An assessment of the levels of physical activity in an academic anaesthetic department.

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A research report submitted to the Faculty of Health Sciences,

University of the Witwatersrand, in partial fulfilment for the requirements for the degree of

Master of Medicine (Anaesthesia).

Johannesburg, 2025.

DECLARATION

I, Peter Belasyse-Smith, declare that this research report is my own, unaided work. It is being submitted for the degree of Master of Medicine (Anaesthesia) at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other university.

Signed: ____

Date: 28th day of January 2025 in Blairgowrie.

Dedication

To my wife and 3 amazing boys for their tireless, unwavering support despite my continual efforts at self-sabotage.

Abstract:

Background:

It has long been known that a positive correlation exists between physical activity, exercise, and health. Individuals who achieve a daily target of 10 000 steps are likely to meet the recommended levels of health-enhancing physical activity to confer long-term benefits.

We aimed to evaluate the physical activity levels of public sector, academic anesthesiologists in Johannesburg, South Africa both on and off duty and determine the proportion meeting recommended guidelines.

Method:

This prospective, cross-sectional observational study was undertaken at three academic hospitals in Johannesburg, South Africa. Ninety-four doctors wore a pedometer on and off duty for a seven-day period. A questionnaire based on the short-form International Physical Activity Questionnaire (IPAQ) was also completed.

Results:

The median (Interquartile Range (IQR)) total daily step count was 6 964 (6 271 - 7 956), the median (IQR) number of steps taken on duty was 5 033 (3 536 – 6 407) and the median (IQR) off-duty daily steps was 3 247 (1 471 - 3 802). Only 5% (5/94) of doctors achieved the recommended target of 10 000 daily steps. The IPAQ data showed that only 3% (3/94) of participants had a high level of physical activity, with 68% (64/94) having an inactive lifestyle. Significant factors influencing the on-duty step count included the duration of the shift, the number of cases performed and being the floor senior.

Conclusion:

Doctors working in the anaesthetic department at the University of the Witwatersrand do not get the recommended level of physical activity either at work or when they are not working. This is placing a large and vital workforce at increased risk for chronic non-communicable disease, mental health issues, and burnout.

Acknowledgements:

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All the keen participants of the study, the medical officers, registrars, and consultants of the Department of Anaesthesiology at the University of the Witwatersrand.

Table of Contents

List of abbreviations

CMJAH	Charlotte Maxeke Johannesburg Academic Hospital
CHBAH	Chris Hani Baragwanath Academic Hospital
CPR	Cardio-Pulmonary Resuscitation
FCA(SA)	Fellowship of the College of Anesthetists (South Africa)
HJH/RMMCH	Helen Joseph Hospital/Rahma Moosa Mother and Child Hospital
IQR	Interquartile Range
IPAQ	International Physical Activity Questionnaire.
PA	Physical Activity
WHO	World Health Organisation

Statement:

The Research Report consists of a literature review, draft article, study proposal, and appendices. The literature review and study proposal are included for background reference and are not for examination.

The formatting of this Research Report, but not the draft article, complies with the University of the Witwatersrand's Style Guide for Theses, Dissertations, and Research Reports.

The formatting of the draft article is in keeping with the author guidelines stipulated by the South African Journal of Anaesthesia and Analgesia, the journal to which it is intended to be submitted.

Section 1. Review of the literature.

1. Introduction

A sedentary lifestyle or physical inactivity has been cited by the World Health Organisation (WHO) as one of the top ten causes of morbidity and mortality worldwide.[1] It is estimated that 4-5 million deaths related to chronic non-communicable diseases could be prevented by increasing levels of activity.[2] In 2016 it was found that 27.5% of adults worldwide did not meet WHO recommended levels of physical activity.[2,3]

It has long been recognised that an increase in physical activity correlates with a reduction in the progression of, or risk of developing, chronic non-communicable diseases such as coronary artery disease, type II diabetes, obesity, osteoporosis, and breast and colon cancer.[1] According to Chastin et al. there is a reduction in all-cause mortality associated with increased daily activity of any intensity (in a dose-response relationship), compared to a sedentary lifestyle.[4] Physical activity is also associated with mental health benefits.[1]

In addition to the human cost in morbidity or premature mortality, there are also huge economic implications to the pandemic of inactivity.[5] It has been estimated that physical inactivity costs global healthcare systems a total of $53.8 billion per annum with higher income countries bearing the brunt of the economic burden, and low to middle income countries having a larger burden of disease.[6]

South Africa has a high level of physical inactivity and a high burden of non-communicable disease. [7] Data from the WHO in 2016 showed that 37% of the South African population were classed as physically inactive.[7] In 2009, it was estimated that 51% of all deaths in South Africa were caused by non-communicable diseases.[8]

The current recommendations for adult physical activity from the WHO are that “Adults should do at least 150–300 minutes of moderate-intensity aerobic physical activity; or at least 75–150 minutes of vigorous intensity aerobic physical activity; or an equivalent combination of moderate and vigorous intensity activity throughout the week, for substantial health benefits.”[1] These recommendations also state that “Adults should limit the amount of time spent being sedentary. Replacing sedentary time with physical activity of any intensity (including light intensity) provides health benefits.” [1]

The WHO has also released recommendations for pregnant women and for people with certain chronic diseases.[1] The main difference for pregnant women is that the recommended level of moderate-intensity aerobic activity is reduced to 150 minutes per week.[1] The recommendations for people with chronic diseases, however, are the same as those for adults without chronic disease.

One way that many global health programs have interpreted these guidelines to simplify them for the general population is to recommend a daily target of a minimum of 10 000 steps.[9] This guidance originated in Japan prior to the Tokyo Olympic games in 1964, as a marketing campaign from a pedometer manufacturer.[9] It was not based on any research or evidence at that time. Subsequent research has shown that 10 000 steps a day equates to approximately 300-400 kcal/day of energy expenditure (depending on walking speed and body size).[10–12] Accumulating 10 000 steps on three or more days a week has been shown to be equivalent to 30 minutes of moderate intensity physical activity on most days of the week, which therefore meets the WHO recommendations.[13] There is a proven inverse correlation between the number of steps per day and body mass index, waist circumference, resting heart rate, and diastolic blood pressure.[14,15]

A classification of physical activity as determined by pedometer-assessed step counts was suggested in 2004 by Tudor-Locke et al. This is shown in Table 1 below: [9]

Table 1: Classification of physical activity determined by number of steps per day.

Number of Steps Per Day	Level of Physical Activity
<5000	sedentary lifestyle
5000-7499	low active
7500-9999	somewhat active
≥10000	active
>12500	highly active

Pedometers or step counters are simple electronic or mechanical devices attached to the waistband, wrist, or arm that give the wearer feedback on the number of steps taken, and hence an indication of physical activity.

Pedometers are gradually being replaced by newer technology such as fitness trackers, accelerometers, and smartphone apps, but they have become a popular, validated tool to motivate the population to increase physical activity. [16,17] There is data that suggests that interventions utilising pedometers are effective in producing a short-term increase in physical activity, but only uncertain evidence of any long-lasting effects. [16,17]

One confounder when using pedometers to study physical activity is that of reactivity; the change in behaviour by participants when they know that they are being monitored, also known as a Hawthorne effect.[18] If a participant is using a pedometer on which they can view the numbers of steps accrued and told to measure and record their step counts, their overall physical activity can increase by 15%.[18] Recommended measures to eliminate this bias include blinding the participants to the screen of the pedometer during the study and using a third party to record the accrued steps.[19] One study has shown that the reactivity (increased physical activity) to an unsealed pedometer lasted for seven days, with step counts returning to a baseline level for the following week of the study.[20] Sealed (blinded) pedometers do not elicit the same degree of reactivity.[18]

One other factor that influences the accuracy of step counts recorded by pedometers is the location that they are worn on the body. It has been shown that the most accurate results are obtained when the pedometer is worn on the hip, rather than on the wrist.[21]

An alternative method to assess the physical activity of a study group is to use a self-administered questionnaire. One such tool is the short form International Physical Activity Questionnaire (IPAQ).[22] This is a validated, open access, free to use questionnaire that assesses the type and duration of any physical activity undertaken in the previous seven days. Participants' physical activity levels are then categorized as either low, moderate, or high. [22,23]

Worldwide, there have been many pedometer studies assessing the physical activity levels for physicians of various medical specialties including anaesthetists. [24–33] Most of these studies have only focused on physical activity during working hours. These studies have found that doctors do not achieve the suggested target of 10 000 steps during working hours. [24–33] This leaves them at increased risk for chronic non-communicable disease, mental health issues, and burnout, unless extra effort is made by the individual to do extra physical activity during their own free time outside of work.

