A multicentre, cross-sectional study investigating the prevalence of hypertensive disease in patients presenting for elective surgery in the Western Cape, South Africa

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- Preoperative Blood Pressure
- Hypertension
- Hypertensive Risk Factors
- Target Organ Damage
- Treatment Compliance
- Perioperative Medicine
- Public Health Concern

DECLARATION

I, KAREN VAN DER [signature], hereby declare that the work on which this dissertation/thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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Abstract:

Background:

Hypertension is common, affecting over one billion people worldwide. Importantly, in Sub-Saharan Africa hypertensive disease not only affects the older population group, but is becoming increasingly prevalent in younger patients. In South Africa, over 30% of the adult population has hypertension, making it the single most common cardiovascular risk factor and the predominant contributor to cardiovascular disease and mortality.

In non-cardiac surgical patients, elevated blood pressure is the most common perioperative comorbidity encountered with an overall prevalence of 20-25%, and it remains poorly controlled in low and middle-income countries. Furthermore, hypertension in the perioperative setting may adversely affect patient outcome. It thus not only flags possible perioperative challenges to anaesthesiologists, but also identifies patients at risk of long-term morbidity and mortality.

Objectives:

The primary objective of this study was to determine the prevalence and severity of hypertension in elective adult surgical patients in the Western Cape.

Results:

The study population included all non-cardiac, non-obstetric, elective surgical patients from seven hospitals in the Western Cape during a one-week period. Hypertension, defined as having had a previous diagnosis of hypertension or meeting the blood pressure criteria of more than 140/90 mmHg, was identified in 51.8% of patients during the preoperative assessment. Significantly, newly diagnosed hypertension was present in 9.6% of all patients presenting for elective surgery.

Although 98.1% of the known hypertensive patients were on antihypertensive therapy, 36.9% were inadequately controlled. Numerous reasons exist for this but notably 32% of patients admitted to forgetting to take their medication, making patient factors the most common cause for treatment non-compliance.

Conclusion:

This study suggests that the perioperative period may be an important opportunity to identify undiagnosed hypertensive patient. The perioperative encounter may have a significant public health implication in facilitating appropriate referral and treatment of hypertension to decrease long-term cardiovascular complications in South Africa.

* 301 words*

Introduction:

Hypertension is common, affecting over one billion people worldwide, and is responsible for over seven million deaths annually.[1] The presence of hypertension increases the risk of myocardial infarction, heart failure, renal failure and cerebrovascular disease.[2] Importantly, in Sub-Saharan Africa hypertensive disease not only affects the older population group, but is becoming increasingly prevalent in younger patient groups.[3] In South Africa, over 30% of the adult population have hypertension,[4] and it remains the single most common cardiovascular risk factor and predominant contributor to cardiovascular disease and mortality.[5,6]

In non-cardiac surgical patients, elevated blood pressure is the most common perioperative comorbidity encountered, with an overall prevalence of 20-25%,[7] and it remains poorly controlled in low and middle-income countries.[8,9] Furthermore, hypertension in the perioperative setting may adversely affect patient outcome.[10] Hypertension therefore poses perioperative challenges to anaesthesiologists, while simultaneously identifying patients at risk of long-term morbidity and mortality.[11,12]

The diagnosis of hypertension and initiation of treatment is most frequently made in the primary health care setting. However, in a resource limited environment, the perioperative period provides clinicians a unique opportunity to identify patients with hypertensive disease, educate patients about the disease, and initiate appropriate therapy. Furthermore, this period provides the opportunity to refer patients for further investigation or follow up at peripheral health care centres for on-going management, thus aiding the decentralization of chronic, long-term care. The efficient identification and diagnosis of hypertension in the perioperative period, could therefore be seen as an effective utilisation of planned surgical admission by simultaneously addressing a primary health care need and this may serve as an efficient health care strategy in reducing long-term cardiovascular morbidity and mortality.[13,14] Identification and/or optimisation of hypertensive management in the perioperative period is an attractive healthcare intervention in a resource limited environment such as South Africa, particularly when considering difficulties with primary healthcare access and treatment compliance.

The primary objective of this study was to describe the prevalence and severity of hypertension in non-cardiac, non-obstetric, elective adult surgical patients in the Western Cape, in order to determine whether perioperative screening can be used to supplement primary healthcare management of hypertension, through developing effective strategies for the diagnosis and management of hypertension in patients presenting for elective surgery.

Methods:

The primary aim of the study was to describe the prevalence and stages of hypertension in adult patients presenting for non-cardiac, non-obstetric elective surgery in all surgical disciplines at seven hospitals in the Western Cape.

The secondary aims of the study were to identify; i) hypertension associated target organ damage, ii) risk factors associated with hypertension, and iii) to assess compliance with prescribed hypertensive therapy.

This was a multicentre, prospective, observational study conducted at seven hospitals in the Western Cape; one tertiary level institution, Groote Schuur Hospital, and six secondary level institutions which included George, Mitchells Plain, New Somerset, Paarl, Victoria and Worcester Hospitals. Ethics approval was obtained for all institutions (HREC Ref: 661/2016; 708/2016 and NHRD WC_2016RP55_876) and written informed consent was sought prior to patient enrolment in the study. The trial was registered on the South African National Clinical Trial Register (NCT03157661).

All adult, non-cardiac, non-obstetric patients, admitted the day before elective surgery during the study period were eligible for inclusion. Exclusion criteria were patient refusal, day case surgery (as no preceding day preoperative assessment was possible) and patients not requiring an anaesthetic. Recruitment was from 7am Monday to 7pm Friday of the week chosen for the study.

Data was collected by anaesthesia medical officers, registrars and specialists assigned to each of the surgical lists at the various institutions. Routine preoperative information was recorded on a specifically designed paper case report form (CRF) and then captured onto the Research Electronic Data Capture (REDcap) web-based application. Compliance with medical therapy was assessed using the Morisky Medication Adherence Questionnaire.[15,16] A positive response to two or more of the four questions was considered as non-compliance with antihypertensive treatment.

