Prevalence of modifiable risk factors in primary elective arthroplasty and their association with infections

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Background and purpose — The aim of this study was to identify the prevalence of modifiable risk factors of surgical site infections (SSI) in patients undergoing primary elective total joint arthroplasty (TJA) receiving conventional preoperative preparation, and to explore their association with infectious outcomes.

Patients and methods — Information regarding modifiable risk factors (anemia, diabetes, obesity, nutritional status, smoking, physical activity) was prospectively gathered in patients undergoing primary TJA of hip or knee in 2018–2020 at a single institution with 6 weeks' follow-up time.

Results — 738 patients (median age 68 years [IQR 61–73], women 57%) underwent TJA (knee 64%, hip 36%). Anemia was detected in 8%, diabetes was present in 9%, an additional 2% had undiagnosed diabetes (HbA1c > 47 mmol/mol), and 8% dysglycemia (HbA1c 42–47 mmol/mol). Obesity (BMI ≥ 30) was observed in 52%. Serum albumin, total lymphocyte count, and vitamin D below normal limits was identified in 0.1%, 18%, and 16%, respectively. Current smokers were 7%. Surgical site complications occurred in 116 (16%), superficial SSI in 57 (8%), progressing to periprosthetic joint infection in 7 cases. Univariate analysis identified higher odds of superficial SSI for BMI ≥ 30 (OR 2.1, 95%CI 1.2–3.8) and HbA1c ≥ 42 mmol/mol (OR 2.2, CI 1.1–4.2), but no association was found with other factors.

Conclusion — In a general population undergoing primary TJA an association was found between obesity (52%) and dysglycemia/diabetes (19%) and superficial SSI (8%), which progressed to PJI in 12% of cases, generating a 1% total rate of PJI. Modification of these risk factors might mitigate infectious adverse outcomes.

Superficial surgical-site infection (SSI) is a feared complication of total joint arthroplasty (TJA), occurring in 1–10% of cases. It may progress into periprosthetic joint infection (PJI), a devastating complication that occurs in between 0.5% and 2.4% of primary hip and knee TJAs (1,2). Several underlying medical conditions have been identified as independent risk factors for development of PJI that might be modified before operation (3). *Preoperative anemia* is present in up to 20% of patients undergoing elective TJA (4) and is associated with a higher rate of PJI, or 4.3% compared with 2% in non-anemic patients (3). *Diabetes mellitus* (Type I and II) has a prevalence of 8.5% worldwide (5) but may be present in up to 20% in patients undergoing TJA (6). The incidence of PJI for patients with diabetes is 1.6% and 2.2% after hip and knee arthroplasty compared with 0.7% and 0.5% in non-diabetic patients (3,7). *Obesity*, defined as body mass index (BMI) ≥ 30, carries increased risk for associated diseases, including diabetes (3) and osteoarthritis (8). The risk of PJI increases exponentially with increasing BMI (3) and PJI rates are reported to rise from 4.7% in patients with BMI > 40 to 9.8% if the patients are also diabetic, contrasted with 0.4% in patients with normal BMI (3,7). Laboratory screening of *nutritional status* in orthopedic surgery patients frequently includes serum albumin levels and total lymphocyte count (9) with risk of poor nutritional status associated with serum albumin level < 35 g/L, or total lymphocyte count < 1.5×10^9/L. Both are independent risk factors for PJI (3). Additionally, vitamin-D deficiency is more common among patients whose surgery is complicated by PJI (10). *Smoking* is a significant risk factor for postoperative wound complications with a rate of SSI of 1.8% for current smoking at the time of TJA compared with 1.3% and 1.1% in former smokers or nonsmokers, respectively. Cessation of smoking

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4–6 weeks prior to and after surgery decreases wound complications (3). Preoperative functional capacity and exercise are also considered an important predictor of postoperative outcome although their association with infectious outcome is unclear (11).

