Association between preoperative physical activity levels and postoperative complications, length of hospital stay and mortality in cancer patients

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KEYWORDS: PHYSICAL ACTIVITY LEVELS; POSTOPERATIVE COMPLICATIONS; LENGTH OF STAY; MORTALITY; CANCER

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IV. ABSTRACT

Introduction: There is a growing interest to understand the impact of preoperative physical activity levels in postoperative morbidity and mortality. The aim of this study is to assess the levels of physical activity through accelerometry and evaluate its association with postoperative complications, length of stay and risk of death in patients with head, neck and digestive cancer. **Methods:** We conducted an observational, longitudinal and prospective study in newly diagnosed patients with digestive or head and neck cancer, recruited at IPO-Porto. The levels of physical activity were evaluated through accelerometry. Afterwards, the results of the postoperative phase, complications, length of stay and mortality were analyzed. **Results:** A total of 81 patients were recruited, mostly men, 68 (76.5%), with digestive cancer, 54 (66.7%), with an average height of 1.64±0.08m, weight 69.08±15.55kg, age 61.8±11.55 years and BMI 25.82±5.29 kg/m^2. Physical activity levels assessment through accelerometry indicated that 46.9% of patients were considered active, exceeding the 150min/week of moderate to vigorous PA (MVPA). During treatment 18 (22.2%) patients died, 8 (9.9%) of whom after surgery (12-240 days). In total, 64 patients underwent surgery, 34.9% had postoperative complications and stayed hospitalized by an average of 13.86 ± 15.58 days. A significant and strong association between higher preoperative physical activity and lower risk of overall mortality and postoperative mortality (x^2=15.985; p=0.000 and x^2=6.567; p=0.010 respectively). **Conclusion:** Complying with the recommendations of physical activity is associated with lower postoperative mortality. Our data suggests that assessing preoperative levels of physical activity could bring value to identify those patients at greater risk of surgical burden and guide them to intervention designed to mitigate that risk by increasing their physical activity, such as prehabilitation.

Keywords: PHYSICAL ACTIVITY LEVELS; POSTOPERATIVE COMPLICATIONS; LENGTH OF STAY; MORTALITY; CANCER

V. RESUMO

Introdução: Existe um grande interesse em compreender o impacto dos níveis de atividade física pré-operatória na redução da morbilidade e mortalidade pós-operatória. O objetivo deste estudo é avaliar os níveis de atividade física através da acelerometria de pacientes de cancro digestivo, cabeça e pescoço e verificar a sua associação com as complicações pós-operatórias, tempo de internamento e risco de morte. **Métodos:** Realizamos um estudo observacional, longitudinal, prospetivo com doentes diagnosticados com cancro digestivo, cabeça e pescoço, recrutados no IPO-Porto. Foram avaliados os níveis de atividade física através da acelerometria na fase pré-operatória e posteriormente, analisados os resultados das complicações pós-operatórias, tempo de internamento e mortalidade. **Resultados:** Foram recrutados 81 doentes, a maioria homens, 68 (78%), com cancro digestivo, 54 (66,7%), com altura média de 1,64 ± 0,08m, peso 69,08 ± 15,55kg, idade 61,8 ± 11,55 anos e IMC 25,82 ± 5,29 kg / m^2. A avaliação dos níveis de atividade física por meio da acelerometria indicou que 46,9% dos doentes foram considerados ativos, ultrapassando os 150min / semana de AF moderada a vigorosa (AFMV). Durante o tratamento 18 (22,2%) pacientes morreram, 8 (9,9%) dos quais após a cirurgia (12-240 dias). No total, 64 doentes foram operados, 34,9% tiveram complicações pós-operatórias e permaneceram internados em média 13,86 ± 15,58 dias. Encontramos uma associação significativa e forte entre os níveis elevados de atividade física pré-operatória e o menor risco de mortalidade geral e mortalidade pós-operatória (x^2 = 15,985; p = 0,000 e x^2 = 6,567; p = 0,010 respetivamente). **Conclusão:** Verificamos que cumprir as recomendações de atividade física está associado a um menor risco de mortalidade pós-operativa. Os nossos dados sugerem que a avaliação pré-operatória dos níveis de atividade física permite identificar doentes de maior risco, os quais poderão ser encaminhados para intervenções que mitiguem os efeitos do tratamento através da atividade física, como os programas de pré-habilitação.

Palavras-chave: NÍVEIS DE ATIVIDADE FÍSICA; COMPLICAÇÕES PÓS-CIRÚRGICAS; TEMPO DE INTERNAMENTO; MORTALIDADE; CANCRO;

VI. ABBREVIATIONS LIST

ACS – American Cancer Association

BMI – Body Mass Index

IPAQ - International Physical Activity Questionnaire.

IPO-Porto – Instituto Português de Oncologia do Porto

LPA – Light physical activity

MPA – Moderate physical activity

MVPA – Moderate to vigorous physical activity

PA – Physical Activity

POC – Postoperative Complications

QoL – Quality of Life

SD – Standard Deviation

VPA – Vigorous Physical Activity

WHO – World Health Organization

1. INTRODUCTION

Cancer is the second leading cause of death in the world, responsible for approximately 9.6 million deaths in 2018. About 1 in 6 deaths is due to cancer (Bray et al., 2018). The risk of cancer is associated with genetic, environmental and behavioral factors. Insufficient physical activity is one of the leading risk factors for death worldwide (WHO, 2018b). Indeed, significant epidemiologic evidence is supporting a major role for physical activity for the prevention of different types of cancer (Moore et al., 2016). There is strong evidence for a reduction in the relative risk (RR) of bladder (15%), breast (12-21%), colon (19%), endometrium (20%), esophagus (21%), gastric (19%) an renal (12%), and moderate evidence for lung cancer (21-25%) (McTiernan et al., 2019).

The benefits also extend to cancer survivors, with research supporting the negative impact of physical inactivity and sedentary behavior on the health of cancer survivors while being physically active has been associated with lower risk of all-cause and cancer-specific mortality for breast, colorectal and prostate cancer. (Lynch, Dunstan, Vallance, & Owen, 2013; McTiernan et al., 2019). Several other cancer-related health outcomes also seem to be positively modulated by physical activity (particularly structured exercise training) such as anxiety, depression, fatigue, health-related quality of life, lymphedema, physical function, bone health and sleep (KRISTIN L. CAMPBELL et al., 2019).

Surgery is a key element for cancer treatment and survival (alone or combined with systemic therapies) but it is not free of adverse effects. Surgical treatment imposes a great metabolic stress that promotes loss of homeostasis and increases the risk for postoperative complications. Postoperative complications are major sources of morbidity and mortality (Scheede-Bergdahl, Minnella, & Carli, 2019). This surgical burden is even more dramatic among frail cancer patients (Ethun et al., 2017).

The above-mentioned beneficial effects of physical activity/exercise have been mainly observed when physical activity/exercise was performed during systemic/adjuvant treatment or survivorship (after ending treatments) (Christensen, Simonsen, & Hojman, 2018). However, there is a growing interest to understand the

impact of physical activity levels/exercise training to optimize patients to better support treatments, particularly surgery.

The aim of this study is to assess the levels of physical activity through accelerometry and evaluate its association with postoperative complications, length of stay and risk of death in patients with head, neck and digestive cancer. This investigation is part of a larger project, IPO-score, with the objective of stratifying the risk of complications from surgical treatment and defining the prognosis through the interpretation of clinical and biopathological data in cancer patients.