Assessment of preoperative hypertension was evaluated using the South African Hypertension practice guidelines.[4] All blood pressure measurements were performed with an appropriately sized non-invasive blood pressure cuff, using an automated oscillometric method of blood pressure measurement. If the patient was found to have a systolic blood pressure of ≥140 mmHg or a diastolic blood pressure of ≥90 mmHg, then two further measurements were performed at least 5 minutes apart. The lowest of the three readings was taken as the preoperative blood pressure. Patients who after these three blood pressure readings still had a systolic blood pressure of ≥140 mmHg or a diastolic blood pressure of ≥90 mmHg where considered to be hypertensive.[4]

Categorical variables were described as proportions and compared using chi-square tests and Fisher's exact tests, as appropriate. Continuous variables were described as mean and standard deviation (SD) or median and interquartile range (IQR), and compared using t-tests or one-way ANOVA as appropriate. Data was analysed using Statistical Package for the Social Sciences (SPSS) version 24 (SPSS Inc., Chicago, IL, USA).

Results:

The Hypertension and Surgery Study (HaSS) included seven state hospitals in the Western Cape (Supplementary Table). The patient recruitment, prevalence and control of hypertension is shown in Figure 1. Of the 397 patients who were screened, five refused to participate, and four did not meet inclusion criterion. Six patients were excluded from the analysis due to incomplete datasets. Analysis was possible on full datasets of 382/388 (98.5%) consenting patients.

Please insert Suppl. Table somewhere here please

Please insert Figure 1 somewhere here please

Previously diagnosed hypertension was present in 160 (41.9%) patients, whilst newly diagnosed hypertension was found in a further 38 (9.9%) patients. Prevalence of hypertension, defined as having had a previous diagnosis of hypertension or meeting the blood pressure criteria of more than 140/90 mmHg, was thus 198/382 (51.8%, 95% CI 46.8-56.8) in the preoperative assessment.

The characteristics of the recruited patients are shown in Table 1. Hypertensive patients were older, carried more risk factors for hypertension and had more co-morbidities as reflected by the higher American Society of Anesthesiologists (ASA) grading. Hypertensive patients had significantly more target organ damage, specifically coronary artery disease (CAD), heart failure (HF), advanced retinopathy, cerebrovascular disease (CVA), chronic renal disease, peripheral arterial disease (PAD), diabetes and dyslipidaemia.

Please insert Table 1 somewhere here please

The severity of hypertension is shown in Table 2. Of all the hypertensive patients, 99/198 (50.0%, 95% CI 43.0 – 57.0%) were found to have a blood pressure greater than 140/90 mmHg. Despite the vast majority of known hypertensive patients (157/160; 98.1%) being on anti-hypertensive therapy preoperatively, inadequate blood pressure control was present in 61/160 (38.1%, 95% CI 31.2 – 46.3%).

Please insert Table 2 somewhere here please

Table 3 lists the most common antihypertensive therapies in the study population. In the patients who presented for surgery with a diagnosis of hypertension, treatment non-compliance was reported in 39/157 (25%, 95% CI 18.2 – 31.8%) (Table 4). A third of patients (50/156) taking anti-hypertensive medication admitted to forgetting to take their medication. Patient factors were the most common cause of treatment non-compliance.

Please insert Table 3 and Table 4 somewhere here please

Discussion:

Statement of principal findings:
Five out of every ten patients presenting for elective surgery in the Western Cape are hypertensive. Of these, 20% are undiagnosed and 40% are inadequately controlled. This study suggests that the perioperative period may be an important opportunity to identify undiagnosed hypertension as well as improve the management of known hypertensive patients in South Africa.

Secondly, once a patient is diagnosed with hypertension, access to medication in the community is good, but compliance of the patient to therapy becomes the more important determinant of subsequent hypertensive control.

These data suggest that the perioperative period could supplement primary healthcare services, through perioperative screening, treatment initiation and referral. This needs to be coupled with an appropriate educational programme to ensure subsequent patient compliance with therapy on discharge. This dual-pronged approach to hypertension in surgical patients therefore has the potential for a large public health benefit in South Africa.

Strengths:
This is a multicentre, prospective observational study of hypertension in the Western Cape. The ability to follow the South African Hypertension Guidelines in confirming the diagnosis of hypertension on the day *prior* to surgery in this study increases our confidence that our results do reflect the true burden of hypertensive disease in preoperative surgical patients. We expect this data to be broadly generalizable across the Western Cape, and possibly across South Africa for patients from similar social circumstances.

Limitations:
It is possible that the prevalence of hypertension may be overestimated in this cohort. Although the evaluation of hypertension was made in elective surgical patients on the day preceding surgery, it is possible that some of the patients may have been anxious, and hence spuriously fulfilled the diagnostic criteria. Furthermore, this study excluded all emergency cases, thus a true prevalence of hypertension in patients presenting for all surgery is not possible. We would however expect the prevalence of hypertension to be higher in patients presenting for emergency surgery as they are likely to have more co-morbid disease compared to the elective population.

Finally, the information related to compliance with medical therapy should be viewed with some caution as it is based on a relatively small sample size.

Implications of this study:
It is estimated that 60% of the world's population is hypertensive, as defined by The World Hypertension Society/International Society of Hypertension.[17]

In the African region the prevalence of hypertension is estimated at 46% for adults aged 25 and above. The number of adults with hypertension in 2025 is predicted to increase by about 60%, with a disproportionately high prevalence in developing countries.[18]

In Sub-Saharan Africa, despite the high burden imposed by communicable diseases, hypertension has emerged as a significant medical and public health problem and is regarded as one of the continent's greatest health challenges after HIV/AIDS.[1] It is estimated that if the 10 – 20 million people who are believed to have hypertension in Sub-Saharan Africa were treated effectively, about 250 000 deaths could be prevented annually.[19]

According to the South African Hypertension Practice Guidelines, 30.4% of our adult population has hypertension.[2] This chronic disease is regarded as the single most prevalent cardiovascular risk factor and predominant contributor to cardiovascular disease related morbidity and mortality.[1] In the 2015 South African mortality statistics, cerebrovascular disease ranked 3rd, accounting for 5.0% of national deaths, heart disease ranked 5th, accounting for 4.8%, and hypertension related diseases ranked 7th, accounting for 4.2% of all national natural causes of death.[20]

Although hypertension is not directly linked to poor perioperative outcomes, it is associated with long-term cardiovascular morbidity and mortality.[2] Treating hypertension improves long term outcome.[13] This study suggests that perioperative evaluation of blood pressure has the potential to i) identify undiagnosed hypertension in 10% of all adult patients presenting for elective surgery, ii) provide surveillance for the adequacy of management of hypertension in the community, and iii) play an active role in the management of hypertension using predefined interventions[21] to improve both the patient's understanding and control of hypertension in as many as 50% of patients who present for all elective surgery.