There are many reasons that are specific to a career in anaesthesia that make it important for anaesthetists to be aware of their physical activity levels. Anaesthesia is a medical speciality that is often considered to be sedentary. A study by Cuthill et al. [24] has shown that 50% of an anaesthetists' time in theatre is spent standing up, and walking is often limited to short bursts around theatre, or in visiting patients pre-operatively in the wards. The amount walked rarely reaches the 15–20-minute duration recommended by the WHO for a brisk walk. [1,24]

Anaesthetists are also shift workers and a correlation between shift work, long working hours, obesity, and other non-communicable disease has been described. [34]This may be due in part to chronically elevated cortisol levels in shift workers but may also be a result of altered levels of physical activity. [35,36] Roskoden et al. have shown that physical activity for shift workers is higher during working hours compared to non-shift-workers, although no difference in total physical activity was found . [37] Shift work may also affect sleep quality and quality of life for anaesthetists and healthcare workers. [38–40] Poor sleep patterns are independently associated with increased mortality, but if combined with overall poor physical activity, there is a synergistic increase in all-cause mortality. [41] Anaesthetists are also at high risk for burnout, [42] described by Bretland et al. as "the chronic state of job stress, where employer expectations and employee workload exceed the individual's perceived psychological capacity and ability to cope with the work demands expected of them". [43] South African anaesthetists employed in the public sector have been shown to have a 36.5% prevalence of clinical burnout. [44]Programmes designed to target increased physical activity have been shown to reduce rates of burnout. [43]

Speciality trainees in anaesthesia study towards exams, the two-part Fellowship of the College of Anaesthetists of South Africa (FCA (SA)) set by the College of Medicines South Africa.[45] Times of high academic stress and demand are known to affect the level of exercise achieved by examination candidates. [46,47]

There is also evidence that the physical activity levels of American trainee anaesthetists are lower than those of their specialist colleagues.[48,49]

There is a paucity of data with respect to South African anaesthetists' activity levels both on and off duty. This study will investigate the current total physical activity levels of anaesthetists working in an academic department in Johannesburg, South Africa.

Problem Statement

The effect of physical activity on long term health is well established. The WHO has devised a set of guidelines that aim to reduce an individual's risk of developing chronic non-communicable disease. Ideally healthcare professionals should be aware of these recommendations and should ensure that they achieve this desired level of physical activity either during their working day or outside of work. The reality is, however, that many doctors do not fulfil the recommended amount of physical activity.

This leads to the potential risk to doctors of contracting chronic disease over the long-term and increasing their risk of burn-out and deterioration in mental health in the short-term. There is a paucity of data with respect to the physical activity levels of South African anaesthetists during working hours, or outside of work. The results of this study may raise awareness of the current activity levels of anaesthetists, which could result in an improvement in acute and long-term health outcomes for South African anaesthetists and may assist with decreasing the rates of burnout.

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Section 2: Author's guidelines

South African Journal of Anaesthesia and Analgesia

Guidelines available from: http://www.sajaa.co.za/index.php/sajaa/about/submissions.

Submitted manuscripts that are not in the correct format and without the required supporting documentation specified in these guidelines will be returned to the author(s) for correction and will delay publication.

AUTHORSHIP

Named authors must consent to publication **by signing a covering letter** which should be submitted as a supplementary file. Authorship should be based on substantial contribution to:

(i) conception, design, analysis and interpretation of data;

(ii) drafting or critical revision for important intellectual content; and

(iii) approval of the version to be published. These conditions must all be met (uniform requirements for manuscripts submitted to biomedical journals; refer to **www.icmje.org**); and

(iv) exact contribution of each author must be stated.

DECLARATION OF CONFLICT OF INTEREST

Authors must declare all sources of support for the research and any association with a product or subject that may constitute a conflict of interest. If there is no conflict of interest to declare please include the following statement: The authors declare no conflict of interest.

FUNDING SOURCE

All sources of funding should be declared. Also define the involvement of study sponsors in the study design, collection, analysis and interpretation of data; the writing of the manuscript; the decision to submit the manuscript for publication. If the study sponsors had no such involvement, this should be stated as follows: No funding source to be declared.

RESEARCH ETHICS COMMITTEE APPROVAL

The submitting author must provide written confirmation of Research Ethics Committee approval for all studies including case reports. The ethics committee as well as the approval number should be included.

STATISTICAL ANALYSIS

Authors are advised to involve medical statisticians at the protocol stage of their research project: to plan sample size, and the selection of appropriate statistical tests for analysis and presentation.

PROTECTION OF PATIENT'S RIGHTS TO PRIVACY

Identifying information should not be published in written descriptions, photographs, and pedigrees unless the information is essential for scientific purposes and the patient (or parent or guardian) gives informed written consent for publication. The patient should be shown the manuscript to be published. Refer to **www.icmje.org**.

ETHNIC CLASSIFICATION

The rationale for analysis based on racio-ethnic-cultural categorisation should be indicated.

CATEGORIES OF SUBMISSIONS

Shorter items are more likely to be accepted for publication, owing to space constraints and reader preferences.

Original articles

Original articles on research relevant to anaesthesia and analgesia should not exceed **3 200** words, no more than **30 references**, with up to **6 tables or figures**. A structured abstract under the following headings, Background, Methods, Results, and Conclusions is a requirement and should not exceed **300 words.**

Clinical Review articles

Review articles relevant to anaesthesia and analgesia should not exceed 2 400 words, with a maximum of 20 references and no more than 6 tables or figures. A summary of 300 words or less is required.

Case reports

Case reports should not exceed 1 800 words with no more than 10 references. Figures are limited to 2 figures and may include images or photographs. The case report should have three headings: Summary (not exceeding 100 words), Case report (with no introduction) and Discussion. Case reports will be published online only. The summary and the URL will appear in the printed version.

Scientific Letters

Scientific Letters should not exceed 2 400 words with a maximum of 10 references. Only one table or illustration is permissible. A structured abstract under the following headings, Background, Methods, Results, and Conclusions, is a requirement and should not exceed 250 words.

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Section 3: Draft Article

An assessment of the levels of physical activity in an academic anaesthetic department.

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Keywords: Physical activity, Anaesthesia, Pedometer, IPAQ, Step count.

Declaration

The authors declare that they have no conflict of interest. This research was done in partial fulfilment of a Master of Medicine degree. No funding source to be declared.

The author/s declare that this submission is in accordance with the principles laid down by the Responsible Research Publication Position Statements as developed at the 2nd World Conference on Research Integrity in Singapore, 2010.

<u>Abstract:</u>

Background:

It has long been known that a positive correlation exists between physical activity, exercise, and health. Individuals who achieve a daily target of 10 000 steps are likely to meet the recommended levels of health-enhancing physical activity to confer long-term benefits.

We aimed to evaluate the physical activity levels of public sector, academic anesthesiologists in Johannesburg, South Africa both on and off duty and determine the proportion meeting recommended guidelines.

Method:

This prospective, cross-sectional observational study was undertaken at three academic hospitals in Johannesburg, South Africa. Ninety-four doctors wore a pedometer on and off duty for a seven-day period. A questionnaire based on the short-form International Physical Activity Questionnaire (IPAQ) was also completed.

Results:

The median (Interquartile Range (IQR)) total daily step count was 6 964 (6 271 - 7 956), the median (IQR) number of steps taken on duty was 5 033 (3 536 – 6 407) and the median (IQR) off-duty daily steps was 3 247 (1 471 - 3 802). Only 5% (5/94) of doctors achieved the recommended target of 10 000 daily steps. The IPAQ data showed that only 3% (3/94) of participants had a high level of physical activity, with 68% (64/94) having an inactive lifestyle. Significant factors influencing the on-duty step count included the duration of the shift, the number of cases performed and being the floor senior.