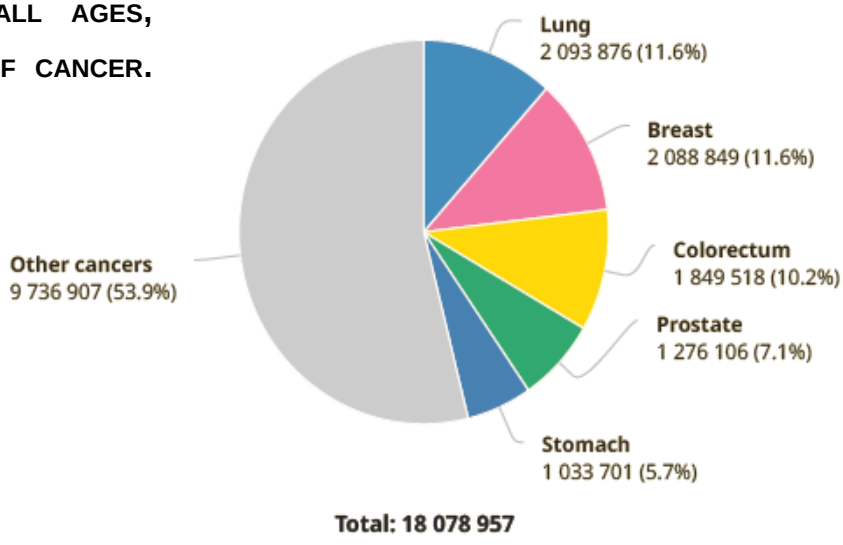
2. BACKGROUND

2.1. Cancer

Cancer is defined as a large group of diseases that can originate in almost any organ or tissue of the body and is characterized by abnormal and uncontrolled cell growth. These cells often acquire the capacity to invade adjoining parts of the body and/or spread to other organs (metastasis), which is a major cause of death in cancer patients. (WHO, 2018a). Although the causes are not completely understood, there are several factors modifiable (e.g. tobacco use and excess body weight) and non-modifiable (e.g. age and inherited genetic mutations) risk factors that increase the risk of cancer. (American Cancer Society, 2020)

As shown in figure 1, cancer is a global burden, with estimates from 2018 pointing to more than 18 million new cases. Lung, prostate, colorectal, stomach and liver cancer are the most common types of cancer in men. In woman, the most common are breast, colorectal, lung, cervical and thyroid cancer. (WHO, 2018a)

FIGURE 1 - NUMBER OF NEW CASES IN 2018 BOTH SEXES AND ALL AGES, ACCORDING TO THE TYPE OF CANCER. SOURCE: GLOBOCAN, 2018



Cancer is the second leading cause of death in the world, responsible for approximately 9.6 million deaths in 2018. About 1 in 6 deaths is due to cancer. (Bray et al., 2018) Figure 2 shows the incidence of the 10 main cancers and the respective mortality rate worldwide. The incidence of certain types of cancer is not directly

associated with mortality rates. For instance, although breast and prostate cancer have a higher incidence, they present lower mortality rates compared to, for example, lung cancer that has a lower incidence but is highly lethal. This is in part due to the ability to perform early diagnosis and the availability of efficient therapeutic options.

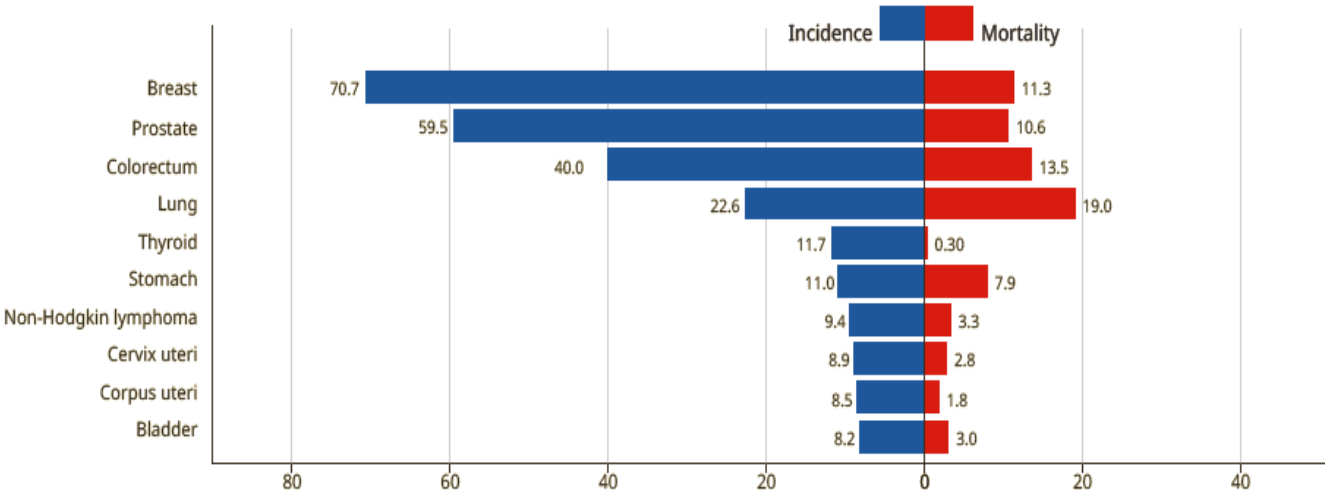


FIGURE 2 - WORLD INCIDENCE AND MORTALITY RATES, TOP 10 CANCERS. SOURCE: GLOBOCAN 2018

In Portugal, data from 2018 shows that the number of new cases of cancer and cancer deaths was 58.199 and 28.960, respectively. Figure 3 indicates that colorectal cancer had the highest number of cases, followed by breast and prostate cancer. (Bray et al., 2018). The prevision of cancer incidence shows that the occurrence of new cases will increase in the next few years. In two decades, the number will exceed 60 thousand cases, with the aging of the population and the consequent increase in average life expectancy acting as a determining factor.

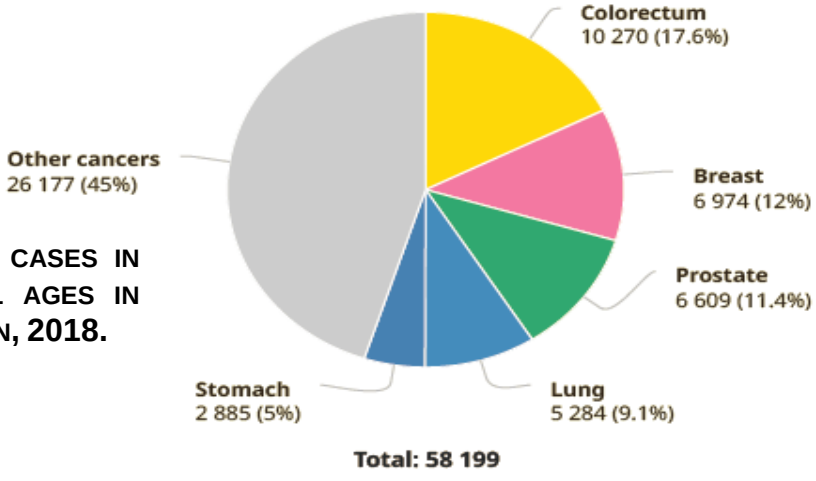


FIGURE 3 - NUMBER OF NEW CASES IN PORTUGAL, BOTH SEXES, ALL AGES IN PORTUGAL. SOURCE: GLOBOCAN, 2018.

2.1.2. Surgical treatment

Cancer treatment is complex and involves multiple procedures. The most common cancer treatment modalities are surgery, radiation therapy, and systemic treatment, including chemotherapy, targeted therapy, hormonal therapy, and immunotherapy. (Miller et al., 2019). The therapeutic strategy is usually a shared decision between the patient and the physician and should take into consideration several aspects, including the type and stage of cancer, the molecular profile, the age of the patient and its underlying health condition (ex: presence and severity of concomitant comorbidities, geriatric syndromes) (Mountzios, 2015).

Surgery is an essential component of multimodality therapy, and often the only curative option, for many solid tumors. As shown in table 1, it can be used for multiple purposes, ranging from prevention, diagnosis, staging, cure or palliative.