The volume of surgery performed worldwide, based on population statistics from 2005 to 2013, estimates an average imputed surgical rate of 5227 per 100 000 population.[22] With a conservative estimate of 20 000 elective (South African Surgical Outcomes Study, unpublished data[23]), adult non-cardiac, non-obstetric surgical procedures per annum in the Western Cape, as many as 2000 (10%) new cases of hypertension could be diagnosed perioperatively. Furthermore, a total of 8000 (40%) of these patients would require further therapy optimisation in the perioperative period. The population attributable risk associated with hypertension for stroke is approximately 50%, and for ischaemic heart disease is 40% in South Africa.[21] Optimisation of hypertension therefore could prevent 125 strokes and 244 coronary events in this population annually, based on the prevalence of stroke and coronary heart disease in our population (2.5% and 6.1% respectively).

Implications for South Africa:
In South Africa, assuming that half of the national surgical rate is performed in the adult population (2614 per 100 000 population),[23] then as many as 261 (10%) per 100 000 new cases of hypertension could be diagnosed annually at the time of surgery. The perioperative period could also present an opportunity to optimise hypertensive treatment in up to 1046 (40%) per 100 000 patients with the potential to prevent 16 strokes and 32 coronary events per 100 000 of the adult population in South Africa, annually.

Conclusion:

We believe that in South Africa there is a significant potential for public health interventions in the perioperative period both in identifying new cases as well as improving management of hypertension. Earlier diagnosis, initiation of treatment and addressing issues of compliance through education programs may create stronger links between the referral hospital and primary health care facility to improve long term outcomes. This model may be followed to address other chronic diseases such as diabetes and anaemia.

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- George Hospital
- Groote Schuur Hospital
- Mitchell's Plain Hospital
- New Somerset Hospital
- Paarl Hospital
- Victoria Hospital
- Worcester Hospital

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Conflicts of interest:
None

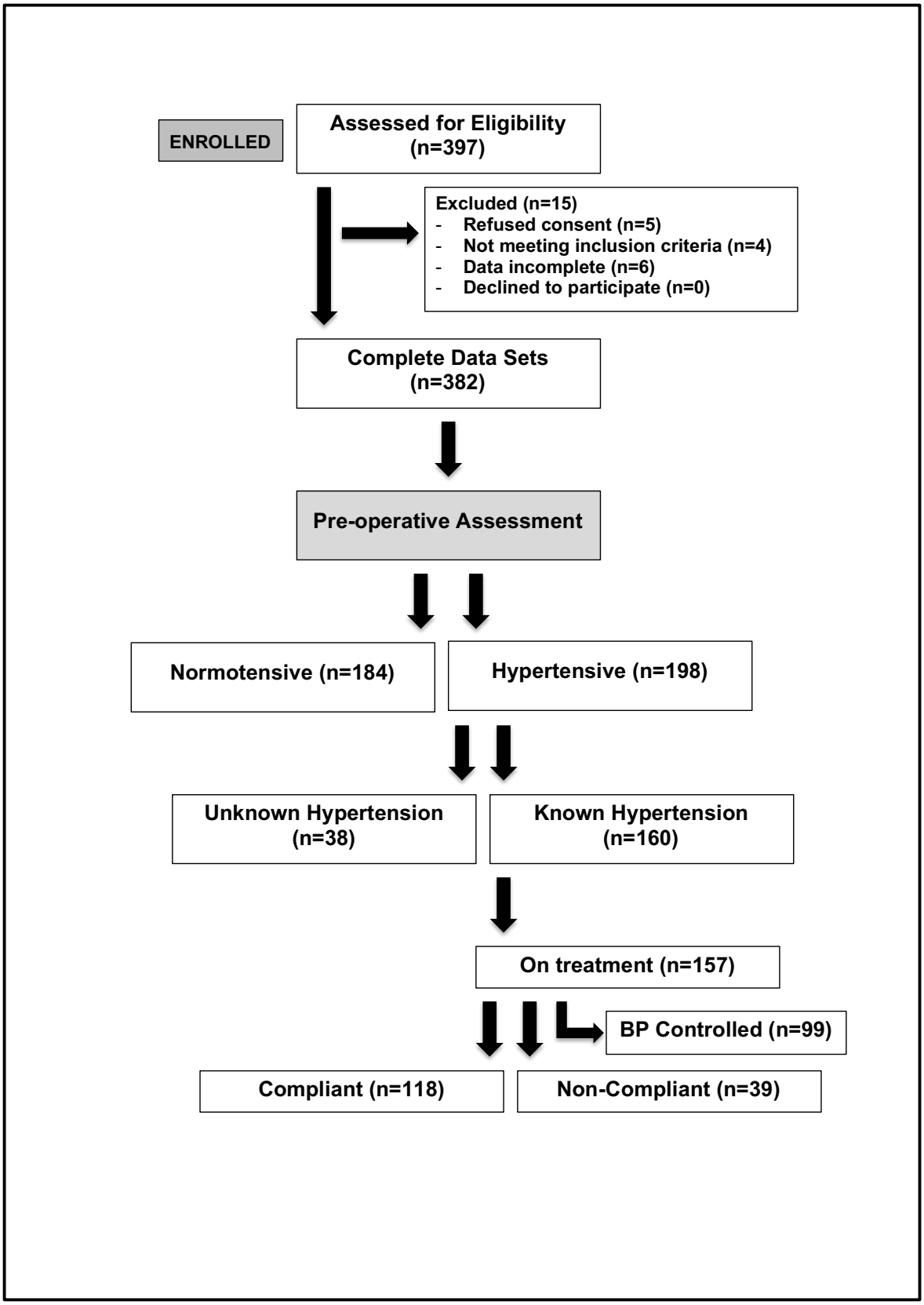

Fig. 1: PRISMA diagram depicting the study recruitment process

Table 1. Characteristics of study population. Data are presented as n(%) or mean(SD).