Conclusion:

Doctors working in the anaesthetic department at the University of the Witwatersrand do not get the recommended level of physical activity either at work or when they are not working. This is placing a large and vital workforce at increased risk for chronic non-communicable disease, mental health issues, and burnout.

Introduction:

Physical inactivity has been cited by the World Health Organisation (WHO) as one of the top ten causes of morbidity and mortality worldwide.[1] Increasing physical activity (PA) has long been known to reduce the risk of developing chronic diseases including coronary artery disease, type II diabetes and hypertension, and is also associated with mental health benefits.[1]

South Africa specifically has a very high level of physical inactivity and a large burden of non-communicable diseases.[2]

Current recommendations for adult PA from the WHO are that 'Adults should do at least 150–300 minutes of moderate-intensity aerobic physical activity; or at least 75–150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate and vigorous intensity activity throughout the week, for substantial health benefits.'.[1]

Guidance for the public to achieve recommended PA levels has long revolved around a daily minimum target of 10 000 steps per day. Evidence has shown that this is a reasonable target that correlates with WHO recommendations for adults less than sixty years old.[3–5]

A recent meta-analysis of step counts and all-cause mortality involving 15 studies and 47 471 adults, has suggested that 'taking more steps per day was associated with progressively lower mortality risk, with the risk plateauing for older adults (aged ≥60 years) at approximately 6 000 – 8 000 steps per day and for younger adults (aged <60 years) at approximately 8 000 – 10 000 steps per day.[6]

A classification of physical activity as determined by pedometer-assessed step counts was suggested in 2004 by Tudor-Locke et al. This is shown in Table 1 below.[7]

Table 1: Classification of physical activity determined by number of steps per day[7].

Number of Steps Per Day	Level of Physical Activity
<5 000	sedentary lifestyle
5 000-7 499	low active
7 500-9 999	somewhat active
≥10 000	active
>12 500	highly active

Pedometer studies have been used for many years to provide a simple and affordable means of tracking daily PA levels.[8,9]

Self-administered questionnaires such as the short form International Physical Activity Questionnaire (IPAQ) are an alternative validated tool for the assessment of PA.[10] The IPAQ is a free to use questionnaire that assesses the type of activity, frequency and duration carried out in the previous seven days. From this activity data a calculation of metabolic equivalents (MET) is made, and then combined with duration and frequency to calculate a MET-minutes value. This then enables classification of the assessed PA levels as 'inactive', 'minimally active', and 'health enhancing physical activity (HEPA)'.[10,11]

Pedometer and questionnaire-based studies have been done before to assess PA levels of anaesthetists in other countries, but not in South Africa.[12–14] These studies have found that anaesthetists do not achieve the suggested target of 10 000 steps during their working day.

Anaesthetists as a workforce face many occupational barriers that impact their ability to achieve recommended levels of PA including long hours, shift work, fatigue, and a high burnout risk.[15–17] Rates of burnout can be reduced by programs designed to increase PA.[18]

For this study, the primary objectives were to describe PA levels of anaesthetists working in a public sector, academic department in Johannesburg, South Africa, and determine the proportion that were meeting recommended daily requirements. Secondary objectives were to describe and compare personal and work factors that were associated with meeting daily exercise requirements.

Methods:

This prospective cross-sectional observational study utilised a pedometer and questionnaire to assess PA levels. Twenty Decathlon Onwalk100 pedometers were self-financed for the study.[19]
Consent was obtained from participants on the morning of the first day of the study period, and an information sheet was given to the participants with the pedometer and details of how to wear it. Participants were encouraged to wear the pedometer both on and off duty. Step count values on the pedometer were shielded from the view of the participants and data was collected covertly to ensure blinding. Step counts were recorded twice daily by the researcher or an independent third-party giving data for all on and off-duty periods. Pedometer readings were taken as usual on weekends from those participants on duty. For those off duty over the

weekend, a reading was taken on Friday at 16:00, and a final reading taken on Monday at 07:00, covering the 63-hour weekend off-duty period. Pedometers were collected from all participants on Monday at 07:00 at the time of obtaining the final reading.

The self-administered questionnaire collected data on age, rank, work location, chronic diseases, anthropometrics, upcoming examinations, and daily clinical workload details. Data allowing for completion of the short-form IPAQ was also included. This was added to the study design to document any activities undertaken whilst wearing a pedometer was not possible. The questionnaire was returned to the researcher at the end of the seven-day study period.

Permission to distribute the questionnaires was obtained from the Academic Head of the Department of Anaesthesiology at The University of The Witwatersrand.

The sample population was drawn from 227 full time members of the Department of Anaesthesiology of the University of the Witwatersrand. Exclusions for the study were refusal, ICU rotations, rotations at satellite locations, annual leave during study period, injury that would limit physical activity and being on call on the first night of the study period.

Consecutive convenience sampling was utilized for doctors rostered to three chosen hospital sites (CMJAH, CHBAH, HJH/RMMCH) over multiple seven-day periods.

After consultation with a biostatistician, a minimum sample size of 92 participants was sought, (providing a 5% margin of error, and 95% confidence level), based on the findings of similar studies[20].

Potential biases in the study were addressed by blinding the pedometers to the study participants and incorporating potential confounders such as CPR events into the questionnaire design. An independent biostatistician was used for the analysis of the data and negative findings were also reported in this report.

The study was approved by the postgraduate assessors' group from the University of the Witwatersrand and was registered on The National Research Database NHRED ref: GP_202205_073. Ethical clearance was obtained from The Human Research Ethics Committee (Medical) at the University of the Witwatersrand (M211066).

Data Analysis:

Study data was entered into a Microsoft Excel spreadsheet and then analysed using SPSS 28. Descriptive statistics summarised the demographic data and key variables used in the study. Categorical data was presented visually using bar charts. Correlation analysis was performed to reveal associations and dependencies within the dataset. Independent t-tests and one-way ANOVA assessed differences in step counts across groups. Regression analysis was conducted to identify factors influencing daily step counts. A 5% significance level was used throughout.

Results

Of the 102 participants initially enrolled, 8 met exclusion criteria during the study period and were excluded from data analysis, leaving a sample size of 94 doctors.

Table 2 shows the step count data for the study. N = number of shifts, IQR = Interquartile Range.

	N	Minimum	Maximum	Median	IQR	25th %ile	75th %ile
Daily on duty steps	440	691	13 560	5 033	2 871	3 536	6 408
Daily off duty steps	444	108	50 949	3 247	2 332	1 471	3 803
Total weekly steps	94	27 818	84 998	48 823	12 790	43 521	5 6311
Daily total steps (averaged)	94	3 974	12 143	6 964	1 739	6 217	7 957

Step count data (Table 2) was obtained for n=440 on-duty shifts. Daily steps on duty ranged from 691 to 13 560 steps with a median (Interquartile Range (IQR)) of 5 033 (IQR: 3 536 - 6 408). Off-duty steps (from n=444 off-duty periods) ranged from 108 to 50 949 steps with a median step count of 3 247 (IQR: 1 471-3802). From the total weekly step counts, an average total daily step count was calculated, with a range of 3 974 to 12 143 steps, and a mean of 7 134 (95%CI: 6 760-7 484) steps.