TABLE 1 - SURGERY AS PART OF A CANCER TREATMENT PLAN (CANADIAN CANCER SOCIETY)

Prevent cancer	Repair damage tissue
Diagnose and stage cancer	Support other treatments
Remove cancer	Support body functions
Relieve symptoms	Surgery with other therapies
Lower the change of recurrence	

It is estimated that approximately 80% of cancer patients, at some point in their journey, will need surgical treatment, with some of them undergoing multiple surgical interventions. In the case of solid tumors early diagnosed, surgical resection, alone or in combination with other therapies such as chemotherapy and radiotherapy, significantly increases the chances of cure (Sullivan et al., 2015). It was estimated that in 2015, 32 million surgeries were needed globally, with projections indicating a substantial increase by 2030, where it is anticipated that 45 million surgeries will be required (Sullivan et al., 2015). This increase is not surprising in view of the trend of evolution of the incidence of neoplasms in the coming years. Despite its key role in cancer management, surgery is not free of adverse effects, being a significant source

of morbidity and mortality, largely because of postoperative complications. (Ethun et al., 2017)

2.1.3. Postoperative complications

Postoperative complications (POC) are defined as any deviation from the normal postoperative course and that results in adverse effects. They can be classified by type (surgical or medical), by organ/system affected (e.g. cardiovascular, pulmonary, urinary system) and by severity (e.g. minor or major). The Clavien–Dindo classification system (table 2) is the most used approach to classify the severity of POC in an objective and reproducible way, being also recommended by several international societies of medical specialties (Jammer et al., 2015). The system categorizes POC into 5 grades, which allow to further divide POC into minor and major complications. Clavien–Dindo degree 1 and 2 are defined as minor complications and degree 3 to 5 as major complication. (Clavien et al., 2009)

TABLE 2 - CLAVIEN-DINDO CLASSIFICATION, (CLAVIEN ET AL., 2009)

Grades	Definition
Grade I	Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic and radiological interventions Allowed therapeutic regimens are drugs as antiemetics, antipyretics, analgesics, diuretics and electrolytes and physiotherapy. This grade also includes wound infections opened at the bedside.
Grade II	Requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included.
Grade III	Requiring surgical, endoscopic, or radiological intervention
- IIIa	Intervention not under general anesthesia
- IIIb	Intervention under general anesthesia
Grade IV	Life-threatening complication (including CNS complications) requiring IC/ICU-management
- IVa	Single organ dysfunction (including dialysis)

- IVb	Multiorgan dysfunction
Grade V	Death of a patient

The overall incidence of 30-day CPO is between 5% and 45% for elective surgery ("Global patient outcomes after elective surgery: prospective cohort study in 27 low-, middle- and high-income countries," 2016). In the oncological context, and specifically in gastrointestinal cancer, incidence of PCO has been described, from approximately 33.5 to 51% after esophagectomy (Baba et al., 2016; Yamashita et al., 2016), 20 to 40% after gastrectomy, 12 to 30% after colectomy, 14 to 27% after colorectal surgery and 30 to 60% after pancreatectomy (Malleo & Vollmer, 2016). In head and neck cancer, estimates point to an incidence ranging from 6%–28%. (Baehring & McCorkle, 2012; Schwam, Sosa, Roman, & Judson, 2015). These variations reflect the influence of multiple factors, including the patient's characteristics (e.g., age, physiological reserve, type and stage of the underlying oncological disease, concomitant presence of comorbidities and risk factors), the surgical procedure (Haverkamp et al., 2013), the volume of surgeries performed, the human, technical and structural resources available (Tevis & Kennedy, 2013), but also the variability inherent in the use of different criteria for the description and classification of CPO (Shah & Hamilton, 2013).

The occurrence of complications in the postoperative period severely limits the prognosis of the cancer patient undergoing surgery. If, on the one hand, it may weaken the patient, delay subsequent treatments and reduce its potential beneficial effects, on the other hand it may prolong the hospital stay, increase the risk of hospital readmission and the need for continued care, increase costs, decrease the quality of life and precipitate premature death (Chiu et al., 2017; Ferraris, Bolanos, Martin, Mahan, & Saha, 2014; Jhanji et al., 2008; Papenfuss et al., 2014; Tevis & Kennedy, 2013; Vonlanthen et al., 2011). It should also be noted that the occurrence of complications up to 30 days after major surgery proved to be a determinant of long-term survival (Artinyan et al., 2015; Dekker et al., 2014; Kim & Kim, 2016), with a more important impact than preoperative risk or intraoperative factors (Booka et al., 2018; Ingraham et al., 2010; Khuri et al., 2005; Shimada, Fukagawa, Haga, & Oba, 2017).

There is also evidence that PCO can induce a long-lasting suppressive effect on patients' immune systems, making them more susceptible to recurrence of the neoplasia (Artinyan et al., 2015; Krarup, Nordholm-Carstensen, Jorgensen, & Harling, 2014; Mavros, de Jong, Dogeas, Hyder, & Pawlik, 2013). An association between CPO (major and minor) disorders of the patient's psychosocial well-being, namely with high levels of stress and depression, was also demonstrated up to 12 months after surgery (Pinto, Faiz, Davis, Almoudaris, & Vincent, 2016). Considering the estimates of an increase in the global volume of surgeries, the population demographic transition and improvements in access to surgical treatment in growing countries, it is anticipated that these numbers may also increase in the coming years. Thus, preventing surgical complications is imperative for the delivery of high quality-care and improvement of patient outcomes.

2.1.4. Preoperative risk in the reduction of complications

Knowledge of the factors associated with postoperative morbidity and mortality will allow better clinical decision-making, to not only act preventively and correct modifiable factors, but also to operate at the right time, optimize surgical results and manage resources. There are modifiable and non-modifiable risk factors related to the individual (e.g., age, anatomical characteristics, location and stage of cancer, physiological reserve/physical capacity, concomitant presence of comorbidities and other risk factors like hypertension, hyperglycemia, smoking, alcohol consumption and being frail) and this are represented in figure 4. However, we should not neglect other sources of risk such as those related to the surgery (e.g., knowledge and technical skills, experience of the surgical team, volume of surgeries performed, type and complexity of surgery) and with the health system (e.g. technical and structural resources available). For the purpose of this work, we will only focus on the patient´s modifiable risk factors, particularly to the importance of pre-operative physical activity levels.

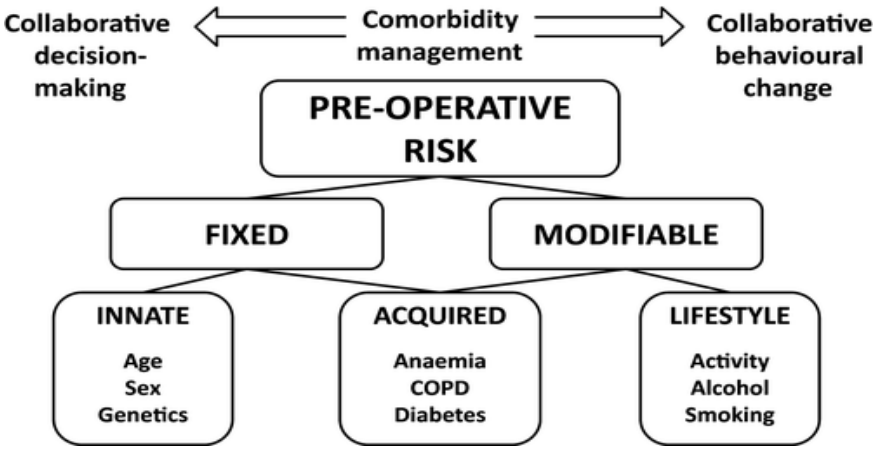


FIGURE 4 - FIXED AND MODIFIABLE PATIENT RISK FACTORS. (GROCOTT, EDWARDS, MYTHEN, & ARONSON, 2019)

2.2 Physical Activity

According to Caspersen, Powell, and Christenson (1985), physical activity is defined as “any bodily movement produced by skeletal muscles that results in energy expenditure”. Physical activity in daily life can be categorized into occupational, sports, conditioning, household, or other activities.

According to the guidelines, depending on the duration and intensity of the activity, an individual can be classified as:

- **Inactive –** without moderate or vigorous activities per day.
- **Insufficiently active –** less than 150 min of moderate or 75 min of vigorous activity per week or the equivalent combination.
- **Active –** equivalent of 150 min to 300 min of moderate-intensity PA a week. This level is the guideline for adults.
- **Highly active –** equivalent or more than 300 min of moderate-intensity PA a week.