	Patients (N=382)	Normotensive (n=184)	Hypertensive (n=198)	*p*-value
Age (years)	50; 16.1	41.2; 14.3	58.5; 12.9	<0.001
Gender				
Male	146 (38.2)	76 (41.3)	70 (35.4)	0.248
ASA status (n=379)				
ASA I	127 (33.5)	107 (59.1)	20 (10.1)	<0.001
ASA II	187 (49.3)	62 (34.3)	125 (63.1)	
ASA III	59 (15.6)	11 (6.1)	48 (24.2)	
ASA IV	6 (1.6)	1 (0.6)	5 (2.5)	
Risk factors for hypertension				
BMI (n=358)	28.2 (7.2)	26.6 (6.8)	29.7 (7.3)	<0.001
Smoking	160 (41.9)	89 (48.4)	71 (35.9)	0.778
Dyslipidaemia	48 (12.6)	7 (3.8)	41 (20.7)	<0.001
NIDDM	19 (5.0)	5 (2.7)	14 (7.1)	0.060
IDDM	42 (11.0)	6 (3.3)	36 (18.2)	<0.001
Men >55 years	55 (14.4)	18 (9.8)	37 (18.7)	0.014
Women >65 years	46 (12.0)	7 (3.8)	39 (19.7)	<0.001
Target organ damage				
Left ventricular hypertrophy	39 (10.2)	4 (2.2)	35 (17.7)	<0.001
Coronary artery disease	14 (3.7)	2 (1.1)	12 (6.1)	0.012
Heart failure	5 (1.3)	1 (0.5)	4 (2.0)	0.204
Chronic kidney disease	27 (10.4)	2 (2.0)	25 (15.7)	<0.001
CVA/TIA	6 (1.6)	1 (0.5)	5 (2.5)	0.120
Peripheral arterial disease	8 (2.1)	2 (1.1)	6 (3.0)	0.185
Retinopathy	8 (2.1)	0 (0.0)	8 (4.0)	0.008
Other comorbid disease				
COPD/Asthma	36 (9.4)	13 (7.1)	23 (11.6)	0.161
HIV/AIDS	24 (6.3)	16 (8.7)	8 (4.0)	0.090

SD = Standard Deviation; BMI = Body Mass Index; CVA = Cerebrovascular Accident; TIA = Transient Ischaemic Attack; NIDDM = Non-Insulin Dependent Diabetes; IDDM = Insulin Dependant diabetes.

Table 2. Classification of the severity of hypertension (n=198)

	Hypertensive (n=198); n (%)
Normotensive	99 (50.0)
Grade 1 - Mild (SBP 140-159 or DBP 90-99 mmHg)	66 (33.3)
Grade 2 - Moderate (SBP 160-179 or DBP 100-109 mmHg)	21 (10.6)
Grade 3 - Severe (SBP≥180 or DBP ≥110 mmHg)	12 (6.1)

Classification of Hypertension as per 2014 South African Hypertension Practice Guideline.[4]

Table 3. Most common anti-hypertensive therapies used

Antihypertensive Treatment	Number (%)
Diuretic	124/198 (62.6)
ACE-I/ARB	97/198 (49.0)
B-Blocker	61/198 (30.8)
Calcium Channel Blocker	46/198 (23.2)
Alpha-blocker	6/198 (3.0)
Other	4/198 (2.0)

ACE-I = angiotensin converting enzyme-inhibitor; ARB = angiotensin receptor blocker

Table 4. Incidence and reasons for hypertensive therapy non-compliance*

	Hypertensive patients on treatment n/total	%; 95% CI
Compliant	117/156	75; 68.2 – 81.2
Non-compliant	39/156	
Standardised questions to elicit non-compliance:		
Do you ever forget to take your medicine?	50/156	32.1; 24.7 – 39.3
Are you careless at times about taking your medicine?	35/154	22.7; 16.1 – 29.3
When you feel better do you sometimes stop taking your medicine?	20/155	12.9; 7.6 – 18.2
Sometimes if you feel worse when taking your medication, do you stop taking it?	20/155	12.9; 7.6 – 18.2
Reasons for non-compliance (n=39):		
Health system	3 /39	7.9; 0.0 – 16.5
Condition	8 /39	21.1; 8.1 – 34.0
Patient	22/39	57.9; 42.2 – 73.4
Therapy	6/39	15.8; 4.2 – 27.3
Socioeconomic	5/39	13.2; 2.4 – 23.9

* Compliance with medical therapy was assessed using the Morisky Medication Adherence Questionnaire.[15,16]

Supplementary Table 1. Participating hospitals

Institution	Level of care	Patients screened (n=397)	Patients recruited with complete data (n=382)
George Provincial Hospital	secondary	49	49
Groote Schuur Hospital	tertiary	187	179
Mitchell's Plain Hospital	secondary	28	27
New Somerset Hospital	secondary	45	42
Paarl Hospital	secondary	46	46
Victoria Hospital	secondary	12	10
Worcester Hospital	secondary	30	29

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Appendices:

1. HaSS Case Report Form and Instructions
2. HaSS Patient Consent Form
3. HaSS Full Ethics Approval
4. HaSS Groote Schuur Hospital Approval
5. Submission to SAMJ and Reviewers Comments 19/12/2017
6. SAMJ Submission Cover Letter Post Revisions
7. SAMJ Acceptance for Publication
8. SAMJ Payment Form
9. SAMJ Research Article Guidelines