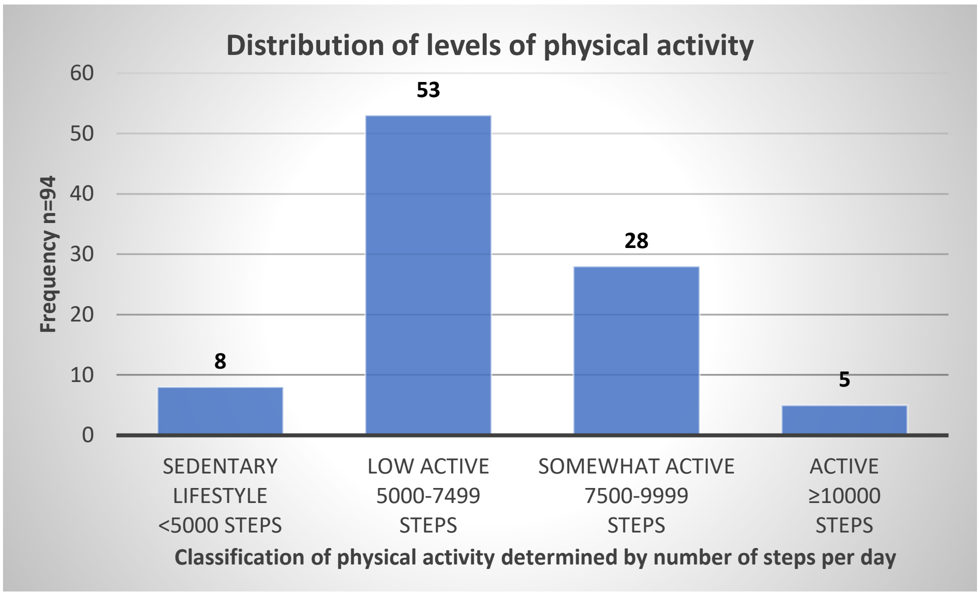

Figure 1. The numbers of participants classified by physical activity ranges according to average daily step counts.[7]

Figure 1 classifies the physical activity by step count according to Tudor-Locke et al.[7] It was found that 65% (n=61) of the study sample fell below the level of a 'somewhat active' average daily step count of 7 500 steps, and five (5%) of the doctors in the study achieved the recommended number of total average daily steps (10,000 steps) as per WHO standard.[1]

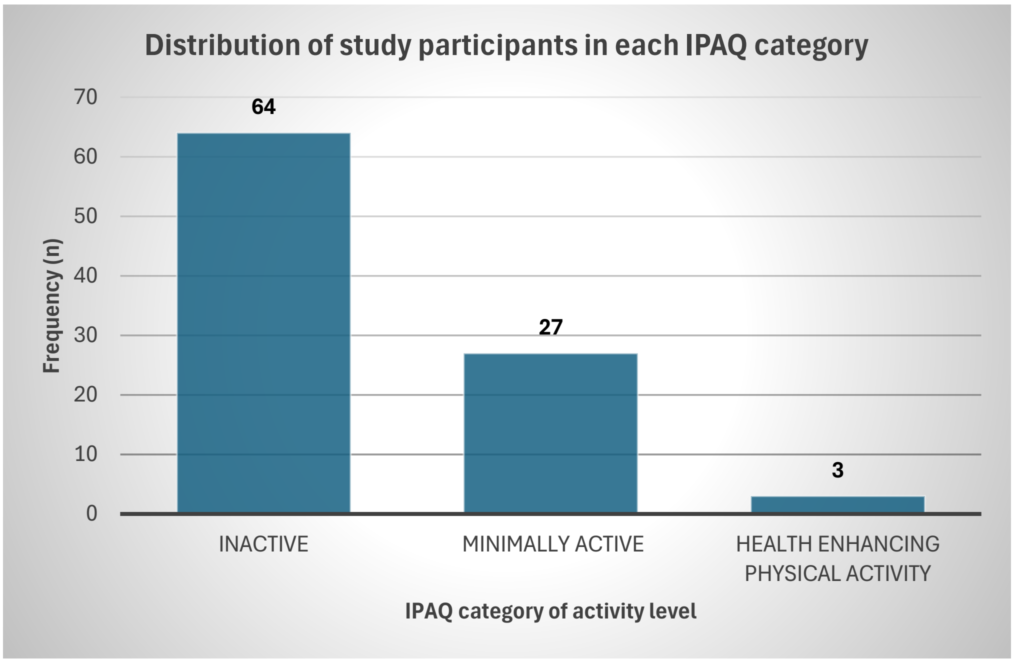

Figure 2. The distribution of study participants categorised according to IPAQ classification.[10,11]

Figure 2 categorises participants' PA level as obtained from the study questionnaire according to the IPAQ guidance.[10,11] It shows that 64 individuals (68%) were classified as being 'inactive', 27 (29%) were minimally active and only 3 (3%) of participants had health enhancing physical activity levels.

The total number of hours on duty for the participants ranged from 33 to 69 hours per week, with a mean of 46 (95%CI: 44-47) hours. Total off-duty hours ranged from 99 to 135 hours over the 7-day study periods, with a mean of 122 (95%CI: 120-123) hours. There was a positive significant association between the total number of hours spent on duty and the on-duty step count ($r=0.513$; $p=0.041$) and (albeit weakly) the total weekly step counts ($r=0.01$; $p=0.02$).

A significant negative association was observed between the total number of off-duty hours in a week and the total weekly step count ($r=-0.17$; $p=0.03$).

Sixty participants (64%) belonged to the age group 25-34, 28% (n=26) were in the age group 35-44, 7% (n=7) were within the age group 45-54, and there was one participant above 54 years (1%). Steps on duty significantly differed by age groups ($p=0.03$), with those between 25-34 years of age having the highest mean on duty step count of 26 769 (95%CI: 24 703-28 836).

Doctors were from different ranks within the department; 18 medical officers (19%), 37 junior registrars (39%), 15 senior registrars (16%) and 24 consultants (26%). Results showed that consultants had a statistically significant higher mean off-duty step count compared to other ranks 7 437 (95%CI: 6 864-8 209; $p=0.01$). Differences in mean on-duty and total daily step counts between ranks were not statistically significant.

Body Mass Index (BMI) values for the participants ranged from a minimum value of 18 to a maximum value of 38, with a mean value of 25.4 (95%CI: 24.5-26.3). 41% (n=39) had a normal weight, 29% (n=27) were overweight and 24% (n=23) were obese. 5% (n=5) were classified as underweight. No correlation was found between BMI class and total daily average steps attained ($r=0.561$, $p=0.061$).

Eleven of the 94 participants (11.7%) disclosed that they suffered from a chronic disease; no significant correlation was found between average total daily step counts and this variable ($p= > 0.05$).

Eleven of the participants (11.7%) were enrolled to write an exam in the next three months. This variable was compared with off-duty steps – but no significant correlation was noted (p= >0.05).

The average number of cases performed daily while on duty was 3 (95%CI: 3.5-3.9), with a range from 0 to 18 cases. A significant association was shown between the number of cases performed and on-duty step counts (r=0.12; p=0.007) but the association between the number of cases performed and off-duty step counts was insignificant at the 5% level (r=0.031; p=0.051).

The role of being the floor senior whilst on duty had a significant correlation with both total on-duty steps taken (r=0.795; p=0.007) and attaining an average daily step count of ≥ 10 000 steps (r=0.652; p=0.01). There were also statistically significant differences found in the values of the means of both on-duty steps and total daily step counts for those who performed senior duties (t-test for equality p= < 0.05 for both variables).

No statistically significant differences were found with on-duty or total daily step counts for those who did administrative work whilst on duty (t-test for equality p= > 0.05). There were also no significant differences found in the step counts of doctors who performed cases in private practice during their off-duty hours. There was only 1 CPR event during the 440 on-duty shifts, this was not included in the analysis.

On duty step counts were compared for the different surgical disciplines but there was no statistically significant relationship found (p= > 0.05 for all disciplines).

Doctors worked at 3 different hospitals during the study period: 56.5% (n=53) of participants were located at CHBAH, 23.5% (n=22) at HJH/RMMCH and 20% (n=19) at CMJAH. Doctors working at CMJAH had significantly higher on duty step counts compared to those based at CHBAH or HJH/RMMCH (p=0.003).

Table 3: Data for daily on duty step counts compared to number of cases (grouped).

	Case numbers (grouped)	N	Mean	SD	95% CI Lower & Upper boundaries		P value
Daily on-duty steps	Cases 0 - 3	239	5 229	149.3	4 935	5 522	0.032
	Cases 4 - 7	183	5 590	170.7	5 255	5 926	
	Cases > 7	18	6 477	544.1	5 407	7 546	

There was a statistically significant relationship between daily on-duty step counts and the number of cases performed on duty (p=0.032).

Regression analysis was performed to identify factors influencing total daily step counts among the study participants. Significant relationships for increasing total daily step counts were found for total daily hours on duty (p=0.03), increased number of daily cases (p=0.04) and being the floor senior on duty (p=0.02). Having a chronic illness, differences in BMI, administrative duties and upcoming exams did not significantly affect average daily step count.