The primary aim of this study was to evaluate the prevalence of modifiable risk factors in patients undergoing primary TJA. The secondary aim was to assess their association with superficial SSI, with the purpose of creating a benchmark for interventional studies focusing on improving those factors.

Patients and methods

Study design, setting, and patient selection

This is a report of the control arm of a non-randomized open-label prospective quality control study evaluating outcome before and after an interventional effort to improve patient condition before TJA (Figure, see Appendix). All adult patients undergoing elective TJA who had received conventional preoperative preparation between August 2018 and September 2020 at Landspitali—the National University Hospital of Iceland in Reykjavik—were offered participation in the control arm of the study when visiting the hospital outpatient preoperative assessment clinic 1 week prior to surgery. 744 accepted and information on modifiable risk factors was gathered, additional blood tests were taken, and patients asked to answer a questionnaire regarding weight, anemia treatment, nutrition, smoking, physical activity, and involvement of healthcare providers in the months preceding the operation.

Procedure

Routine TJA at our institute are performed with spinal anesthesia; if not applicable, general anesthesia is administered. Prophylactic antibiotic treatment is provided with dicloxacillin, with the first dose given within 1 hour before surgery and repeated doses given 2 and 6 hours after surgery starts. Low molecular weight heparin is given as thromboprophylaxis, starting the evening before operation, and tranexamic acid is given during operation to decrease blood loss. Infiltration of ropivacaine at the surgical site is used for postoperative pain treatment in knee prosthesis patients. Drains are usually not inserted.

Clinical variables

Information was gathered regarding age, sex, smoking, comorbidities, type of surgery, type of anesthesia, ASA classification, laboratory values, blood transfusions, and length of stay.

Hemoglobin values were acquired 1 week prior to surgery and on the morning of the first postoperative day. Preoperative anemia was defined according to WHO's definition as a hemoglobin concentration of < 120 g/L and < 130 g/L in women and men, respectively (12), and divided into mild (110–120/130 g/L per sex), moderate (80–109 g/L), and severe (< 80 g/L).

A serum-glucose value was acquired 1 week prior to surgery and controlled on the morning of the 1st postoperative day. Patients were considered to have diabetes if they had received this diagnosis preoperatively or had a HbA1c level > 47 mmol/mol. Non-diabetic patients were considered to have dysglycemia if HbA1c was 42–47 mmol/mol and undiagnosed diabetes if HbA1c > 47mmol/mol.

Patients were asked through questionnaire at the preoperative visit to estimate what their weight had been when surgery was decided on, and subsequently they were weighed. BMI was classified according to WHO's definition: < 18.5 underweight, 18.5–24.9 normal weight, 25–29.9 overweight, 30–34.9 obesity class I, 35–39.9 class II, and ≥ 40 class III (13).

Patients who had serum albumin < 35g/L or lymphocyte count < 1.5×10^9/L (9) were considered to be at risk of malnutrition. Vitamin-D deficiency was defined as 25OHD concentration < 50 nmol/L (14).

Information regarding smoking was gained from a questionnaire and divided into those who had quit smoking > 1 year ago, > 6 months ago, > 6 weeks ago, and < 6 weeks ago.

Patients were asked via questionnaire about their level of physical activity when waiting for operation and use of prescribed physical activity from primary healthcare and physiotherapy (15). Physical activity was divided into 2 classes, 0–2 times per week and 3–5 times per week. Each occasion was graded from 1 to > 60 minutes.