The current guidelines consider intensity according to energy expenditure, expressed in metabolic equivalent of the task (METs), with 1 MET (3.5 ml/kg/min $\mathbf{O_2}$) being the resting energy expenditure rate (ODPHP, 2018). Based on this, an activity can be classified by its intensity in 4 categories:

Sedentary activity – 1 MET or less

Light-intensity activity – more than 1 to less than 3 METs;

Moderate-intensity activity – requires 3 to less than 6 METs;

Vigorous-intensity activity – requires 6 METs or more;

The importance of this classification is due to the fact that it relates the levels of aerobic physical activity with the health benefit (ODPHP, 2018). To be considered "active", an adult person must engage in at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity activity each week. Aerobic activity should be performed in bouts of at least 10 minutes duration. Muscle-strengthening activities should be done involving major muscle groups on 2 or more days a week. (WHO, 2010). Walking (5km.h), dancing, yoga and garden maintenance are examples of moderate activities. While jogging, running, soccer and fast cycling are examples of vigorous activities (Kushi et al., 2012).

2.3 Physical Activity and Cancer

Significant epidemiologic evidence is supporting a major role for physical activity for the prevention of different types of cancer (Moore et al., 2016). There is strong evidence for a reduction in the relative risk (RR) of bladder (15%), breast (12-21%), colon (19%), endometrium (20%), esophagus (21%), gastric (19%) an renal (12%), and moderate evidence for lung cancer (21-25%) (McTiernan et al., 2019). The benefits also extend to cancer survivors, with research supporting the negative impact of physical inactivity and sedentary behavior on the health of cancer survivors while being physically active has been associated with lower risk of all-cause and cancer-specific mortality for breast, colorectal and prostate cancer (Lynch et al., 2013; McTiernan et al., 2019).

Physical activity has a potential benefit at all stages of the cancer and in different domains such as physical, psychological and social. A recent consensus concluded that there is sufficient evidence to support the efficacy of specific doses of exercise training to address cancer-related health outcomes, including fatigue, quality of life, physical function, anxiety, and depressive symptoms. (Schmitz et al., 2019) In addition,

many cancer patients have concomitant comorbidities such as cardiovascular, metabolic, musculoskeletal and psychological disorders and physical activity may have a role in the management of these conditions (Sarfati, Koczwara, & Jackson, 2016).

The above-mentioned beneficial effects of physical activity/exercise have been mainly observed when physical activity/exercise was performed during systemic/adjuvant treatment or survivorship (after ending treatments) (Christensen et al., 2018). However, there is a growing interest to understand the impact of physical activity levels/exercise training to optimize patients to better support treatments, particularly surgery. A recent meta-analysis of 8 studies found that higher levels of physical activity were associated with shorter length of hospital stay (OR=3.66; 95% CI=1.38 to 9.69), better postoperative quality of life (R=1.29; 95%CI=1.11 to 1.49) (REF) but not with reduced postoperative complications (OR 2.60; 95%CI=0.59 to 11.7) in cancer patients undergoing surgery. However, this study also highlighted the lack of high-quality evidence on the association of preoperative physical activity level and postoperative outcomes in cancer patients undergoing surgery. This was attributed in part to the heterogeneity between included studies in terms of physical activity assessment (mainly by questionnaires) and poor definition of outcomes.

Regarding physical activity assessment, previous studies have demonstrated that cancer patients overestimate their self-reported physical activity level by 366% when compared to objective measures (Vassbakk-Brovold et al., 2016). Thus, it is important that future studies use validated and reliable instruments to measure physical activity. Small and wearable physical activity monitors, particularly accelerometers, are continually being refined as potentially very useful techniques in the accurate and detailed measurement of free-living PA. (Chen & Bassett, 2005) Accelerometers are among the most common devices to objectively measure physical activity. (Strath et al., 2013) As an objective method to measure PA, accelerometers offer some advantages over subjective methods such as the ability to capture large amounts of data, and ease of administration, particularly in large studies (Westerterp, 2009). Accelerometers measure acceleration (counts) in real time and detect the body movement accelerations in one to three orthogonal planes (anteroposterior, mediolateral, and vertical), (Chen & Bassett, 2005; Sylvia, Bernstein, Hubbard, Keating, & Anderson, 2014). Currently, most calibration studies use the accelerometer output to determine energy expenditure and physical activity intensity levels. However,

accelerometers are expensive and require technical expertise, specialized hardware, software, and individual programming. Additionally, some accelerometers are unable to differentiate body position (i.e., sitting, lying, and standing), (Sylvia et al., 2014).

Thus, the association between objectively measured physical activity levels and postoperative outcomes needs to be further explored. Such information would help health care providers to better predict the risk of postoperative burden and thus guide on patient selection, to determine which thresholds of preoperative physical activity levels are associated with a greater risk of postoperative morbidity and mortality, and to identify those patients who need to be optimized before surgery with a prehabilitation program.

Cancer prehabilitation has been defined as a process on the cancer continuum of care that occurs between the time of cancer diagnosis and the beginning of acute treatment. It includes physical and psychological assessments that establish a baseline functional level, identify impairments, and provide interventions that promote physical and psychological health to reduce the incidence and/or severity of future impairments. (Silver, Baima, & Mayer, 2013). Prehabilitation can have an important role in the patient's recovery, reducing post-operative complications (table 3), which could be especially interesting to high-risk patients as those with poor pre-operative physical activity levels.

TABLE 3 – PREHABILITATION EVIDENCES IN CANCER PATIENTS

Authors (year)	Cancer / Treatment	Variable	Methods	Conclusion
Nadler, Desnoyers, Langelier, and Amir (2019)	Advanced/ metastatic cancers	Baseline and post-intervention of QoL, physical function, fatigue, and the effect of physical exercise	Meta-analysis. 16 trials. Moderate/high intensity aerobic exercise or resistance training.	Exercise is associated with improvements in QoL, function, and (6-MWT)

(van Rooijen et al., 2019)	Colorectal surgery	Postoperative complications with multimodal prehabilitation	714 patients. Intervention group with 4 weeks of prehabilitation and group without prehabilitation.	Reduction in postoperative complications, length stay, intensive care stays and mortality rate.
(Inoue et al., 2013)	Esphagectomy	Postoperative pulmonary complications (PPC) and additional medical costs	63 patients. 37 in the non-preoperative rehabilitation. Prehabilitation group received preoperative respiratory rehabilitation for >7 days.	Intensive preoperative respiratory rehabilitation reduced PPC
Dunne et al. (2012)	Liver cancer / hepatic resection	Increase cardiorespiratory fitness - Anaerobic threshold measured by a cardiopulmonary exercise test for	11 participants mean age 46 years. 4 week of interval training. 12 sessions on a stationary bike	30% of patients from high risk to low risk with a 10% increase in fitness.

3. OBJECTIVE

The purpose of this work was to explore the association between preoperative levels of physical activity (assessed by accelerometer) in the preoperative phase and postoperative outcomes (complications, length of hospital stays and mortality) in patients with digestive or head and neck cancer.

4. METHODS

4.1. Study Design

This is an observational, longitudinal and prospective study. The data were collected at the Institute of Oncology of Porto (IPO- Porto), in the department of Head and Neck Cancer and Gastrointestinal Cancer.

The study has been approved by the ethical committee of the IPO-Porto (Comissão de Ética para a Saúde do Instituto Português de Oncologia do Porto Francisco Gentil, E.P.E- (Doc. CES-IPOP 03, projeto 193/016)).

4.2. Participants

Inclusion criteria were: i) patients diagnosed with digestive or head and neck cancer; ii) in the preoperative phase; iii) aged 18 years or older; iv) both sexes; v) returning the signed informed consent. All participants were informed about the aim of this investigation After informed, (appendix I), all participants signed the informed consent (appendix II). The patients were evaluated at IPO-Porto, every Monday morning, between December 2018 and July 2019. Postoperative data were collected by the nursing service of IPO-Porto.

4.3. Measurements

The data was collected in two phases: the preoperative and the postoperative phase. In the first phase, all patients were submitted to the following assessments: i) socio-demographic characterization; ii) anthropometric and body composition assessment; iii) physical activity assessment using accelerometry. In the postoperative

phase, data such as postoperative complications, length of hospital stay and mortality, were collected from patients' clinical records.

4.3.1. Preoperative data assessment phase

Socio-demographic characterization: a questionnaire was developed for the collection of socio-demographic information (age, gender, marital status and educational level). (appendix III).

Anthropometric assessment: The height was measured using a stadiometer (seca 213). Patients were measured without shoes and instructed to look straight ahead with an upright posture. (appendix III)

Body composition assessment: using a bioimpedance scale (Tanita Inner Scan BC 532) body mass, fat-free mass, fat mass, bone mass and consequently BMI were measured. (appendix III). The participants were measured wearing light clothing and barefoot.