Hypertension and Surgery Study (HASS)

Consent given ☐ Yes ☐ No

Age ☐☐☐ years Gender ☐ M ☐ F Current smoker ☐ Y ☐ N

Ethnicity: ☐ Black ☐ Coloured ☐ Asian ☐ Caucasian

Height ☐☐☐ cm Weight ☐☐☐ kg ASA ☐ I ☐ II ☐ III ☐ IV ☐ V

Blood results (no more than 30 days before surgery): Haemoglobin ☐☐.☐ g/dL Creatinine ☐☐☐ µmol/L

Chronic co-morbid disease (tick all that apply):

☐ Coronary artery disease ☐ Heart failure ☐ Advanced retinopathy
☐ Stroke or Transient ischaemic attack ☐ COPD / Asthma ☐ HIV / AIDS
☐ Known hypertension ☐ Chronic renal disease ☐ Peripheral arterial disease
☐ Diabetes (without insulin) ☐ Diabetes (requiring insulin) ☐ High cholesterol or statin Rx

Functional status: ☐ Totally independent ☐ Partially dependent ☐ Totally dependent

Pre-operative ECG (within the last 6 months) (tick all that apply):

☐ LVH (left ventricular hypertrophy) ☐ Rhythm irregular ☐ ECG not done

Surgical procedure category (select *single* most appropriate):

☐ Anorectal ☐ Aortic ☐ Bariatric
☐ Brain ☐ Breast ☐ ENT (except thyroid/parathyroid)
☐ Foregut (hepatopancreaticobiliary) ☐ Gallbladder, appendix, adrenal, spleen ☐ Hernia (ventral, inguinal, femoral)
☐ Intestinal ☐ Neck (thyroid/parathyroid) ☐ Gynaecology
☐ Orthopaedic/ nonvascular extremity ☐ Other abdominal ☐ Peripheral vascular
☐ Skin ☐ Spine ☐ Non-oesophageal thoracic
☐ Vein ☐ Urology

Current antihypertensive medications i.e. taking for at least 30 days prior to hospital admission (tick all that apply):

☐ ACE-I or ARB ☐ Diuretic ☐ Beta-blocker
☐ Calcium channel blocker ☐ Alpha-blocker ☐ Other

Drug compliance (tick all that apply): Do you ever forget to take your medication? ☐ Y ☐ N

Are you careless at times about taking your medication? ☐ Y ☐ N

When you feel better, do you sometimes stop taking your medication? ☐ Y ☐ N

Sometimes if you feel worse when you take the medicine, do you stop taking it? ☐ Y ☐ N

Reasons for non-drug compliance (only answer if 2 or more drug compliance questions above marked 'Yes'):

Health system ☐ Condition ☐ Patient ☐ Therapy ☐ Socioeconomic ☐

Blood pressure during pre-operative assessment: BP measured with: ☐ automated ☐ manual

1st BP reading: SBP ☐☐☐ DBP ☐☐☐ MAP ☐☐☐ HR ☐☐☐

2nd BP reading (if 1st >140/90): SBP ☐☐☐ DBP ☐☐☐ MAP ☐☐☐

3rd BP reading (if 1st >140/90): SBP ☐☐☐ DBP ☐☐☐ MAP ☐☐☐

HASS unique patient ID ☐☐☐ ☐☐☐ ☐☐☐☐

✂- -

Patient name: ______________________________ DOB d d m m y y y y

Patient hospital number : ______________________

Perioperative data capture

Surgery performed: ☐ Yes ☐ No If no, reason: ____________________

Pre-induction blood pressure: SBP ☐☐☐ DBP ☐☐☐ MAP ☐☐☐ HR ☐☐☐

Anaesthetic technique (✔) ☐ General ☐ Spinal ☐ Epidural ☐ Sedation ☐ Local ☐ Other regional

Major surgery: ☐ Y ☐ N

Blood loss during surgery: ☐☐☐☐☐ ml Duration of surgery: ☐☐☐☐ minutes

Vasopressors: ☐ Phenylephrine ☐ Ephedrine ☐ Adrenaline

Intraoperative fluid administration:

	Total volume given (ml)
Crystalloid	
Colloid	
Blood	

Intraoperative haemodynamics (please record total intra-operative time in minutes):

Heart rate > 100: ☐ No ☐ Yes If yes, total time HR> 100 ☐☐☐ minutes

MAP < 55mmHg ☐ No ☐ Yes If yes, total time MAP<55mmHg ☐☐☐ minutes

HASS unique patient ID ☐☐☐ ☐☐☐ ☐☐☐☐

✂- -

Patient name: ____________________ DOB d d m m y y y y

Patient hospital number : ____________________

Guidance for use of paper case record form (CRF)

Remove this page before use in data collection

1. **Baseline data on page one should be collected on the preoperative anaesthetic visit on the day before surgery.**
2. **BP assessment during the preoperative anaesthetic visit should ideally be measured as follows;**

Allow patient to sit for 3–5 minutes before commencing measurement. The SBP should be first estimated by palpation to avoid missing the auscultatory gap. If the 2nd and 3rd readings 1–2 minutes apart, are only required if the 1st reading >140/90. If there is a discrepancy in readings between arms, then use the side with the higher BP. The patient should be seated, back supported, arm bared and arm supported at heart level. Patients should not have smoked, ingested caffeine-containing beverages or food in previous 30 min. An appropriate size cuff should be used: a standard cuff (12 cm) for a normal arm and a larger cuff (15 cm) for an arm with a mid-upper circumference > 33 cm (the bladder within the cuff should encircle 80% of the arm). Measure BP after 1 and 3 minutes of standing at first consultation in the elderly, diabetics and in patients where orthostatic hypotension is common. When adopting the auscultatory measurement use Korotkoff 1 and V (disappearance) to identify SBP and DBP respectively. Take repeated measurements in patients with atrial fibrillation and other arthythmias to improve accuracy.[1]