First planned instance of patient follow-up occurred 2–3 weeks postoperatively at primary care for suture removal and evaluation of surgical site complications. A 2nd routine follow-up occurred at the hospital orthopedic outpatient clinic 6 weeks postoperatively. Patient records from both primary care and hospital were reviewed to identify whether diagnosis of SSI (superficial or deeper) had been set or other complications had appeared. Diagnosis of superficial SSI was set according to the Centers for Disease Control and Prevention (CDC) definition of superficial SSI when clinical features were mentioned in medical notes of peri-incisional pain or tenderness, localized swelling, erythema, or heat and if antibiotics had been prescribed (16). Other signs of surgical site complications were also recorded such as drainage, bleeding, dehiscence, and hematoma. Referral to the hospital was in some cases direct after such diagnosis or later if the patient was not responding to treatment. In cases of deeper SSI or PJI involving the fascia, muscle layers and prosthesis, diagnosis was made by orthopedic surgeons according to evidence-based and validated criteria of periprosthetic hip and knee infection and confirmed with 5 tissue cultures during surgery with debridement, antibiotics, and implant retention (DAIR operation) (17).

Statistics

Patient demographics were described as median (interquartile range [IQR]) for continuous variables, and number (percentage) for categorical variables. Mean and standard deviation (SD) were reported for normally distributed data. The number

Table 1. Patient characteristics. Values are count (%) unless otherwise specified

Patient characteristics	Overall (N = 738)	Missing
Age in years, median [IQR]	68 [61–73]	
Female sex	421 (57)	
BMI when operation decided		136 (18)
Median BMI [IQR]	31 [27–35]	
< 18.5	1 (0.1)	
18.5–24.9	76 (10)	
25–29.9	198 (27)	
30–34.9	188 (26)	
35–39.9	99 (13)	
40–44.9	30 (4)	
45–49.9	8 (1)	
≥ 50	2 (0.3)	
BMI at operation		1 (0.1)
Median BMI [IQR]	30 [27–34]	
<18.5	1 (0.1)	
18.5–24.9	94 (13)	
25–29.5	258 (35)	
30–34.9	238 (32)	
35–39.5	108 (15)	
40–44.9	33 (4)	
45–49.9	5 (0.7)	
≥5 0	0 (0)	
Patient comorbidities		11 (1)
Smoking	54 (7)	
Hypertension	401 (54)	
Ischemic heart disease	80 (11)	
Arrythmias	105 (14)	
Anticoagulation preop	78 (11)	
Congestive heart failure	13 (2)	
Lung disease	131 (18)	
Pulmonary embolism	7 (0.9)	
Deep vein thrombosis preop	10 (1)	
Diabetes	65 (9)	
Chronic renal failure	45 (6)	
Transient ischemic attack	48 (7)	
Neuro bleeding	5 (0.7)	
Inflammatory arthritis	50 (7)	
Depression	73 (10)	
Anxiety	43 (6)	
Cancer	78 (11)	
Type of operation		
Knee replacement	476 (65)	
Hip replacement	262 (35)	

Patient characteristics	Overall (N = 738)	Missing
Type of anesthesia		
Spinal	659 (89)	
General	79 (11)	
ASA classification		
Class 1	44 (6)	
Class 2	528 (72)	
Class 3	164 (22)	
Class 4	2 (0.3)	
Blood tests		
Hemoglobin, g/L, mean (SD)		
preoperative	141 (13)	2 (0.3)
postoperative	116 (13)	34 (5)
Hemoglobin dropp, mean (SD)	25 (11)	34 (5)
Anemia preoperative [a]	56 (8)	2 (0.3)
mild	47 (6)	
moderate	8 (1)	
severe	1 (0.1)	
Creatinine, μmol/L, mean (SD)		
preoperative	78.5 (23)	2 (0.3)
postoperative	81.4 (29)	34 (5)
Glucose, mmol/L, mean (SD)		
preoperative	6 (2)	13 (2)
postoperative	7 (1)	38 (5)
HbA1c, mmol/mol, mean (SD)		
preoperative	38.1 (8)	17 (2)
HbA1c, n (%)		
42–47 mmol/mol preoperative	52 (8)	
> 47 mmol/mol preoperative	13 (2)	
Albumin, g/L, mean (SD)	44 (3)	12 (2)
Lymphocytes < $1.5x10^9$/L, n (%)	129 (18)	2 (0.3)
Vitamin D nmol/L, mean (SD)	80 (34)	16 (2)
Vitamin D < 50 nmol/l, n (%)	121 (16)	16 (2)
Blood transfusions	19 (3)	
Days of stay, median [IQR]	1 [1–2]	
Postoperative complications		
≤ 6 weeks from operation		
Myocardial infarction	2 (0.3)	
Heart failure	3 (0.4)	
Pneumonia	7 (0.9)	
Transient ischemic attack	1 (0.1)	
Pulmonary embolism	3 (0.4)	
Deep vein thrombosis	3 (0.4)	
Kidney failure	11 (1)	