Discussion:

This pedometer study looking at the PA of anaesthetists was the largest of its kind in the literature. The results show that most of the doctors working in the Department of Anaesthesiology at the University of the Witwatersrand are not meeting WHO recommended PA levels. The pedometer data showed that 95% were below recommended levels, and the IPAQ data found 97% did not achieve the WHO targets.[1,7,10,11]

These findings are consistent with previous global research on anaesthetists which found low PA levels among this workforce. However, they does not correlate with the findings of a questionnaire-based study from the same institution, which found 55.4% of the study had a high level of PA.[21] Study designs and differences in questionnaire formats are likely to account for the variance.

A daily on-duty median of 5 033.50 (IQR: 3 537 -6 408) steps compares well with other studies of anaesthetists worldwide, being just below those from Boston, but higher than those found in Melbourne or Glasgow[12–14]. A pedometer-based study from Bloemfontein involving twenty medical registrars included a subgroup of 5 anaesthetists with a daily median step count of 4 521 (range: 2 318-6 519).[22]

Several factors were positively associated with achieving higher daily step counts and PA levels. Having more hours on duty, performing more cases, and being the designated floor senior were all associated with increased step counts. This may all reflect a greater degree of movement required on busier clinical days.

Age was a factor, with the youngest cohort (25-34 years) having the highest on-duty step counts, perhaps due to greater energy levels. BMI category and having chronic diseases did not seem to influence physical activity levels in this study sample.

Consultants had significantly higher off-duty step counts in comparison with other ranks, which could relate to different lifestyle factors in this group.

Doctors at CMJAH had significantly higher on-duty step counts which is most likely just a reflection of the differing physical layout of the hospital sites.

Limitations:

Due to the nature of the working hours of the study sample, and the need for covert data collection, per-person daily step counts were not attainable. We instead relied on weekly and hence daily averages which may underestimate spikes in activity on one or more days.

As recommended for studies of this type, efforts were made to reduce the 'reactivity' of the pedometer study via covert sampling and blinding of the step counts to the participants.[23] Nonetheless, there might still have been some performance bias and increased daily step counts, despite the low overall physical activity levels noted.

Correlation between participant IPAQ data and pedometer step count data was not done, as the purpose of this study was not to further validate the IPAQ, and the reason for inclusion of the IPAQ in the study design was to account for physical activity done off duty when wearing a pedometer was potentially not feasible.

Conclusion:

Doctors working in the anaesthetic department at the University of the Witwatersrand do not get the recommended level of physical activity either at work or when they are not working. This is placing a large and vital workforce at increased risk for chronic non-communicable disease, mental health issues, and burnout. Interventions from workplace management to promote physical activity may play a role in improving this situation.

Balancing the stressors of long hours, a high-stress occupation, fatigue, and trying to increase levels of PA outside of work isn't an easy task – but it is one that we must be better at.

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Proposal

An assessment of the levels of physical activity in an academic anaesthetic department.

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1. Introduction

A sedentary lifestyle or physical inactivity has been cited by the World Health Organisation (WHO) as one of the top ten causes of morbidity and mortality worldwide [1]. It is estimated that 4-5 million deaths related to chronic non-communicable diseases could be prevented by increasing levels of activity [2]. In 2016 it was found that 27.5% of adults worldwide did not meet WHO recommended levels of physical activity [2,3].

It has long been recognised that an increase in physical activity correlates with a reduction in the progression of, or risk of developing, chronic non-communicable diseases such as coronary artery disease, type II diabetes, obesity, osteoporosis, and breast and colon cancer [1]. According to Chastin et al. there is a reduction in all-cause mortality associated with increased daily activity of any intensity (in a dose-response relationship), compared to a sedentary lifestyle [4]. Physical activity is also associated with mental health benefits [1].

In addition to the human cost in morbidity or premature mortality, there are also huge economic implications to the pandemic of inactivity [5]. It has been estimated that physical inactivity costs global healthcare systems a total of $53.8 billion per annum with higher income countries bearing the brunt of the economic burden, and low to middle income countries having a larger burden of disease [6].

South Africa has a high level of physical inactivity and a high burden of non-communicable disease [7]. Data from the WHO in 2016 showed that 37% of the South African population were classed as physically inactive [7]. In 2009, it was estimated that 51% of all deaths in South Africa were caused by non-communicable diseases [8].

The current recommendations for adult physical activity from the WHO are that “Adults should do at least 150–300 minutes of moderate-intensity aerobic physical activity; or at least 75–150 minutes of vigorous intensity aerobic physical activity; or an equivalent combination of moderate and vigorous intensity activity throughout the week, for substantial health benefits.” [1]. These recommendations also state that “Adults should limit the amount of time spent being sedentary. Replacing sedentary time with physical activity of any intensity (including light intensity) provides health benefits.” [1].

The WHO has also released recommendations for pregnant women and for people with certain chronic diseases [1]. The main difference for pregnant women is that the recommended level of moderate-intensity aerobic activity is reduced to 150 minutes per week [1]. The recommendations for people with chronic diseases, however, are the same as those for adults without chronic disease.

One way that many global health programs have interpreted these guidelines to simplify them for the general population is to recommend a daily target of a minimum of 10 000 steps [9]. This guidance originated in Japan prior to the Tokyo Olympic games in 1964, as a marketing campaign from a pedometer manufacturer [9]. It was not based on any research or evidence at that time. Subsequent research has shown that 10 000 steps a day equates to approximately 300-400 kcal/day of energy expenditure (depending on walking speed and body size) [10–12]. Accumulating 10 000 steps on three or more days a week has been shown to be equivalent to 30 minutes of moderate intensity physical activity on most days of the week, which therefore meets the WHO recommendations [13]. There is a proven inverse correlation between the number of steps per day and body mass index, waist circumference, resting heart rate, and diastolic blood pressure [14,15].

A classification of physical activity as determined by pedometer-assessed step counts was suggested in 2004 by Tudor-Locke et al. This is shown in Table 1 below [9].

Table 1: Classification of physical activity determined by number of steps per day.

Number of Steps Per Day	**Level of Physical Activity**
<5000	sedentary lifestyle
5000-7499	low active
7500-9999	somewhat active
≥10000	active
>12500	highly active

Pedometers or step counters are simple electronic or mechanical devices attached to the waistband, wrist, or arm that give the wearer feedback on the number of steps taken, and hence an indication of physical activity.

Pedometers are gradually being replaced by newer technology such as fitness trackers, accelerometers, and smartphone apps, but they have become a popular, validated tool to motivate the population to increase physical activity [16,17]. There is data that suggests that interventions utilising pedometers are effective in producing a short-term increase in physical activity, but only uncertain evidence of any long-lasting effects [16,17].

One confounder when using pedometers to study physical activity is that of reactivity; the change in behaviour by participants when they know that they are being monitored, also known as a Hawthorne effect [18]. If a participant is using a pedometer on which they can view the numbers of steps accrued and told to measure and record their step counts, their overall physical activity can increase by 15% [18]. Recommended measures to eliminate this bias include blinding the participants to the screen of the pedometer during the study and using a third party to record the accrued steps [19]. One study has shown that the reactivity (increased physical activity) to an unsealed pedometer lasted for seven days, with step counts returning to a baseline level for the following week of the study [20]. Sealed (blinded) pedometers do not elicit the same degree of reactivity [18].

One other factor that influences the accuracy of step counts recorded by pedometers is the location that they are worn on the body. It has been shown that the most accurate results are obtained when the pedometer is worn on the hip, rather than on the wrist [21].

An alternative method to assess the physical activity of a study group is to use a self-administered questionnaire. One such tool is the short form International Physical Activity Questionnaire (IPAQ) [22]. This is a validated, open access, free to use questionnaire that assesses the type and duration of any physical activity undertaken in the previous seven days. Participants' physical activity levels are then categorized as either low, moderate, or high [22,23].

Worldwide, there have been many pedometer studies assessing the physical activity levels for physicians of various medical specialties including anaesthetists [24–33]. Most of these studies have only focused on physical activity during working hours. These studies have found that doctors do not achieve the suggested target of 10 000 steps during working hours [24–33]. This leaves them at increased risk for chronic non-communicable disease, mental health issues, and burnout, unless extra effort is made by the individual to do extra physical activity during their own free time outside of work.