3. **Baseline data on page two should be collected on the anaesthetist who provides the anaesthesia for the patient.**
4. **Definitions:**
   a. **Advanced retinopathy: defined as haemorrhages or exudates or papilloedema**
   b. **LVH ECG definitions; defined as;**
      i. **S in V1 plus R in V5 or V6 > 35 mm or**
      ii. **R in aVL > 11 mm or**
      iii. **(R in aVL + S in V3 + 6 in females) × QRS duration > 2 440 (mm/ms)**
   c. **Major surgery: defined as Aortic and other major vascular surgery, peripheral vascular surgery, or intraperitoneal or intrathoracic surgery with major fluid shifts**
   d. **Non-drug compliance definitions;[2]**

HASS unique patient ID | | | | | | | | | | |

✂- -

Patient name: ______________________ **DOB** | d | d | m | m | y | y | y | y |

Patient hospital number : ______________________

i. **Health system: Poor quality of provider-patient relationship; poor communication; lack of access to healthcare; lack of continuity of care**
ii. **Condition: Asymptomatic chronic disease (lack of physical cues); mental health disorders (eg, depression)**
iii. **Patient: Physical impairments (eg, vision problems or impaired dexterity); cognitive impairment; psychological/behavioural; younger age;**
iv. **Therapy: Complexity of regimen; side effects**
v. **Socioeconomic: Low literacy; higher medication costs; poor social support**

5. **Please try to ensure complete data submission. If an ECG or blood results are not available at the time of the preoperative anaesthetic assessment, please can the anaesthetist for the operative procedure complete these data.**

Reference

1. Hypertension guideline working g, Seedat YK, Rayner BL, et al. South African hypertension practice guideline 2014. *Cardiovasc J Afr* 2014;25(6):288-94. doi: 10.5830/CVJA-2014-062
2. Ho PM, Bryson CL, Rumsfeld JS. Medication adherence: its importance in cardiovascular outcomes. *Circulation* 2009;119(23):3028-35. doi: 10.1161/CIRCULATIONAHA.108.768986

HASS unique patient ID | | | | | | | | | |

Patient name: _____ **DOB** d d m m y y y y

Patient hospital number : _____

INFORMED CONSENT FORM

Title of Studies:

An audit of the prevalence of hypertensive disease in patients presenting for elective surgery. HREC ref: 661/2016

Is there a relationship between pre-operative blood pressure measurement and intra-operative haemodynamic changes that are known to be associated with postoperative morbidity? HREC ref: 708/2016

Investigators: Dr Karen van der Spuy, Dr Marcelle Crowther, Dr Marcin Nejthardt, Dr Francois Roodt, Prof Bruce Biccard

Department of Anaesthesia and Perioperative Medicine, University of Cape Town, South Africa

INFORMATION

You are being approached to be a part of a research study on blood pressure. The doctors that are part of this study are trying to understand more about your blood pressure before and during surgery.

If you have no objection, the doctors would appreciate your permission to collect information relating to your blood pressure measured in the ward, in theatre and during your surgery. This study will have no benefits for you, but may help doctors treat patients in the future.

If you agree to be a part of this study, the doctors will be collect the following information, which is routinely written down as part of your standard patient care in hospital:

• Your blood pressure, factors known to be associated with high blood pressure and blood pressure medication, and

• Details about your operation which include how long the operation took, the type of intravenous fluids, any changes in your blood pressure and heart rate, and whether any medication was given to manage your blood pressure.

Being a part of this study will not result in any additional measurements, tests or investigations during your time in the hospital. The only difference for patients in the study when compared to standard care patients, is that the above information will be taken down by one of the doctors. This information will be stored both on paper and on computer. To protect your privacy, the information will be labelled in a way that will not identify you. If the results of these studies are published, your identity will be kept confidential.

By signing this form, you are allowing the use of this information for the research study. These research projects have been approved by the University of Cape Town's Human Research Ethics Committee. If you have any ethical concerns or questions about your rights or welfare as a participant in this research, the Human Research Ethics Committee can be contacted on 021 406 6338.

Please read this form carefully and ask the investigator (study doctor) to explain any words or information that are not clear to you. This will help to ensure you understand the details of your participation before you give your consent. You will be given a copy of this consent form to take home with you. The doctors will answer any questions you may have about this consent form and about the studies.

CONSENT STATEMENT

I therefore certify the following:

- I have read the above information form and understand that the study involves research.
- I understand that the doctors will make a copy of some of my routinely recorded data from my standard patient care.
- I have had the opportunity to ask questions. All my questions have been answered to my satisfaction.
- I understand that any information that leaves the doctor's office will be de-identified (i.e., identifying information will be removed from the documents).

_____YES _____ NO

Participant/Legal Representative's name (printed) **Signature** **Date:**

Name of person obtaining consent (printed) **Signature** **Date:**

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room E52-24 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 404 7682 • **Facsimile** [021] 406 6411
Email: nosi.tsama@uct.ac.za
Website : www.health.uct.ac.za/fhs/research/humanethics/forms

18 October 2016

HREC REF: 661/2016

Dr M Nejthardt
Anaesthesia
D23
NGSH

Dear Dr Nejthardt

PROJECT TITLE: AN AUDIT OF THE PREVALENCE OF HYPERTENSIVE DISEASE IN PATIENTS PRESENTING FOR ELECTIVE SURGERY AT A TERTIARY INSTITUTION, GROOTE SCHUUR HOSPITAL (MMed-Candidate-Dr K van der Spuy)

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee for review.

It is a pleasure to inform you that the HREC has **formally approved** the proof of concept for phase 1 of the above-mentioned study.

Approval is granted for one year until the 30th October 2017.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

We acknowledge that the student Dr K van der Spuy will be involved in this study.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval before the research may occur.

Please quote the HREC REF in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE
Federal Wide Assurance Number: FWA00001637.