Physical activity assessment: Patients were instructed to wear an accelerometer, Actigraph GT3X model (Pensacola, FL, USA), on the right hip for seven consecutive days to measure physical activity. They were instructed to maintain their daily routine and to remove the device only at the time to sleep, for showering or for activities that involved water. The patients also took a record sheet to describe the (if possible) the activities they were involved and their duration (appendix IV). All physical active minutes during all valid wearing time were divided by the number of valid wear days, in order to calculate the mean number of minutes of physical activity per day. The assessment of physical activity is express in counts per minute. For the present study, the accelerometers were programmed to record data in 1-second epochs (counts/min) and subsequently converted to 60-second epochs. The cutoff points used to differentiate physical activity times were defined based on sedentary time (0 - 200 counts/min), Light PA (200 – 2689 counts/min) and moderate to vigorous AF (AFMV) (≥2690 counts/min). We also measured the number of daily steps. The data were downloaded and analyzed using the software ActiLife (Actigraph, Florida, EUA, version 6.13.4).

4.3.2. Postoperative data assessment phase

Postoperative data was collected in clinical records in May 2020 by an outcome researcher from the IPO-Porto, with no previous involvement on the project and no knowledge about the purpose of the study. It was possible to have access to the type of treatment, days of hospitalization, postoperative complications and its severity according to Clavien-Dindo classification (Clavien et al., 2009), overall mortality (number of deaths that occurred before and after surgery) and postoperative mortality (number of deaths that occurred after surgery).

4.4. Data Analysis

The data were organized in Microsoft Office Excel software and analyzed using IBM SPSS (Statistical Package for Social Sciences Statistics) 25 software (USA). Kolmogorov-Smirnov and Shapiro-Wilk test were used to assess distribution normality. Data are presented in frequency (%), mean (SD) or median (min-max) as appropriate.

To analyze the difference between groups, the T-student test and Mann-Whitney test were used as appropriate. The association between PA levels and postoperative variables was tested with the Chi-square test and the magnitude of the association was explored using the Phi or Cramer V test and classified as week (>0.05), moderate (>0.10), strong (>0,15) or very strong (>025), (Akoglu, 2018). For this analysis, we stratified the participants as those who complied or did not complied with the international recommendations for physical activity.

Results were considered statistically significant when $p < 0.05$.

5. RESULTS

Sample data

A total of 81 patients were recruited, mostly men, 68 (78%), with digestive cancer, 54 (66.7%), with an average height of 1.64±0.08m, weight 69.08±15.55kg, age 61.8±11.55 years and BMI 25.82±5.29 kg/m^2 (table 4). We found significant differences between digestive and head and neck cancer for BMI and level of education.

TABLE 4 - SAMPLE CHARACTERIZATION

		Total	Digestive	Head and Neck	p
Patients, n (%)		81(100)	54 (66.7)	27 (33.3)	
Gender, n (%)	**Male**	62 (76.5)	38 (70.4)	24 (88.9)	0.064
	Female	19 (23.5)	16 (29.6)	3 (11.1)	
Age (years)		61.8±11.55	62.85±12.37	59.74±9.582	0.336
Weight (kg)		69.08±15.55	70.87±15.80	65.81±15.03	0.172
Height (m)		1.64±0.08	1.64±0.07	1.63±0.09	0.824
BMI (kg/m^2)		25.82±5.29	26.49±5.48	24.68±4.81	0.151
	< 18.5	3 (3.7)	0	3 (11.1)	**0.031**
	18.5 – 24.9	32 (39.5)	19 (35.2)	13 (48.1)	
	25 – 29.9	33 (40.7)	25 (46.3)	8 (29.6)	
	30 – 34.9	10 (12.3)	8 (14.8)	2 (7.4)	
	>35	1 (1.2)	0	1 (3.7)	
Marietal status, n (%)	**Single**	7 (4.9)	3 (5.6)	4 (14.8)	0.168
	Married	56 (38.9)	39 (72.2)	17 (63)	
	Divorcied	8 (5.6)	4 (7.4)	4 (14.8)	
	Widow	9 (6.3)	8 (14.8)	1 (3.7)	
	Other	1 (0.7)	0	1 (3.7)	

Education, n (%)	**Illiterate**	4 (5)	4 (7.4)	0	**0.012**
	1º Basic	42 (52.5)	33 (61.1)	9 (33.3)	
	2/3º Basic	24 (30)	10 (18.5)	14 (51.9)	
	Secondary	9 (11.3)	5 (9.3)	4 (14.8)	
	Higher Degree	1 (0.7)	2 (3.7)	0	

Data present as Frequency (%) or Mean±SD; BMI – Body Mass Índex;

Characterization of physical activity levels and pattern

Table 5 presents the results of physical activity levels. On average, participant wore the accelerometer for an average of 6.78±0.73 days, with a daily use of 12.47±1.86 hours per day. The total sample spent a mean of 2708.20±743.18 minutes/week, 2160.75±921.26 minutes/week, 132 (3-1851) minutes/week and 1 (0-144) minutes/week in sedentary, light, moderate and vigorous activity, respectively. Their mean weekly MVPA was 132 (3-1860) min, which is below the recommended levels, and only 38 participants (27 patients with digestive cancer and 11 patients with head and neck cancer) accomplished the physical activity recommendations of MVPA.

An average of 5730.06±3395.01 steps per day have been recorded by pedometer. No significant changes were detected between patients with digestive cancer and patients with head and neck cancer.

TABLE 5 – LEVELS OF PHYSICAL ACTIVITY

		Cancer			
		Total	**Digestive**	**Head and Neck**	**p**
Physical Activity Level (min/week)	**Sedentary**	2708.20±743.18	2676.85±766.71	2770.89±703.58	0.595
	Ligth	2160.75±921.26	2221.70±913.53	2038.85±941.88	0.403
	Moderate	132 (3-1851)	150 (3-1190)	130 (5-1851)	0.314
	Vigorous	1 (0-144)	1 (0-144)	1(0-17)	0.920

MVPA (min/week)	132 (3-1860)	150.50 (3-1219)	131 (6-1860)	0.302
Accomplishing PA Guidelines, N (%)	38 (46.9)	27 (50)	11 (40.7)	0.437
Steps/day	5730.06±3395.01	6058,64±3485.15	5072,91±3167.41	0.155
Acellerometer (days/week)	7 (3-7)	7 (3-7)	7 (4-7)	0.149
Acellerometer (hours/day)	12.47±1.86	11.93 (10-15.89)	12,49±1.7	0.535

Data present as mean±SD or median (min-max) or frequencies (%). Pa – physical activity; MVPA – moderate-vigorous physical activity; p value to compare mean between type of cancer.

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The classification of the physical activity levels is shown in figure 5. In the total sample that was assessed, 53% are classified as “insufficiently active”, 24% as “active” and 23% as “highly active”.

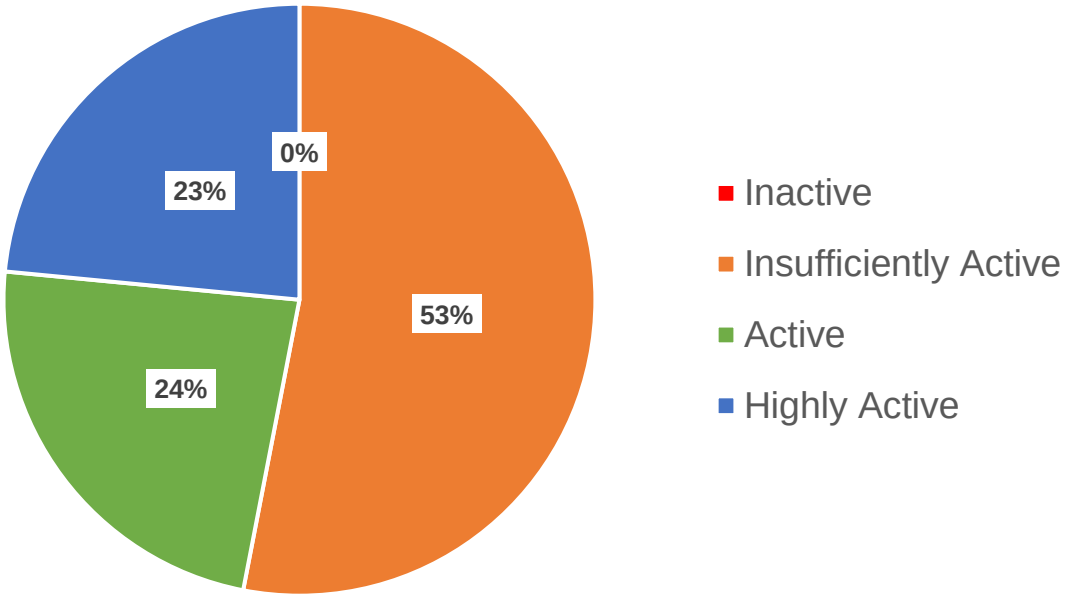


FIGURE 5 - CLASSIFICATION OF PHYSICAL ACTIVITY LEVELS

In figure 6, we show the weekly pattern of physical activity, were it is possible to observe that participants spent the majority of their wearing time in sedentary behavior (54% of their time), followed by light physical activity (42% of their time) and lastly in