There are many reasons that are specific to a career in anaesthesia that make it important for anaesthetists to be aware of their physical activity levels. Anaesthesia is a medical speciality that is often considered to be sedentary. A study by Cuthill et al. [24] has shown that 50% of an anaesthetists’ time in theatre is spent standing up, and walking is often limited to short bursts around theatre, or in visiting patients pre-operatively in the wards. The amount walked rarely reaches the 15–20-minute duration recommended by the WHO for a brisk walk [1,24].

Anaesthetists are also shift workers and a correlation between shift work, long working hours, obesity, and other non-communicable disease has been described [34]. This may be due in part to chronically elevated cortisol levels in shift workers but may also be a result of altered levels of physical activity [35,36]. Roskoden et al. have shown that physical activity for shift workers is higher during working hours compared to non-shift-workers, although no difference in total physical activity was found [37]. Shift work may also affect sleep quality and quality of life for anaesthetists and healthcare workers [38–40]. Poor sleep patterns are independently associated with increased mortality, but if combined with overall poor physical activity, there is a synergistic increase in all-cause mortality [41]. Anaesthetists are also at high risk for burnout [42], described by Bretland et al. as “the chronic state of job stress, where employer expectations and employee workload exceed the individual’s perceived psychological capacity and ability to cope with the work demands expected of them”[43]. South African anaesthetists employed in the public sector have been shown to have a 36.5% prevalence of clinical burnout [44]. Programmes designed to target increased physical activity have been shown to reduce rates of burnout [43].

Anaesthetic speciality trainees study towards exams, the two part Fellowship of the College of Anaesthetists of South Africa (FCA (SA)) set by the College of Medicines South Africa[45]. Times of high academic stress and demand are known to affect the level of exercise achieved by examination candidates [46,47].

There is also evidence that physical activity levels of American trainee anaesthetists are lower than those of their specialist colleagues [48,49].

There is a paucity of data with respect to South African anaesthetists’ activity levels both on and off duty. This study will investigate the current total physical activity levels of anaesthetists working in an academic department in Johannesburg, South Africa.

2. Problem Statement

The effect of physical activity on long term health is well established. The WHO has devised a set of guidelines that aim to reduce an individual's risk of developing chronic non-communicable disease. Ideally healthcare professionals should be aware of these recommendations and should ensure that they achieve this desired level of physical activity either during their working day or outside of work. The reality is, however, that many doctors do not fulfil the recommended amount of physical activity.

This leads to the potential risk to doctors of contracting chronic disease over the long-term and increasing their risk of burn-out and deterioration in mental health in the short-term. There is a paucity of data with respect to the physical activity levels of South African anaesthetists during working hours, or outside of work. The results of this study may raise awareness of the current activity levels of anaesthetists, which could result in an improvement in acute and long-term health outcomes for South African anaesthetists and may assist with decreasing the rates of burnout.

3. Aim

The aim of this study is to assess whether anaesthetists in the Department of Anaesthesia at the University of the Witwatersrand are meeting recommended levels of daily physical activity.

4. Objectives

<u>Primary Objectives:</u>

- To describe the level of physical activity taken by anaesthetists over a seven-day period.
- To determine the proportion of anaesthetists that are meeting their recommended daily exercise requirements over a seven-day period.

<u>Secondary Objectives:</u>

- To describe and compare personal and work factors that are associated with meeting daily exercise requirements over a seven-day period.

5. Research Assumptions

Level of physical activity: A numerical expression of an individual's daily physical activity used as an estimate of a person's total energy expenditure [1,9,22,23].

Recommended daily exercise requirements over a seven-day period: The levels of exercise and physical activity recommended by the World Health Organisation for various population groups to mitigate health risks and achieve health benefits [1]

Working hours: Day shifts (from 07:00 to 16:00) and night shifts (from 16:00 to 07:00 the following morning).

After hours: Any other time outside of working hours.

Pedometer: Pedometers are simple electronic or mechanical devices attached to the waistband, wrist or arm that give the wearer feedback on the number of steps taken, and hence an indication of physical activity [17].

Non-Communicable Disease: "A non-communicable disease, or NCD, is a medical condition or disease which … is non-infectious and cannot be passed from person to person" [50]. Examples include most cancers, most heart diseases, diabetes, stroke, and hypertension.

Anaesthetist: Any qualified doctor performing anaesthesia who works in the University of the Witwatersrand Department of Anaesthesiology including medical officers, registrars, and consultants**.**

Medical officer: A qualified doctor practicing in the University of the Witwatersrand Department of Anaesthesiology under specialist supervision.

Career medical officer: A medical officer with more than 10 years of experience and is regarded as a consultant.

Registrar: A qualified doctor who is registered with the Health Professions Council of South Africa (HPCSA) as a trainee specialist anaesthetist.

Junior Registrar: A registrar in their first or second year.

Senior Registrar: A registrar in their third, fourth or subsequent years.

Consultant: A qualified doctor who is registered with the HPCSA as a specialist anaesthetist capable of independent practice, or a career medical officer.

6. Demarcation of Study Field

The study will be conducted in the Department of Anaesthesiology of the University of the Witwatersrand. The department comprises 234 Anaesthetists: 75 consultants (68 full time, seven part-time), 12 career medical officers, 108 registrars, and 39 medical officers [email from Prof. E Oosthuisen. CMJAH. Received 19.07.2021, email from Dr B Gardner. HJH received 16.07.2021. email from Dr T Kleyenstuber RMMCH received 16.07.2021. Email from Dr P Mogane CHBAH received 16.07.2021].

The following hospitals are affiliated with the department:

- Charlotte Maxeke Johannesburg Academic Hospital (CMJAH)
- Chris Hani Baragwanath Academic Hospital (CHBAH)
- Helen Joseph Hospital (HJH)
- Rahima Moosa Mother and Child Hospital (RMMCH)
- Wits Donald Gordon Medical Centre (WDGC)
- Thelle Mogoerane Hospital
- Klerksdorp-Tshepong Hospital

Of the 108 registrars on the circuit, at any one time there are 14 who are rotating through either Intensive Care Units at CHBAH/HJH/CMJAH/WDGMC or at outreach satellite sites (Thelle Mogoerane Hospital or Klerksdorp-Tshepong Hospital).

7. Ethical Considerations

An application for ethics clearance will be submitted to the Human Research Ethics Committee (HREC) of the University of the Witwatersrand. The study will not and is not intended to assess anyone, and not be used as part of any disciplinary undertaking against any of the participants.

The study will only commence once after obtaining ethical clearance from the HREC.

A self-administered questionnaire will be utilised in this study (Appendix 1). Questionnaires will be completed anonymously, and no identifying information will be collected on the questionnaire. Confidentiality will be ensured as only the researcher and supervisor will have access to the raw data.

Permission to distribute the questionnaires will be obtained from the Academic Head of the Department of Anaesthesiology at The University of The Witwatersrand (Appendix 2).

The data collected will be stored on a password protected computer for six years once the study is completed as per the HREC regulations.

The study will be conducted according to the principles of the Declaration of Helsinki [51] and the South African Guidelines for Good Clinical Practice [52].

8. Data Collection

8.1 Research Design

The study will be conducted as a prospective cross sectional observational study with the use of a pedometer and a researcher completed questionnaire.

A prospective study is one in which the data for the study is not yet in existence when the study is being planned. A population is chosen by the researcher and followed over the duration of the study to determine outcomes [53]. This study will be prospective as currently there is no information on the physical activity of anaesthetists in the study group.

A cross-sectional study is one which collects data at one time from many participants, rather than from a small group of participants over multiple time periods. This study is choosing a cross-sectional design as these are best for assessing for population-based surveys [53].

An observational study is one which descriptive data is collected as it occurs. It requires that the data be collected under strictly defined conditions and in a precise, controlled manner. This study is observational as there is no experimental arm [53].

All participants will use a commercially available, standardized, pre-tested pedometer (Sportline® Pedometer 340, EB Brands, Yonkers, NY). Sportline® pedometers have been validated in several previous studies [21,54,55]. Twenty Sportline® pedometers have been kindly lent to the researcher, by Dr Craig Berringer a consultant emergency physician at Chris Hani Baragwanath Hospital, who conducted a similar study among emergency care physicians [31].

Participants will be assisted in completing a questionnaire detailing demographic characteristics, daily theatre activities, and details of any daily out of-hours activities. Participants' activity levels will be charted twice daily by the researcher over the course of the seven-day study period.