Western Cape Government
Health

GROOTE SCHUUR HOSPITAL
Enquiries: Dr Bernadette Eick
E-mail : Bernadette.Eick@westerncape.gov.za

Dr M. Nejthardt
Anaesthetics & Perioperative Medicine
D23 - NMB

E-mail: bruce.biccard@uct.ac.za

Dear Dr Nejthardt

RESEARCH PROJECT: An Audit of the Prevalence of Hypertensive Disease in Patients Presenting for Elective Surgery at a Tertiary Institution, Groote Schuur Hospital (MMed Dr K. van der Spuy)

Your recent letter to the hospital refers.

You are hereby granted permission to proceed with your research which is valid until **30 October 2017.**

Please note the following:

a) Your research may not interfere with normal patient care.
b) Hospital staff may not be asked to assist with the research.
c) No additional costs to the hospital should be incurred i.e. Lab, consumables or stationary may be used.
d) **No patient folders may be removed from the premises or be inaccessible.**
e) Please discuss the study with the HOD before commencing.
f) Please introduce yourself to the person in charge of an area before commencing.
g) Please provide the research assistant/field worker with a copy of this letter as verification of approval.
h) Confidentiality must be maintained at all times.
i) Should you at any time require photographs of your subjects, please obtain the necessary indemnity forms from our Public Relations Office (E45 OMB or ext. 2187/2188).
j) Should you require additional research time beyond the stipulated expiry date, please apply for an extension.
k) **On completion of research, please submit a copy of the publication or report.**

I would like to wish you every success with the project.

Yours sincerely

DR BERNADETTE EICK
CHIEF OPERATIONAL OFFICER
Date: 20 October 2016
BE/vms

C.C. Mr L. Naidoo, Dr A. Krajewski, Professor J. Swanevelder

G46 Management Suite, Old Main Building, Observatory 7925
Private Bag X, Observatory, 7935
Tel: +27 21 404 6288 fax: +27 21 404 6125
www.capegateway.go.v.za

Ref.: SAMJ13022
A multicentre, cross-sectional study investigating the prevalence of hypertensive disease in patients presenting for elective surgery in the Western Cape, South Africa
South African Medical Journal

Dear Dr van der Spuy,

Reviewers have now commented on your paper. You will see that they are advising that you revise your manuscript.

For your guidance, reviewers' comments are appended below.

If you are prepared to undertake the work required, please submit a list of changes or a rebuttal against each point which is being raised when you submit the revised manuscript.

Your revision is due by Jan 16, 2018. Please let us know if you require additional time.

To submit a revision, go to http://samj.edmgr.com/ and log in as an Author. You will see a menu item called Submission Needing Revision.

Best wishes

Bridget Farham, PhD
Editor
South African Medical Journal

Reviewers' comments:

Reviewer's Responses to Questions

Please comment on your General impression of this manuscript - bear the following in mind:

Is the article relevant?

Does it offer anything new?

Are there similar studies in our region/outside the region?

Does it add to the existing medical body of knowledge?

On first glance, are the methods, results and conclusions reasonable?

Do the conclusions actually draw on the results?

Does the article have a clear message?

Will it help SAMJ readers make better clinical decisions and, if so, how?

Is a general medical journal the right place for it?

Reviewer #1: This is a well conducted study, and a well written paper.
There are important public health implications.

Please comment on the Methods and analysis presented in this manuscript

Study design

Is the research question and planned outcomes clearly defined?

Was the sample adequate and sufficiently described?

Are the methods adequately described and appropriate to the study objectives?

Statistical considerations

Are simple statistical methods applied appropriately?

Reviewer #1: Clear definitions, appropriate statistical approach
Suggested minor changes in Abstract, Introduction and Methods:
Abstract:
L 7: suggest "in younger patients" as opposed to "in younger patient groups"
L 33: 140 mmHg, ... (i.e. add comma)

Methods:
L 8: "compliance with"
L 15: "Ethics approval"
L 16: "written informed consent was sought"
L 22: "preoperative" one word throughout please
L 30: "Compliance with" throughout

Please comment on the Results, Discussion and Conclusions presented in this manuscript

Results

Is the population/sample adequately described?

Are the results clearly presented?

Are they credible and do they answer the research question?

Are tables clear and useful, not simply mirroring data discussed in the Results text?

Reviewer #1: Results well presented.
Minor changes suggested:
Results:
L 2: "state hospitals"
L 14: "patients, ..."
L 18: "mmHg, was"

Discussion

Are the results well discussed in light of previous evidence and the literature?

Are the limitations of the study sufficiently discussed?/ Are the strengths and weakness discussed?

Is the meaning and relevance of the study discussed?

Reviewer #1: Discussion good.
Minor changes:
Discussion:
L 26-27: "confidence that our results do reflect..."
L 53-54: "disproportionately high"
Page 7, L 7-8: "Guidelines, 30"
L 11: Reference says 2011? Would this not read better as "South African mortality statistics"?
L 12 Not sure what is meant by "hypertensive related"?
L15-16: This is a repeat of what has been said earlier in the Discussion, so please omit first sentence
L 25: "patients"

L 30: Please write out SASOS in full
L 35: "approximately 50%, and for ischaemic heart disease is 40%..."

Conclusion

Are the implications of the research summarised?

Do the authors make relevant recommendations for future research or application?

Reviewer #1: Minor changes suggested for Conclusions:
Suggest leave out last sentence before "Conclusions" and change as follows:
"Conclusion
We believe that in South Africa there is a significant potential for public health interventions in the perioperative period. In particular, we have demonstrated a unique diagnostic and therapeutic opportunity in patients with hypertension. Further research is needed into other co-morbidities such as anaemia and diabetes, where similar potential benefits may apply."

Reviewer #1: This is a well conducted study, and a well written paper.
There are important public health implications.

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UNIVERSITY OF CAPE TOWN

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9 January 2018

Prof Bridget Farham

Editor, *South African Medical Journal*
Email: em@editorialmanager.com

Dear Prof Bridget Farham

Revision:

Ref.: SAMJ13022
A multicentre, cross-sectional study investigating the prevalence of hypertensive disease in patients presenting for elective surgery in the Western Cape, South Africa

Thank you for the opportunity to submit a revised version of our manuscript for publication in the *South African Medical Journal*.