MVPA (4% of their time). We also stratified this analysis by those patients who complied or did not complied with the international guidelines. Those complying spent 46% of their time in sedentary, 46% in light physical activity and 8% in MVPA, while those not complying spent 61% of their time in sedentary behavior, 28% in light physical activity and 1% in MVPA.

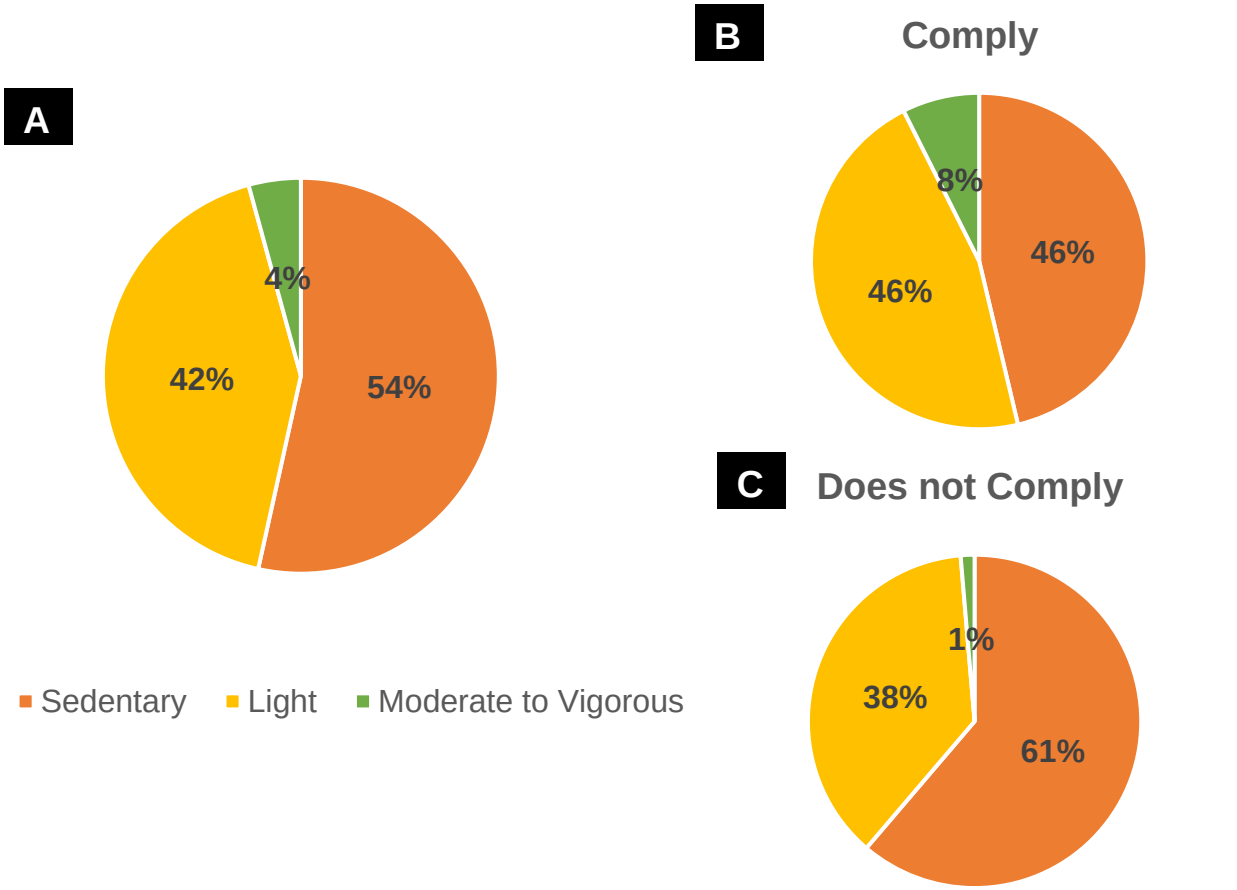


FIGURE 6 - WEEKLY PATTERN OF PHYSICAL ACTIVITY IN THE TOTAL SAMPLE (A), IN PATIENTS COMPLYING (B) AND NOT COMPLYING (C) WITH THE GUIDELINES.

Characterization of postoperative outcomes

Postoperative burden is summarized in table 6. From the 81 patients that were initially scheduled for surgery, only 64 (41 patients with digestive cancer and 23 with head and neck cancer) were indeed submitted to surgical treatment (the others excluded by their physicians due to disease progression). From those submitted to surgical treatment, 41 (65.1%) had no postoperative complications (26 patients with digestive cancer and 15 with head and neck cancer), 15 had minor complications (9

patients with digestive cancer and 6 with head and neck cancer) and 8 had major complications (6 patients with digestive cancer and 2 with head and neck cancer). On average, the hospital length stay was 13.86 ± 15.58 days (12.73 days for patients with digestive cancer and 15.87 days for patients with head and neck cancer). Death was registered for 18 patients (10 patients with digestive cancer and 8 with head and neck cancer), from which 8 occurred after surgery (2 patients with digestive cancer and 6 with head and neck cancer). Mortality rate was superior among head and neck patients than in digestive cancer patients (4.9% and 26.1%, respectively).

TABLE 6 - POSTOPERATIVE COMPLICATIONS AND MORTALITY

		Cancer			
		Total	**Digestives**	**Head and Neck**	**p**
N patients (%)		81 (100)	54 (100)	27 (100)	
Surgery, n (%)		64 (79)	41 (75.9)	23 (85.2)	0.335
Complications	**Without,** n (%)	41 (64.1)	26 (48.4)	15 (65.2)	0.465
	Minor, n (%)	15 (23.4)	9 (16.7)	6 (26.1)	
	Major, n (%)	8 (12.5)	6 (11.1)	2 (8.7)	
Length of stay (days), Median (min-max)		9 (1-105)	9 (1-61)	8 (2-105)	0.129
≤5, n		10	4	6	0.087
>5, n		54	37	17	
Overall mortality, n (%)		18 (22.2)	10 (18.5)	8 (29.6)	0.257
Postoperative mortality, n (%)		8 (9.9)	2 (4.9)	6 (26.1)	**0.012**

Data presented as Frequency (%), Mean±SD. Or Median (min-max)

Association between preoperative physical activity levels and postoperative complications, length of hospital stay and mortality.

To analyze the association between physical activity levels and postoperative outcomes, we categorized patients by complying or not complying with the

international recommendations of physical activity (150min/MVPA/week). Overall mortality, postoperative mortality, postoperative complications and length of hospital stay was superior among those patients not complying with international recommendations, but statistical differences were found only for overall mortality and postoperative mortality (table 7).

