.5)	
2-3 times a week	3 (23.1)	2 (15.4)	
4-5 times a week	2 (15.4)	0 (0.0)	

Results are expressed as median (interquartile of 25% and 75%) or in number of individuals and percentage (n (%)). Statistical analysis: chi-square test (X²), # Fisher test, and &Wilcoxon test. Source: elaborated by the authors.

Most patients self-reported consuming meat or eggs (before: 100.0%; after: 92.3%), the most common daily consumption being two pieces or eggs (before: 61.5%; after: 53.8%, *p*=0.5866), as seen in Table 4. Before the intervention, 5 (38.5%) patients self-reported that they usually removed visible fat from the meat. After the intervention, there were 10 (76.9%) patients (*p*=0.1107). The frequency of fish consumption remained similar before and after the intervention, but there was an increase in the consumption of milk and dairy products (before: 61.5%; after: 84.6%; *p*=0.3783). Whole milk was the most

common type of milk consumed by patients (before: 53.8%; after: 69.2%; $p=0.3928$). Consumption of meat, fish, dairy products, and milk remained similar before and after the intervention. The habit of removing visible fat from meat was the only change in animal protein consumption, most patients self-reported that they had this behavior after the intervention.

Red meat consumption is one of the main risk factors for CRC (Wilde et al., 2019), and the consumption profile of patients before diagnosis may have contributed to the development of cancer. Participation in the intervention did not change the amount of meat consumed.

Table 4 - Analysis of animal protein (meat, fish, milk, and dairy products) consumption by patients before and after the intervention.

Variable	Before the intervention	After the intervention	<i>p</i>
n	13 (100.0 %)	13 (100.0)	
Meats (cattle, pig, poultry, fish and other) or Eggs[#]	n (%)	n (%)	
Yes	13 (100.0)	12 (92.3)	>0.9999
No	0 (0.0)	1 (7.7)	
Daily consumption of meat or eggs	n (%)	n (%)	
Non-consumption	0 (0.0)	1 (7.7)	0.5866
2 pieces or 2 eggs	8 (61.5)	7 (53.8)	
> 2 pieces or 2 eggs	5 (38.5)	5 (38.5)	
Usually remove the apparent fat from the meat?[#]	n (%)	n (%)	
Yes	5 (38.5)	10 (76.9)	0.1107
No	8 (61.5)	3 (23.1)	
Type of fat used	n (%)	n (%)	
Animal lard or butter	3 (23.1)	4 (30.8)	>0.9999
Vegetable oil such as: soybean, corn, or canola	10 (76.9)	9 (69.2)	
Fish[#]	n (%)	n (%)	
Yes	13 (100.0)	13 (100.0)	>0.9999
No	0 (0.0)	0 (0.0)	
Frequency of fish consumption	n (%)	n (%)	
A few times a year	3 (23.1)	3 (23.1)	0.8219
1 to 4 times a month	8 (61.5)	9 (69.2)	
≥ 2 times a week	2 (15.4)	1 (7.7)	
Milk and dairy products[#]	n (%)	n (%)	
Yes	8 (61.5)	11 (84.6)	0.3783
No	5 (38.5)	2 (15.4)	
Amount of Milk and dairy products (cups or pieces or slices per day)	n (%)	n (%)	
Non-consumption	5 (38.5)	2 (15.4)	0.2806
≤ 1 time a day	4 (30.8)	6 (46.2)	
2 times a day	4 (30.8)	3 (23.1)	
≥ 3 times a day	0 (0.0)	2 (15.4)	
Type of milk and derivatives	n (%)	n (%)	
Non-consumption	5 (38.5)	2 (15.4)	0.3928
Whole milk	7 (53.8)	9 (69.2)	
Low fat (skimmed, semi-skimmed and light milk)	1 (7.7)	2 (15.4)	

Results are expressed in number of individuals and percentage (n (%)). Statistical analysis: chi-square test (X²), [#]Fisher test.
Source: Elaborated by the authors.

Table 5 shows the types of activity and the frequency performed by the patients before and after the intervention. Before the intervention, 5 (38.5%) patients self-reported practicing physical activity, with two reporting practicing walking and five reporting practicing other physical activities, such as running, bodybuilding, beach tennis, and pilates. After the intervention, 7 (53.8%) patients reported practicing physical activity, with walking being the most common activity (6/13; 46.1%). As expected, walking was the most practiced physical activity after the intervention since the physicians at the clinic advised all patients to prioritize walking, light, and low-impact physical exercise. As a positive result, we had an increase in the practice of physical activity by patients, even during the active phase of treatment, although no statistical difference was observed. This result suggests that the model stimulated the practice of physical activity by the patients. However, during treatment, patients usually experience various adverse effects due to the antineoplastic drugs administered, which typically contribute to decreased physical exercise.

Table 5 - Distribution of the type and frequency of physical activity the patient performed before and after diagnosis.

Variable	Before the intervention	After the intervention	<i>p</i>
n	13 (100.0 %)	13 (100.0)	
Physical activity practice[#]	n (%)	n (%)	
Yes	5 (38.5)	7 (53.8)	0.6951
No	8 (61.5)	6 (46.2)	
Type of Physical Activity[#]	n (%)	n (%)	
Walking	Yes (2)	Yes (6)	0.2016
	No (11)	No (7)	
Others (running, bodybuilding, beach tennis, pilates)	Yes (5)	Yes (2)	0.3783
	No (8)	No (11)	
Frequency of Physical Activity	n (%)	n (%)	
No practice	8 (61.5)	6 (46.2)	0.3658
Occasionally	0 (0.0)	2 (15.4)	
Daily	4 (30.8)	3 (23.1)	
2 times a week	1 (7.7)	0 (0.0)	
3 times a week	0 (0.0)	1 (7.7)	
4 times a week	0 (0.0)	1 (7.7)	

Results are expressed in number of individuals and percentage (n (%)). Statistical analysis: chi-square test and [#]Fisher test.
Source: Elaborated by the authors.

Table 6 presents the general score of the questionnaire self-reported by the patients before and after the intervention. From 0 to 28 points, the standard feedback in the questionnaire is "You need to make your diet and life habits healthier!". From 29 to 42, the feedback is "Be careful with your diet and other habits such as physical activity and fluid consumption.". Finally, 43 points or more, "Congratulations! You're on the way to healthy living.". Patients' scores indicate an exciting improvement in eating habits before and after the intervention, corroborating that the use of the new monitoring model may have contributed to a better quality of life for the patient.

Table 6 - Overall score of the Food Guide: how to have a healthy diet questionnaire.

Variable	Before the intervention	After the intervention
n	13 (100.0 %)	13 (100.0)
Questionnaire Score	n (%)	n (%)
0 to 28	5 (38.5)	0 (0.0)
29 to 42	8 (61.5)	11 (84.6)
43 to –	0 (0.0)	2 (15.4)

Source: Elaborated by the authors.

4. Conclusion

In conclusion, it was observed that the model may have contributed to a change in the patient's behavior. Most patients consumed carbohydrates, fast food, red meat, and alcohol, and few practiced physical activities. The results suggest that the intervention through the application of the model contributed to an increase in the consumption of fruits and the practice of physical activity, in addition to helping to reduce the intake of alcoholic beverages and the consumption of fast food. For future work, we suggest applying this model to patients with other types of cancer to assess and extend the benefits of the model in different contexts of cancer treatment.

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