We agree with all suggested changes to our article, and have made all changes as requested.

I herewith submit *"Hypertension and Surgery Study – Revised"* for consideration for publication.

We thank you for giving us the opportunity to revise and resubmit our paper. We believe the reviewers' comments have improved our manuscript. Thank you for your interest in our submission.

Yours truly.

Karen van der Spuy (on behalf of all the authors)

Ref.: SAMJ13022
A multicentre, cross-sectional study investigating the prevalence of hypertensive disease in patients presenting for elective surgery in the Western Cape, South Africa
South African Medical Journal

Dear Dr van der Spuy,

We are pleased to tell you that your work has now been accepted for publication in South African Medical Journal.

Please note that as per the author guidelines, page-fee charges have been implemented since March 2017 for all research articles. Please find payment form attached herewith. As soon as proof of payment and the completed form have been received, we will send your article into production. Please send proof of payment to claudian@hmpg.co.za

Thank you for submitting your work to the journal.

Best wishes

Bridget Farham, PhD
Editor
South African Medical Journal

SAMJ
South African Medical Journal

Invoice Details - PLEASE PRINT CLEARLY	
Name:	KAREN VAN DER SPUY
Postal address:	15 UNION AVENUE
	PINELANDS
	CAPE TOWN
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Manuscript Details	Author Name	Author Details	Acceptance Date
SAMJ13022 - A multicentre, cross-sectional study investigating the prevalence of hypertensive disease in patients presenting for elective surgery in the Western Cape, South Africa	Karen van der Spuy	Registrar, Groote Schuur Hospital Anaesthesiology and Perioperative Medicine Anzio Road, Observatory Cape Town, Western Cape 7925 +27829285393 karenvdspuy@gmail.com	08 Jan 2018 TOTAL DUE: R5700 (Vat Incl.)

METHOD OF PAYMENT: EFT ☑ CASH DEPOSIT ☐

NB. Please note that if payments are made by cheque an extra R120 should be added to the publication fee in order to cover the cost of bank charges for cheque deposits.

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SAMJ RESEARCH ARTICLE guidelines:

Guideline word limit: 4 000 words

Research articles describe the background, methods, results and conclusions of an original research study. The article should contain the following sections: introduction, methods, results, discussion and conclusion, and should include a structured abstract (see below). The introduction should be concise – no more than three paragraphs – on the background to the research question, and must include references to other relevant published studies that clearly lay out the rationale for conducting the study. Some common reasons for conducting a study are: to fill a gap in the literature, a logical extension of previous work, or to answer an important clinical question. If other papers related to the same study have been published previously, please make sure to refer to them specifically. Describe the study methods in as much detail as possible so that others would be able to replicate the study should they need to. Results should describe the study sample as well as the findings from the study itself, but all interpretation of findings must be kept in the discussion section, which should consider primary outcomes first before any secondary or tertiary findings or post-hoc analyses. The conclusion should briefly summarise the main message of the paper and provide recommendations for further study.

Select figures and tables for your paper carefully and sparingly. Use only those figures that provided added value to the paper, over and above what is written in the text.

Do not replicate data in tables and in text .

Structured abstract

- This should be 250-400 words, with the following recommended headings:
  - **Background:** why the study is being done and how it relates to other published work.
  - **Objectives:** what the study intends to find out
  - **Methods:** must include study design, number of participants, description of the intervention, primary and secondary

outcomes, any specific analyses that were done on the data.
- **Results:** first sentence must be brief population and sample description; outline the results according to the methods described. Primary outcomes must be described first, even if they are not the most significant findings of the study.
- **Conclusion:** must be supported by the data, include recommendations for further study/actions.

- Please ensure that the structured abstract is complete, accurate and clear and has been approved by all authors.
- Do not include any references in the abstracts.

Here is an example of a good abstract.

Main article

All articles are to include the following main sections: Introduction/Background, Methods, Results, Discussion, Conclusions.

The following are additional heading or section options that may appear within these:

- Objectives (within Introduction/Background): a clear statement of the main aim of the study and the major hypothesis tested or research question posed
- Design (within Methods): including factors such as prospective, randomisation, blinding, placebo control, case control, crossover, criterion standards for diagnostic tests, etc.
- Setting (within Methods): level of care, e.g. primary, secondary, number of participating centres.
- Participants (instead of patients or subjects; within Methods): numbers entering and completing the study, sex, age and any other biological, behavioural, social or cultural factors (e.g. smoking status, socioeconomic group, educational attainment, co-existing disease indicators, etc)that may have an impact on the study results. Clearly define how participants were enrolled, and describe selection and exclusion criteria.
- Interventions (within Methods): what, how, when and for how long. Typically for randomised controlled trials, crossover trials, and before and after studies.
- Main outcome measures (within Methods): those as planned in the protocol, and those ultimately measured. Explain differences, if any.

Results

- Start with description of the population and sample. Include key characteristics of comparison groups.
- Main results with (for quantitative studies) 95% confidence intervals and, where appropriate, the exact level of statistical significance and the number need to treat/harm. Whenever possible, state absolute rather than relative risks.
- Do not replicate data in tables and in text.
- If presenting mean and standard deviations, specify this clearly. Our house style is to present this as follows:
- E.g.: The mean (SD) birth weight was 2 500 (1 210) g. Do not use the ± symbol for mean (SD).
- Leave interpretation to the Discussion section. The Results section should just report the findings as per the Methods section.

Discussion

Please ensure that the discussion is concise and follows this overall structure – sub-headings are not needed:

- Statement of principal findings
- Strengths and weaknesses of the study
- Contribution to the body of knowledge
- Strengths and weaknesses in relation to other studies
- The meaning of the study – e.g. what this study means to clinicians and policymakers
- Unanswered questions and recommendations for future research

Conclusions

This may be the only section readers look at, therefore write it carefully. Include primary conclusions and their implications, suggesting areas for further research if appropriate. Do not go beyond the data in the article.