TABLE 7 – COMPARISON OF POSTOPERATIVE OUTCOMES BETWEEN PATIENTS COMPLYING AND NOT COMPLYING WITH THE RECOMMENDATIONS OF PHYSICAL ACTIVITY

	Does not comply	Comply	P value
Overall mortality, n (%)	17 (94.4)	1 (5.5)	**0.000**
Postoperative mortality, (%)	7 (87.5)	1 (12.5)	**0.019**
Total postoperative complications, n (%)	18 (62.1)	23 (65.7)	0.798
Minor postoperative complications, n (%)	9 (31)	6 (17.1)	0.193
Major postoperative complications, n (%)	2 (6.9)	6 (17.1)	
Length of hospital stay, in days, median(min-max)	9 (2-61)	9 (1-105)	0.485

Next, we tested the association between complying/not complying with physical activity recommendations and postoperative burden. As shown in table 8, we did not find any association with postoperative complications or with length of hospital stay for the total sample, for digestive cancer patients or head and neck cancer patients.

However, overall mortality and postoperative mortality were strongly associated with the level of physical activity in the total sample, while this was also true for overall mortality in digestive cancer patients, suggesting that those patients complying with the recommendations have better outcomes.

TABLE 8 - ASSOCIATIONS BETWEEN COMPLYING/ NOT COMPLYING WITH PHYSICAL ACTIVITY RECOMMENDATIONS AND POST-OPERATIVE ADVERSE EVENTS

	Total	Digestive	Head and Neck
Postoperative Complications	X^2=2.671; p= 0.263 DF=2 V=0.204; p=0.263	X^2=1.489; p=0.475 DF=2 V=0.191; p=0.475	X^2=2.383; p= 0.304 DF=2 V=0.322; p=0.304
Length of hospital stay	X^2= 1.121; p= 0.290 (*p=0.327) DF=1 V=0.132; p= 0.290	X^2=0.366; p=0.545 (*p=1) DF=1 V=0.095; p=0.545	X^2=1.776; p= 0.183 (*p=0.341) DF=1 V=0.278; p= 0.183
Overall mortality	**X^2=15.895; p= 0.000** **DF=1** **V=0.443; p=0.000**	**X^2= 12.273; p=0.000** **(*p=0.001)** **DF=1** **V= 0.477; p=0.00**	X^2=3.755; p=0.053 (*p=0.09) DF=1 V=0.373; p=0.053
Postoperative Mortality	**X^2=6.567; p=0.010** **(*p=0.019)** **DF=1** **V=0.320; p= 0.010**	X^2=3.285; p=0.070 (*p=0.146) DF=1 V=0.283; p= 0.070	X^2=2.375; p= 0.123 (*p=0.179) DF=1 V=0.321; p=0.123

X^2 – chi-square; Df – degrees of freedom; V – Cramer´s V test; *Fisher test p value

6. DISCUSSION

The aim of this observational, longitudinal and prospective study was to evaluate the association between complying/not complying with physical activity recommendations in the preoperative period, measured by accelerometry, with postoperative burden. The results of this study indicate that those patients complying with physical activity recommendations are at-lower risk of postoperative death.

In the current study, 35.9% of the patients had postoperative complications, mostly minor. The complication rate among patients with digestive cancer was 16.7% for minor and 11.1 for major, while in head and neck patients the rate was 26.1 for minor and 8.7 for major complications, which is in the range of the values described in the literature for these patients (Baba et al., 2016; Baehring & McCorkle, 2012; Malleo & Vollmer, 2016; Yamashita et al., 2016).Postoperative mortality rate was 9.9% when considering the overall sample, 4.9% when just considering digestive cancer patients and 26.1% when just considering head and neck cancer patients, which is higher than published values (Alves et al., 2005; Bhattacharyya & Fried, 2001; Ciesielski et al., 2017; Schultz, Chambres, Wiorowski, Hemar, & Debry, 2005). We believe that this could be due to clinical differences, but we were not able to explore this issue as the full clinical characterization was not available at time to be included in this work. For instance, cachexia is a major risk factor for postoperative complications (Mason et al., 2016). Despite that we did not evaluate this variable, we found significant differences in BMI among head and neck and digestive patients, with the former presenting a higher rate of patients in the underweight category. Also, unhealthy lifestyle habits like smoking and alcohol drinking are highly prevalent in this type of cancer and are also major risk factors for postoperative complications (Tønnesen, Nielsen, Lauritzen, & Møller, 2009). The average length of hospital stay was 13.86 days for the entire cohort and ranged from an average of 12.73±1.28 days (for digestive patients) to 15.87±22.29 days (for head and neck patients), with a greater proportion of digestive cancer patients spending more than 5 days in hospital. This might be explained in part by the greatest postoperative mortality rate that was observed among head and neck cancer patients.

We found that 53% of our patients did not complied with the amount of MVPA recommended by the international guidelines on physical activity (K. L. Campbell et al., 2019) and thus were classified as insufficiently active, spending 61% of their weekly

time in sedentary behavior, 31% in light activity and only 1% in MVPA. This is in line with previous reports in newly diagnosed cancer patients, before starting their treatment (Douma et al., 2020; Steindorf et al., 2020) We also found that a higher physical activity level was associated with lower postoperative mortality in the total study population, which is in line with a previous observation in major oncological abdominal surgery (Dronkers, Chorus, van Meeteren, & Hopman-Rock, 2013). The finding that postoperative mortality occurred less frequently in patients performing >150 min/week of MVPA suggests that increasing activity during the preoperative period may be of benefit. Thus, preoperative physical activity levels should be assessed, and those patients identified as not complying should be instructed to increase their time in MVPA. Such an intervention could be encouraged in the weeks before surgery. This is known as prehabilitation and several studies support the efficacy of this intervention to improve the physical capacity and to reduce postoperative morbidity and mortality in cancer patients submitted to abdominal or thoracic surgery (Gillis et al., 2018; Hughes et al., 2019; Kamarajah, Bundred, Weblin, & Tan, 2020; Moran et al., 2016).

We did not find any association between a higher physical activity level and postoperative complications or length of hospital stay. A previous meta-analysis suggested that higher levels of preoperative physical activity in patients undergoing cancer surgery were associated with shorter length of hospital stay, but not postoperative complications (Steffens et al., 2019). We believe that this deserves further attention in future studies as in addition to its severity, complications must be interpreted according to their type (surgical vs. non-surgical). Surgical complications are related to surgical procedures or techniques (e.g. bleeding, leaks, sepsis due to leaks etc.) while non-surgical complications are related to the patient's physiological health or comorbidities (e.g., acute kidney injury, acute respiratory failure, preexisting sepsis, etc.) (VASAVADA & Patel, 2020). We could not discriminate which type of complications were more frequent in our study population. If surgical complications were the most prevalent, it is conceivable that a higher physical activity level could do little to prevent them, as these are not related to the patient's physiological reserve. A previous study using prehabilitation in high-risk patients for undergoing elective major abdominal surgery showed that the intervention reduced non-surgical complications but had no effect on surgical complications (Barberan-Garcia et al., 2018).

7. LIMITATIONS

This study has some limitations. First, the small sample size limited the analysis, particularly the comparisons between cancer type. Second, we were not able to characterize the patient's full clinical profile and stage of cancer. The data had to be extracted from clinical records by an authorized outcome researcher and it was not possible to obtain it on time for its inclusion. Finally, a better characterization of postoperative complications (e.g., rate of surgical and non-surgical) would be of additive value to understand which were more prevalent and which were associated with physical inactivity.

8. CONCLUSION

There was an association between the levels of physical activity observed in the preoperative period and postoperative mortality. The same was not true of postoperative complications and length of hospital stay.

Our data suggests that assessing preoperative levels of physical activity could bring value to identify those patients at greater risk of surgical burden. In addition, it could provide guidance to identify those patients who need to be optimized before surgery with a prehabilitation program.

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10. APPENDIX

APPENDIX I - PATIENT INFORMATION



FOLHA DE INFORMAÇÃO AO PARTICIPANTE

Qual o propósito deste estudo?

A fragilidade é uma condição caracterizada por diminuição da reserva fisiológica do organismo, que predispõe o indivíduo a um maior risco de complicações e mortalidade pós-cirúrgica. A identificação do instrumento de diagnóstico de fragilidade com maior capacidade discriminativa do prognóstico irá auxiliar a tomada de decisão sobre o tratamento cirúrgico e permitirá identificar os indivíduos frágeis que mais beneficiarão de programas de reabilitação/preparação pré-cirúrgica. Assim, o presente estudo tem como objetivo melhorar a determinação do risco cirúrgico, através da avaliação do nível de fragilidade e aptidão física. O estudo foi apresentado e aprovado pelo CES-IPO Porto (projeto n.º 193/016).