[a] Anemia severity: mild (110–120/130 g/L per sex), moderate (80–109 g/L) and severe (< 80 g/L)

of patients with a missing variable was reported, but variables were assumed to be missing at random.

A univariate association between the presence of the 5 modifiable risk factors and the presence of postoperative SSI was performed with logistic regression, estimating the odds and 95% confidence intervals (CI) of superficial SSI as a function of preoperative anemia, HbA1c ≥ 42 mmol/mol, BMI ≥ 30, smoking, vitamin D < 50 nmol/L, and physical activity.

As this was a descriptive study no assessment of power was performed prior to analysis.

All statistics were performed in R, version 1.3.1093 (Rstudio IDE) using Rstudio (R Foundation for Statistical Computing, Vienna, Austria).

Ethics, registration, funding, data sharing, and disclosures

The study was approved by the Science Committee of the Capital area's Primary Care and University of Iceland and by the Icelandic National Bioethics Committee (case number: VSN-18-098) and is registered at ClinicalTrials.gov (NCT05399186). This study was supported by grants from Landspitali Research Fund (A-2019-056, A-202-042, A-2021-036) and Research fund of Sigridur Larusdottir by University of Iceland. Data sharing is possible after reasonable request. The authors declare no conflict of interest. Completed disclosure forms for this article following the ICMJE template are available on the article page, doi: 10.2340/17453674.2023.8480

Table 3. Surgical site complications at 6 weeks follow up after operation. Values are count (%)

Surgical site complications	Overall (N = 738)	Missing
All	116 (16)	3 (0.4)
Superficial SSI	57 (8)	3 (0.4)
Drainage	58 (8)	3 (0.4)
Bleeding	42 (6)	3 (0.4)
Dehiscence	12 (2)	3 (0.4)
Limb hematoma	13 (2)	3 (0.4)
Periprosthetic joint infection	7 (1)	3 (0.4)
DAIR operation [a]	7 (1)	3 (0.4)

[a] DAIR = Debridement, antibiotics and implant retention

Table 4. Odds ratio (OR) and (95% confidence interval) of superficial SSI for patients with preoperative risk factors

Superficial SSI	OR (95% CI)	Missing
Preoperative anemia	0.91 (0.27–2.3)	2
HbA1c ≥ 42 mmol/mol	2.2 (1.1–4.2)	17
BMI at operation ≥ 30	2.1 (1.2–3.8)	1
Smoking	1.2 (0.41–3.0)	11
Vitamin D ≤ 50 mmol/L	0.85 (0.38–1.7)	16
Weekly motion ≤ 2	1.4 (0.73–2.6)	71

Results

744 patients accepted to participate but 6 were excluded (2 with contraindication to surgery and 4 had surgery in another joint). Thus, 738 patients, 69% of all eligible TJA patients, were included in the study (Figure, see Appendix). For patient characteristics, comorbidities, ASA classification, and anesthesia technique see Table 1, for results from questionnaires see Table 2 (see Appendix), and for postoperative surgical site complications see Table 3. Within 6 weeks postoperatively 26 (4%) patients had suffered other complications, but no deaths had occurred (Table 1).

The mean value of preoperative hemoglobin was 141 g/L (SD 13) but anemia was detected in 56 (8%) patients (Table 1) and 22 (3%) reported taking iron supplementation (Table 2, see Appendix). Perioperative blood transfusion was given to 19 (3%) patients with a median of 2 units (range 1–6) (Table 1), of whom 47% were anemic preoperatively.