8.2 Study Population

The study population consists of all full-time anaesthetists employed by the Wits Department of Anaesthesiology rostered to non-ICU and non-satellite locations.

8.3 Study sample method

The sample population will be drawn from doctors rostered for a seven-day period to one of the four chosen hospital sites (CMJAH, CHBAH, HJH, RMMCH). Consecutive convenience sampling will be utilized.

8.4 Inclusion criteria

- Full time Anaesthetists working in the Department of Anaesthesiology of the University of the Witwatersrand.

8.5 Exclusion criteria

- Anaesthetists declining participation in the study.
- Non-full-time consultants.
- Interns rotating though the department of anesthesiology.
- Registrars allocated to ICU rotations.
- Registrars allocated to satellite outreach hospitals.
- Members of staff injured at the time of study such that their ability to walk is hindered.
- Members of the department who are on leave or not present at work for seven consecutive days during the study duration.
- Participants on night call on the first Monday evening during the week of data collection.

8.6 Sample size

The department comprises 234 Anaesthetists: 75 consultants (68 full time, seven part -time), 12 career medical officers, 108 registrars, and 39 medical officers. After non-full-time consultants, and those allocated to satellite sites and ICU were excluded; there were 213 eligible members of staff who could be considered.

In consultation with a biostatistician, it was determined that a minimum sample size of 92 participants is required to ensure a 5% margin of error, and 95% confidence level [email from Dr Zvifadzo Matsena-Zingoni, University of the Witwatersrand, received 29.09.2021]. The sample size was determined based on the findings of similar studies, assuming that 11.7% of participants will achieve the recommended step target [31]

8.7 Collection of Data

A questionnaire was developed to provide extra information over and above a daily step count (Appendix 1). Questions regarding physical activity during off duty hours were adapted from the short form International Physical Activity Questionnaire (IPAQ) [22,23].
Other details included in the questionnaire are:

- Demographics (age, presence of chronic disease, height, weight, anaesthetic rank, hospital, and whether writing exams in the next 3 months)
- Pedometer step counts – recorded twice daily (at the onset or end of shifts)
- On or off duty
- If on duty, nature of shift performed (day/night).
- Surgical speciality assigned to, and number of cases performed.
- Details of work done whilst on duty e.g., clinical duties, administrative duties, floor senior.
- Details of daily physical activity performed during off duty hours.
- Details of off duty work activities e.g., performance clinical work in private healthcare facilities.

Data collection will take place at four hospital sites (CHBAH, CMJAH, RMMCH, HJH) over consecutive weeks. The researcher will request to be placed at the relevant hospitals via leave replacement for the duration of the study periods at each hospital.
Participants will be approached consecutively for inclusion upon release of the relevant weekly roster for the following week. On arrival at work on Monday morning, the participants will be given an information sheet and will be asked to sign informed consent for participation [Appendices 3 &4]. A numbered pedometer (correlating to the participants' study number) will then be affixed to their waistband.
The screen of the pedometer will be covered in a way to blind the participant from the number of steps achieved. Step counts will be recorded twice a day by the researcher (or trained research assistant); on the participants' arrival into work at 07:00 and on their departure at 16:00 either in the anaesthetic tea-room or in the theatre where the participant is working. The 07:00 recording will include any out of hours activity from the previous night and morning prior to 07:00, thus giving a total for the 24-hour period. The step count will then be reset and read again at 16:00 to record physical activity during working hours.

Pedometer readings will be taken twice daily by the researcher or trained research assistant, on Saturday and Sunday to capture data from participants on call over the weekend. If the participants did not have any on call shifts over the weekend, a reading will be taken on Friday at 16:00, and the next (and final) reading will be on Monday at 07:00. This will be a 48-hour reading captured as weekend off-hours activity. The pedometers will be collected on the following Monday at 07:00 and then re-allocated to the next cohort of participants.
With 20 pedometers available, the data collection is expected to be completed in a minimum of five weeks.
A questionnaire will also be completed by the researcher daily, upon consultation with the participant recording the daily levels of physical activity.

9: Data Analysis

Data captured from the participants will be entered into a Microsoft Excel® spreadsheet and analysed in conjunction with a biostatistician using the statistics programme STATA® version 16.1.
Descriptive and inferential statistics will be used to analyse the data. Categorical data will be described using frequency and percentage.
Continuous variables that are normally distributed will be summarised using means and standard deviations, and those not normally distributed will be summarised using medians and interquartile ranges. Comparison between groups will be done using Chi-squared tests, Mann-Whitney, and Kruskal-Wallis tests.
Associations between categorical variables will be determined by performing chi-squared tests, and odds ratios will be calculated. Logistic regression analysis will be performed to determine factors predictive of achieving the recommended number-of daily steps over a seven-day period.

10: Significance of the study

This study is significant as it will investigate the physical activity of a group of South African anaesthetists for the first time. The data obtained will be useful in educating the department on the risks of a sedentary lifestyle, and the importance of incorporating minimum recommended daily physical activity levels into their daily routines.

This will help to reduce the staff members' risk of developing future chronic diseases, improve their overall mental health and reduce burnout. This will also hopefully reduce absenteeism and sick leave in the department.

11: Validity and reliability of the study

Methods to ensure validity and reliability include:

- Use of a representative sample population.
- Use of a validated pedometer.
- Blinding of the pedometer.
- Use of a questionnaire based on the International Physical Activity Questionnaire.
- Analysing data in conjunction with a biostatistician.

12: Potential Limitations of the study

The study is contextual in nature and will only include anaesthetists working in the CMJAH, CHBAH, RMMCH, and HJH theatres. It will only represent the physical activity of individuals working in those locations and will not be applicable to other institutions, or individuals in the department working outside of these theatres.

Should doctors not be willing to participate due to concerns of poor fitness, there may be a selection bias leaving behind a pool of more active, fitter participants.

It is known that just the act of wearing a pedometer can introduce an awareness of the participant's physical activity and cause the wearer to increase their number of steps [18]. To counter this bias, the screens of the pedometers will be covered, and pedometers taped shut so the participants will not be able to monitor their progress.

It is possible that certain activities performed during the working day could cause 'pseudo steps' which would falsely elevate the step count recorded.

One such activity is Cardio-pulmonary resuscitation (CPR) hence its inclusion in the self-administered questionnaire. It is possible that there would be other such events which would increase the recorded physical activity. A hip mounted pedometer was chosen for this study to increase accuracy of the readings and to try to reduce the likelihood of pseudo-steps being a confounder.

13: Project Outline

Year	2021									
Month	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April
Proposal	X	X								
Ethics approval				X						
Postgraduate approval			X							
Data collection					X	X	X	X		
Data analysis									X	
Submission										X

14: Financial Plan

Document	Price per unit	Number of Pages/ hours	Total
Proposal	R1/page	90	R90
Questionnaire	R1/page	260	R360
Final report	R1/page	200	R200
Research assistant	R50/hour	56	R2800
Total			R3450

The Department of Anaesthesiology will incur the costs of paper and printing for the post graduate application. The researcher will incur the remaining costs.

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A: Demographic data:

1. **Study Number: ________________**
2. **Pedometer Number: ____________**
3. **Age:**

25-34	
35-44	
45-54	
55-64	
65+	

4.1 Chronic disease: Y/N

4.2 If yes:

Prefer not to disclose	
Cancer	
Hypertension	
Type II Diabetes Mellitus	
HIV	
Other	

If other, please specify________________________________

5. **Height (cm): ______________**
6. **Weight (kg): ______________**
7. **Rank:**

MO	
Registrar (junior)	
Registrar (senior)	
Career MO	
Consultant	

8. **Current hospital rotating at:**

CHBAH	
HJH/RMMCH	
CMJAH	
Other	

If other, please specify_______________________________

9. **Enrolled to writing exams in next 3 months: Y/N**

B: Data pertaining to step counts   Study number:___________

10. Physical activity assessment

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
12.1 Date							
12.2 Duty							
07:00-16:00 on duty steps							
16:00-07:00 on duty steps							
07:00-16:00 off duty pre-call steps							
07:00-16:00 off duty post-call steps							
07:00-16:00 off duty other steps							
16:00-07:00 off duty other steps							
12.3 Type of surgery							
General surgery							
Trauma							
Orthopaedic							
Obstetrics							
Gynaecology							
ENT							
Paediatrics							
Other (specify)							
12.4 Number of cases performed							
12.5 Floor senior Y/N							
12.6 Administrative work Y/N							
12.7 CPR performed Y/N							

Activities in off duty period: **study number ____________ Pg. 3 of 3**

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
13.1 Performance of anaesthesia in private during off duty period: Y/N							
13.2 Physical Activity in off duty period: Y/N							
13.2a: If yes, Nature of Activity:							
Walking							
Moderate activity (Such as carrying light loads, bicycling at a regular pace, or doubles tennis)							
Vigorous activity (like heavy lifting, digging, aerobics, or fast bicycling) (specify)							
Other **(Please specify)**							
13.4 If Yes: **Duration of** **Activity (mins)**							
0-15							
16-30							
31-60							
60+							

Appendix 2: Permission request for Dr Motshabi

Dear Professor Motshabi,

My name is Dr Peter Belasyse-Smith. I am one of the registrars in Department of Anaesthesiology. I am planning to do my MMed research, titled "An assessment of the levels of physical activity in an academic anaesthetic department".