O que acontece se aceitar participar no estudo?

Os indivíduos que aceitarem participar no estudo serão submetidos a um conjunto de avaliações (testes físicos e preenchimento de questionários) que visam recolher informação sobre aspetos relacionados com a condição física, psicológica e nutricional. Para além disso, poderá ser realizada uma simples colheita de sangue venoso, sendo que o eventual desconforto poderá ser minimizado pelo facto de ser efectuada por pessoal de enfermagem treinado e experiente nesse procedimento. Finalmente, será fornecido e colocado um pequeno aparelho de uso diário, durante uma semana, com o objetivo de avaliar o movimento corporal.

Quanto tempo demoram as avaliações? Tem custos associados?

A realização da totalidade das avaliações não deverá ultrapassar os 30 minutos e será feita somente numa sessão, sem necessidade de consultas extra, exames complementares ou deslocações. A realização das avaliações é completamente gratuita, não havendo qualquer custo adicional.

Como será utilizada a informação recolhida?

A informação recolhida será posteriormente analisada para avaliar o nível de fragilidade ou robustez de cada participante. A performance obtida nas avaliações será

combinada com os dados da sua recuperação pós-cirúrgica, permitindo assim identificar as variáveis mais discriminativas do prognóstico pós-cirúrgico. Todos os dados recolhidos são anónimos e confidenciais e serão trabalhados estatisticamente a nível colectivo e nunca individual.

A participação no estudo implica algum risco?

Os riscos de participação neste estudo são mínimos, já que os procedimentos são simples e com supervisão e monitorização adequada por profissionais qualificados.

O que acontece se optar por não participar no estudo?

A participação neste estudo é totalmente voluntária. Assim sendo, poderá optar por não participar, sem qualquer penalização nos cuidados médicos que lhe são prestados e nos seus direitos legais, e sem qualquer obrigação de justificação.

De seguida, ser-lhe-á apresentado o Consentimento Informado, documento que indica que aceita participar no estudo, devendo ser assinado por ambas as partes e que ficará na posse do investigador.

Se aceitar participar neste estudo, por favor, assine este documento e guarde-o para si. Para qualquer questão ou se quiser tomar conhecimento dos resultados globais do estudo, deverá contactar o investigador através dos seguintes contactos:

- llarasantos@gmail.com
- +351 225 084 000

APPENDIX II - PATIENT CONSENT FORM

Consentimento Informado

Considerando a "Declaração de Helsinquia", da Associação Médica Mundial
(Helsinquia 1964; Tóquio 1975; Veneza 1983; Hong Kong 1989; Somerset West 1996; Edimburgo 2000; Washington 2002, Tóquio 2004 e Seoul, 2008)

Designação do estudo / projeto de investigação (em português)

"Estudo dos mecanismos moleculares subjacentes ao acastanhamento do tecido adiposo branco induzido pelo cancro e do impacto do estilo de vida"

Eu, abaixo-assinado (nome completo do doente adulto ou do voluntário são) _____

_____

Recebi o texto de *Informação ao Participante* relativo ao procedimento que concordei em efetuar. Compreendi a explicação que me foi fornecida pelo investigador que assina este documento. Foi-me ainda dada oportunidade de fazer as perguntas que julguei necessárias, e de todas obtive resposta satisfatória.
Tomei conhecimento de que, de acordo com as recomendações da Declaração de Helsínquia, a informação ou explicação que me foi prestada versou os objetivos, os métodos, os benefícios previstos, os riscos potenciais e o eventual desconforto. Além disso, foi-me afirmado que tenho o direito de anular a todo o tempo a minha participação no estudo, sem que isso possa ter como efeito qualquer prejuízo na assistência que me é prestada.

Por isso, consinto que me seja aplicado o método, o tratamento ou o inquérito proposto pelo investigador.

Assinatura do doente ou voluntário são:_____ *Data:___/___/201_*

Nome do Investigador responsável: Lúcio Lara Santos

Assinatura do Investigador:_____ *Data:___/___/201_*

Anulação do Consentimento Informado

Declaro que recebi a *Informação ao Participante* relativo ao estudo / projeto de investigação em questão, que me foi proposto pelo investigador que assina este documento e **pretendo anular** o consentimento dado na data ____/____/201___.

Assinatura do doente ou voluntário são:_____ Data:___/___/201_

Assinatura do Investigador responsável:_____ *Data:___/___/201_*

Nota: Fornecimento obrigatório de cópia ao participante

Comissão de Ética Para a Saúde do Instituto Português de Oncologia do Porto Francisco Gentil, E.P.E. (Doc. CES-IPOP 03)

APPENDIX III - QUESTIONNAIRE ON SOCIODEMOGRAPHIC DATA, BODY COMPOSITION AND TEST RECORD

DADOS SOCIODEMOGRÁFICOS

NOME: _____ ID: _____
DATA:_____IDADE:_____ SEXO: ( ) FEMININO ( ) MASCULINO
ESTADO CIVIL: ( ) Solteiro ( ) Casado ( ) Divorciado ( ) Viúvo ( )
Outro:_____
NÍVEL DE ESCOLARIDADE: _____

DADOS DA COMPOSIÇÃO CORPORAL

ESTATURA (cm): _____ PERCENTAGEM ÁGUA (%): _____
PESO (Kg): _____ MG (%):_____
PERDEU PESO NO ULTIMO ANO? ( ) S ( ) N Se sim, quantos quilos? _____

TESTES FUNCIONAIS

TESTES	1ª AVAL.	2ª AVAL.	3ª AVAL.	MÉDIA
SENTAR E LEVANTAR 30 segundos máx. de repetições		X	X	X
SENTAR E ALCANÇAR Alcançar a ponta do pé e sustentar por 2 seg. Caso não alcance o valor será negativo. Membro dominante				
FLEXÃO DE ANTEBRAÇO Mão dominante. Máximo de repetições 30s. Virar a mão durante execução.		X	X	X
LEVANTAR DA CADEIRA, CAMINHAR E VOLTAR A SENTAR 2,44 metros; Anotar tempo total do percurso.		X	X	X
FORÇA DE PREENSÃO MANUAL Mão dominante. 3x caso os 2 primeiros valores sejam diferentes.				
ALCANÇAR ATRÁS DAS COSTAS Alcançar mão atras das costas. Caso não alcance os valores serão negativos.				
VELOCIDADE DA MARCHA 5 METROS		X	X	X
STEP- 2MIN				

Levou acelerómetro? Sim (___) ID do AC: _____;
Não (___)

Contacto: _____
Morada:
_____
_____

1

APPENDIX IV - DAILY RECORD OF THE PHYSICAL ACTIVITY MONITOR - ACTIGRAPH

Nome: _____ **Código:** _____

Data de início: ___/___/____ **Hora:** _____ **Data do fim:** ___/___/___ **Hora:**_____



DIÁRIO DO ACTIGRAPH

- O aparelho que vai usar a partir de agora é um monitor de actividade. Pretende medir a quantidade de movimento que vai efectuar ao longo do dia.
- Deve por isso usá-lo durante todo o dia, colocando-o à cintura (lado direito), logo pela manhã e retirando-o quando se for deitar.
- O ActiGraph tem que ser colocado sempre no mesmo lado da cintura e sempre na mesma posição. A seta deve apontar para cima.
- Enquanto usar o aparelho deve fazer tudo o que costuma fazer habitualmente.
- O aparelho ***não é à prova de água***, por isso quando for tomar banho, ou nadar, não o pode utilizar.
- Se por um acaso esquecer de colocar o aparelho, registar o horário em que não utilizou o aparecelho e apontar o horário que o aparelho foi colocado.
- Se aparecer alguma luz, não se preocupe, o aparelho está a armazenar as informações.
- Qualquer dúvida, entrar em contato com a professora Cristine Schmidt (911-595-958).

Obrigado pela colaboração!

Hora/Dia	1º dia	Atividade	2º dia	Atividade	3º dia	Atividade	4º dia	Atividade
6:00								
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10:30								
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Hora/Dia	5º dia	Atividade	6º dia	Atividade	7º dia	Atividade	8º dia	Atividade
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