The mean value of HbA1c was 38 mmol/mol (SD 8). A previous diagnosis of diabetes had been made in 65 (9%) of the patients. Among the non-diabetic patients, 52 (8%) had dysglycemia with HbA1c 42–47 mmol/mol and 13 (2%) patients had undiagnosed diabetes with HbA1c > 47 mmol/mol (Table 1).

At the time of decision for operation 44% of patients reported their BMI ≥ 30 according to the questionnaire. At the time of operation 52% had BMI ≥ 30 (Table 1).

The mean concentration of albumin was 44 g/L (SD 3) with 1 individual (0.1%) just below 35 g/L. The mean value of lymphocytes was 2×10^9/L with 129 (18%) having a count below 1.5×10^9/L. The mean value of Vitamin D was 80 nmol/L (SD 34) while 16% were below 50 nmol/L and considered deficient (Table 1).

Current smoking at the time of operation was reported by 54 (7%) of the patients (Table 2, see Appendix).

According to the questionnaire, 68% of patients had tried to increase their physical activity while waiting for surgery while motion occasions per week were estimated to be none by 15% of patients. Preoperative use of prescribed physical activity from primary healthcare occurred in 6% and 27% had received treatment by a physiotherapist (Table 2, see Appendix).

58 of the patients (8%) had visited a primary care physician preoperatively and 90 (12%) had received a consultation from a cardiologist (Table 2, see Appendix).

Surgical site complications occurred in 116 (16%) of the patients (Table 3), including superficial SSI in 57 (8%) and 7 of these progressed to PJI, generating a rate of 1% PJI. Reoperation due to PJI with debridement, antibiotics, and implant retention (DAIR operation) was performed in all 7. Cultures were taken in 49% of SSI cases, including all PJI, of which 64% were positive. Staphylococci were the pathogen in 95% of cases and Pseudomonas in 5%.

An exploratory secondary analysis was performed to assess the correlation between preoperative modifiable risk factors and postoperative superficial SSI. This revealed higher odds of superficial SSI for BMI ≥ 30 (OR 2.1, CI 1.2–3.8) as well as HbA1c ≥ 42 mmol/mol (OR 2.2, CI 1.1–4.2). No association was found with other factors (Table 4).

Discussion

In this study of patients undergoing primary TJA after conventional preoperative preparation the rates of several known modifiable risk factors for adverse infectious outcomes were in the lower range of previous studies but superficial SSI in the higher. An association was found between elevated BMI and HbA1c and superficial SSI.

In recent years the advantage of optimizing the patient's condition before an elective TJA has been emphasized for the benefit of the patient and healthcare systems (**3,18**). Selection of patients for such intervention and what methods to use are not clear though. Improvements in modifiable risk factors might be unobtainable in individual patients or the efforts required to attain a general modification of them and the amount of decrease in negative outcome so small that they are uneconomical. This study might lay the ground for evaluation of such interventional studies on preoperative optimization.

The patient group was comparable with other studies in regard to age, sex ratio, ASA classification, length of hospital stay, and ratio between total hip (36%) and total knee arthroplasty (64%) (**8,19**). Neuraxial anesthesia was used in

the majority of cases (89%), as generally recommended, but may vary between institutions (20).

The prevalence of preoperative anemia was 8%, considerably lower than the 15–30% reported in previous studies (4). However, only 3% had received treatment for anemia, suggesting that a preoperative blood management program could have been beneficial. The drop in hemoglobin at postoperative day 1 was 26 g/L and only 3% (19 patients) received blood transfusion, comparable with a recent study with the same drop in hemoglobin and a transfusion rate of 4% (21).