Please may I have your permission to approach the members of the department to participate in my study? I would be requesting medical officers, registrars, and consultants to wear a pedometer and complete a questionnaire for a seven-day period.

Participation in the study is voluntary and anonymous. Written informed consent will be obtained from all participants prior to entry into the study. Information will remain confidential and only my supervisor and I will have access to the raw data.

The aim of the study is to assess the current physical activity levels of the anaesthetists in our department. With the results of this study, hopefully I can raise awareness of the importance of physical activity in our department.

Yours faithfully,

Dr Peter Belasyse-Smith

0765991175

drpeterbsmith@gmail.com

Appendix 3: Study information sheet

Study title: "An assessment of the levels of physical activity in an academic anaesthetic department."

Dear Colleague,

My name is Dr Peter Belasyse-Smith, and I am a registrar in the Department of Anaesthesiology at the University of the Witwatersrand. I would like to invite you to participate in my MMED research project which seeks to describe the physical activity of full-time anaesthetists within the Department of Anaesthesiology, University of the Witwatersrand.
This will be accomplished with the use of a blinded pedometer, to be worn on the waistband of the participant for a seven-day period during work duties and outside of work with twice-daily recordings of step counts by the researcher, and a short researcher completed questionnaire detailing levels of daily physical activity during the duration of the study period. The pedometer will be given to the participant by the researcher on Monday morning and returned on Monday morning of the following week. Research will take place in theatres at CHBAH, CMJAH, HJH/RMMCH during your normal working week.

The study has been approved by the Human Research Committee (Medical). Ethics approval number: ______.

If you have any concerns, please contact the research administrator of the committee, Mr Rhulani Mkansi on email: Rhulani.Mkansi@wits.ac.za or telephone: 011 717 1252.

Participation in the study is voluntary and anonymous. There are no personal identifiers included within the questionnaire. All information will remain confidential and only my supervisor and I will have access to the raw data. There is no penalty for not participating in the study.

No incentives will be provided for participating in the study or completing the questionnaire. All questionnaires and pedometers must please be returned to the researcher at the end of the study. If there are any questions prior to or during the study, please feel free to ask.

Kind regards

Dr Peter Belasyse-Smith

Researcher (Tel. 0765991175) Date: October 2021

Appendix 4: Written Consent Form for Participants

PARTICIPANT CONSENT SHEET

An assessment of the levels of physical activity in an academic anaesthetic department.

1. I have been given a Participant Information Sheet which explains the nature and processes involved in this study, which is attached hereto.
2. I was given time to read it, or had it read to me, in the language I best understand.
3. I was given time to ask any questions I wanted to and found any answers given to me to be reasonable and satisfactory.
4. I believe I fully understand why the study is being conducted and what the intended outcomes will be.
5. I understand that there will be no immediate benefit to me, should I agree to participate, nor will I receive any payment; conversely, participation will not cost me anything but my time.
6. I understand that, even if I initially consent to take part in the study, I may subsequently withdraw at any time and would not be required to give any reasons; if that happened, any data collected about me for the purposes of the study would immediately be destroyed, unless I give consent for it to be retained
7. I have been given a range of contact details, listed below. If I require further information or become concerned about any aspect of this study, I am free to speak to any of these contacts.

Contact details:

Dr Peter Belasyse-Smith, Principal Investigator, telephone no. 0765991175, or by e-mail at drpeterbsmith@gmail.com,

Dr Janine Wagner, Supervisor, on telephone no. 0829337194, or by e-mail at drjaninewagner@gmail.com

Professor CB Penny, Chairperson of the Human Research Ethics Committee (Medical) at the University of Witwatersrand, on telephone no. 011 717 2301, or by e-mail at Clement.Penny@wits.ac.za.

Ms. Z Ndlovu or Mr Rhulani Mkansi, Committee Secretariat, telephone nos.: 011 717 2700 or 1234, or by e-mail at: Zanele.Ndlovu@wits.ac.za or Rhulani.Mkansi@wits.ac.za

Name of Participant: ____

Date: ____

Place: ____

Signature or mark ____

Section 5:

Annexure A: Permission from the Head of Department

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

FACULTY OF HEALTH SCIENCES

WITS SCHOOL OF CLINICAL MEDICINE

DEPARTMENT OF ANAESTHESIOLOGY
Tel.(011)488 4344

20 April 2022

Postgrad Office

School of Clinical Medicine

Faculty of Health Sciences

University of the Witwatersrand

To Whom It May Concern

Permission To Conduct Research: Dr Peter Belasyse-Smith- Student Number: 375150

This is to confirm that I have read and given permission for **Dr Peter Belasyse-Smith** to conduct research at in the Department of Anaesthesiology towards his/her Mmed project titled ***"An assessment of the levels of physical activity in an academic anaesthetic department"***

Thank you.

Assoc. Prof. P Motshabi Chakane

WITS UNIVERSITY

Ass Prof P. Motshabi Chakane
HOD Wits Anaesthesia
HOU Cardiac Anaesthesia

Tel: +27 (0)11 488 4344
Cell: 083 432 1994
Email: palesa.motshabi@wits.ac.za
Website: www.wits.ac.za

WITS SCHOOL OF CLINICAL MEDICINE
FACULTY OF HEALTH SCIENCES

Charlotte Maxeke Johannesburg Academic Hospital, 6th Floor, Area 361/16, Jubilee Road, Parktown, Johannesburg

Annexure B: Postgraduate Assessors Group Approval

UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

Private Bag 3 Wits, 2050
Fax: 027117172119
Tel: 02711 7172076

Reference: Mrs Sandra Benn
E-mail: sandra.benn@wits.ac.za

05 October 2021
Person No: 375150
PAG

Dr PB Belasyse-Smith
28 Pekin Avenue
Blairgowrie
2194
South Africa

Dear Dr Peter Belasyse-Smith

Master of Medicine in Anaesthesia: Approval of Title

We have pleasure in advising that your proposal entitled *An assessment of the levels of physical activity in an academic anaesthetic department* has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

100 1922 2022

Annexure C: Human Research Ethics Committee clearance certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG	HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

Office of the Deputy Vice-Chancellor (Research and Innovation)

TO:	Dr P Belasyse-Smith School of Clinical Medicine Department of Anaesthesia Medical School University E-mail: drpeterbsmith@gmail.com
CC:	Supervisor: Dr J Wagner <drjaninewagner@gmail.com> and <HREC-Medical Research Office@wits.ac.za>
FROM:	Mr Iain Burns Human Research Ethics Committee (Medical) Tel: 011 717 1252 E-mail: Iain.Burns@wits.ac.za
DATE:	
REF:	R14/49
PROTOCOL NO:	**M211066** (This is your ethics application reference number. Please quote it in all enquiries, oral or written, relating to this study.)
PROJECT TITLE:	*An assessment of the levels of physical activity in an academic anaesthetic department*

Please find attached the Clearance Certificate for the above project. I hope it goes well and that an article in a recognized publication comes out of it. This will reflect well on your professional standing and contribute to Government funding of the University.

MSWorks2000/Iain0007/Clearscan.wps

Annexure D: Turnitin report.

PBS MMED Jan 25 Final Submission -1.docx

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