In our cohort 9% of the patients had been diagnosed with diabetes, which is slightly higher than the 8.3% in the general population of Iceland (22). Of the non-diabetic patients, 8% had dysglycemia and 2% had undiagnosed diabetes. The prevalence of diagnosed diabetes varies substantially between countries and therefore also in studies on TJA, or between 6% and 12%, as does undiagnosed diabetes, or up to 41% (23,24).

At the time of decision for operation, 44% of the patients self-reported their BMI as ≥ 30 but at operation 52% were measured with BMI ≥ 30. It is questionable how reliably individuals estimate their own weight, but the information possibly points to weight gain during wait for operation. The distribution of BMI classes at operation was comparable with a recent study from the USA (25). Guidelines support weight reduction to decrease risk of PJI, but there is no consensus on what method to use to induce weight loss (18,26).

The prevalence of poor nutritional status estimated by low levels of albumin and lymphocytes was very infrequent compared with previous studies (9,10), pointing towards a good nutritional status of the patients in general, except that 16% were defined as being vitamin-D deficient, ranging from 13–80% in the USA with prevalence of 42% (10).

The prevalence of smoking was reported by the patients to be 7%, which is the same as in society in general (27); 39% had stopped smoking > 1 year ago and 3% within a year but missing data were noted from 59%.

Two-thirds of the patients reported that they had tried to increase their physical activity during the wait for operation and half exercised 3–5 times per week, but 15% reported no motion at all. Utilization of prescribed physical activity from primary health care (15) followed by digital communication and physiotherapy was relatively low. It therefore seems that the general physical status of patients could be improved with more purposeful pre-habilitation (Tables 4 and 2, see Appendix) (11).

Surgical site complications were identified in 16% of the patients, which is higher than in previous reports of 5.5–14.3% (28), although definitions likely vary.

Superficial SSI occurred in 8%, which is higher than the 1% to 2.5% reported from the USA (29) but similar to the 7% in Sweden (1). We identified an association with elevated BMI and HbA1c. With the high number of patients with BMI ≥ 30 and patients with elevated HbA1c without a diagnosis of diabetes (Tables 1 and 4), perhaps targeting these risk factors would be most likely to result in a reduced rate of SSI.

Superficial SSI progressed to PJI in 7 of 57 (12%) cases, which is lower than in a recent report from Sweden where the progression rate was 29%. However, their follow-up time was slightly longer than was used in our study (1).

PJI occurred in 7 patients (1%), 5 total knee and 2 total hip arthroplasties, which is within the range as compared with other studies or 0.5–2.5% and with the 1.45% PJI rate recently reported from the Swedish Knee Arthroplasty Register (2,30). All progressed from superficial SSI, and reoperation with debridement, antibiotics, and implant retention (DAIR operation) was necessary in all cases.

Examination of the surgical wound and removal of sutures occurred 2 weeks after the operation at primary care. This was, though, changed at the end of the study as orthopedic surgeons became aware of the high incidence of superficial SSI after a preliminary report from the study, and the last 17 patients in the knee arthroplasty group were followed up at the hospital outpatient clinic. None of those were diagnosed with a superficial SSI, which might indicate a difference in interpretation of infectious signs or improved performance of orthopedic surgeons. A visit to the hospital orthopedic outpatient clinic for clinical evaluation 6 weeks after operation occurred in 99% of cases. For the remaining 1% information at 6 weeks postoperatively was gathered from medical notes, either from primary care or hospitals and rehabilitations centers where patients had been admitted, so no patient was lost to follow-up.

Limitations

The foremost limitation of the study is a rather low number of patients, causing a challenge to identify modifiable risk factors of SSI. Also, the follow-up time of 6 weeks is rather short allowing only study of acute development of PJI.

Strengths

The main strength of this study is detailed prospective gathering of data, thorough follow-up and very low ratio of missing clinical data. No selection was performed due to health status or comorbidities and a high ratio of eligible patients (69%) were included. The demographics of the patient group are similar to other studies, allowing the results to be compared with them.

Conclusion

In this study of a general population undergoing primary TJA after conventional preoperative preparation the prevalence of several known modifiable risk factors was generally in the lower range and deviations in these not as severe as in previous reports. However, obesity was present in 52% and dysglycemia and diabetes together in 19%. An association was found between obesity (BMI ≥ 30) and elevated HbA1C (> 42 mmol/mol) and superficial SSI (8%), which progressed to PJI in 12% of cases, generating a 1% total rate of PJI in the patient group after 6 weeks' follow-up. This may indicate that focus on these modifiable risk factors might mitigate infectious adverse outcomes after primary TJA.

This study will lay the ground for an interventional study of preoperative improvement before TJA.

MS: study initiation and design, data collection, data analysis, manuscript writing. MIS: data analysis, interpretation of data, manuscript writing. YO: study design, manuscript writing. SHS: inclusion of patients, manuscript writing. IG: study design, interpretation of data, manuscript writing. ELS: interpretation of data, manuscript writing. SK: Study initiation and design, data analysis and interpretation, manuscript writing.

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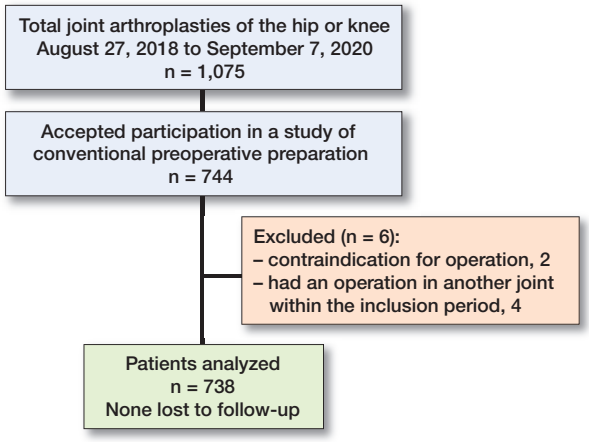
Appendix



Consort flow diagram.

Table 2. Answers to questionnaire at preoperative visit. Values are count (%)

Answers	Yes	Not applicable	Missing
During wait for surgery have you been informed of following health factors and possible influence of them on the outcome of the operation?			
Weight	321 (44)	130 (18)	21 (3)
Motion	381 (52)	112 (15)	18 (2)
Nutrition	281 (38)	138 (19)	27 (4)
Smoking	182 (25)	320 (43)	27 (4)
Still smoking at time of surgery	54 (7)		11 (2)
Anemia	83 (11)	257 (35)	59 (8)
During wait for surgery have you tried to influence the following health factors?			
Weight	440 (60)	54 (7)	31 (4)
Motion	500 (68)	45 (6)	27 (4)
Use of primary care prescribed physical activity	42 (6)		486 (66)
physiotherapy	201 (27)		388 (53)
Motion incidences/week			71 (10)
0	114 (15)		
1	49 (7)		
2	131 (18)		
3	158 (21)		
4	93 (13)		
≥ 5	122 (17)		
Motion length, minutes			78 (11)
0	101 (14)		
0–20	117 (16)		
20–40	200 (27)		
40–60	170 (23)		
> 60	72 (10)		
Nutrition	440 (60)	57 (8)	34 (5)
Smoking	102 (14)	450 (61)	66 (9)
Still smoking at time of surgery	54 (7)	11 (2)	
If previous smoker when did you quit?			434 (59)
< 6 weeks	6 (0.8)		
6 weeks to < 6 months	6 (0.8)		
6 months to < 1 year	6 (0.8)		
≥ 1 year	286 (39)		
Anemia (treatment with iron)	22 (3)	323 (44)	90 (12)
During wait for surgery have you been in contact with other health care providers?			
Cardiologist	90 (12)	147 (20)	77 (10)
Pulmonologist	25 (3)	180 (24)	90 (12)
Diabetologist	14 (2)	206 (28)	90 (12)
Nephrologist	9 (1)	207 (28)	93 (13)
Primary care	58 (8)		102 (14)