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Efficacy of a weight loss program prior to robot assisted radical prostatectomy in overweight and obese men with prostate cancer.

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ABSTRACT

Background:

Obesity in prostate cancer patients is associated with poor prostate-cancer specific outcomes. Exercise and nutrition can reduce fat mass; however, few studies have explored this as a combined pre-surgical intervention in clinical practice.

Purpose:

This study examined the efficacy of a weight loss program for altering body composition in prostate cancer patients prior to robot assisted radical prostatectomy (RARP).

Methods:

A retrospective analysis of 43 overweight and obese prostate cancer patients, aged 47 to 80 years, who completed a very low-calorie diet (~3000-4000kJ) combined with moderate-intensity exercise (90minutes/day) prior to RARP. Whole body and regional fat mass (FM) and lean mass (LM) were assessed by dual-energy x-ray absorptiometry pre- and post-program. Body weight, waist circumference, and blood pressure were assessed weekly, with surgery-related adverse effects recorded at time of surgery and follow-up appointments.

Results:

With a median of 29 days (IQR: 24-35days) on the program, patients significantly ($p<0.001$) reduced weight (-7.3 ± 2.9kg), FM (-5.0 ± 2.6kg), percent body fat (-3.1 ± 2.5%), trunk FM (-3.4 ± 1.8kg), LM (-2.4 ± 1.8kg), and appendicular LM (-1.2 ± 1.0kg). Lower weight, FM, percent FM, trunk FM, and visceral FM were associated with less surgery-related adverse effects (r_s=0.335 to 0.468, $p<0.010$). Systolic and diastolic blood pressure were reduced ($p<0.001$) by 15 ± 22 and 8 ± 10 mmHg, respectively over the weight loss intervention.

Conclusion:

Undertaking a combined low-calorie diet and exercise program for weight loss in preparation for RARP resulted in substantial reductions in FM, with improvements in blood pressure, that may benefit surgical outcomes.

Words: 249

Key Words: Radical prostatectomy; prostate cancer; weight loss.

1.0 INTRODUCTION

Reducing obesity is of critical interest when considering prostate cancer patients' tolerance and response to treatment as well as their long-term health outcomes [1]. Radical prostatectomy is a common surgical treatment for prostate cancer, however, obesity status places a patient at increased risk of poor surgical and prostate-cancer specific outcomes [2, 3]. During surgery, obese patients are at increased risk of longer operation time and higher blood loss, as well as central nervous system and head and neck complications due to excessive peak expiratory airway pressure while in the Trendelenburg position, with complications such as pneumoperitoneum [2, 4, 5]. The surgical technique may also be impacted, with obese patients reported to be at increased odds of capsular incision (inferior surgical technique), and a higher risk of converting to an open prostatectomy [6]. Post-surgery, obese patients may experience inferior urinary and sexual outcomes, increased risk of post-operative infection, lymphedema, and positive surgical margins [2, 6, 7]. Furthermore, there is a strong level of evidence for the association of obesity and increased risk of aggressive prostate cancer [8], as well as an increased risk of biochemical recurrence, reduced time to the development of castrate resistance, development of other comorbidities such as cardiovascular disease (CVD), and earlier prostate cancer-specific death [1, 9-14].

Lifestyle medicine is the inclusion of non-surgical and non-pharmaceutical therapies, such as exercise and nutrition, within a patient's treatment plan to prevent the development, or worsening, of side effects and chronic medical conditions such as obesity [15, 16]. While one third of prostate cancer patients are likely to make lifestyle changes upon receiving a cancer diagnosis [17], the substantial amount of clinician contact at diagnosis represents an opportune time to implement a clinically delivered lifestyle medicine weight loss intervention. This ensures patients can be monitored collaboratively by medical and allied health (exercise and nutrition) professionals to provide a tailored prescription to achieve the desired outcome of

healthy intentional weight loss [18], a reduction in fat mass (FM) and maintenance of lean mass (LM). The majority of previous pre-surgical studies in men with prostate cancer have assessed physiotherapy-led programs focusing on a particular disease-specific outcome, such as urinary incontinence [19-22], or utilised exercise or nutrition strategies in isolation [23-25]. Only two randomized controlled trials have examined weight loss using a combined exercise and nutrition intervention prior to radical prostatectomy but results were inconsistent. Demark-Wahnefried et al. [26] demonstrated no significant change in FM or LM compared to a usual care control group, however, the intervention group did experience a substantial reduction in FM (3.1 kg), although within group significance was not reported. Henning et al. [27] reported a significant reduction in total and gynoid fat with no change in trunk FM compared to a usual care control. Both studies were controlled research trials, rather than the evaluation of weight loss achieved in clinical practice pragmatically recommended by a clinician as part of their pre-surgery standard of care.

Clinically, it is important to quantify both FM and LM alterations with weight loss induced by combined exercise and nutrition interventions, as substantial loss in LM may negatively impact physical function, patient independence, and long-term weight maintenance [28]. Except for monitoring bone health, assessment of body composition by dual-energy x-ray absorptiometry (DXA) in a clinical setting is not often performed, ‘nor considered a part of standard practice when weight loss is advised. The use of total body weight, body mass index, and waist/hip circumference are considered satisfactory indicators of positive FM change; however, these do not accurately identify changes in body composition [29] ‘nor differentiate between subcutaneous and visceral fat reductions. Here we report a retrospective analysis of the effect of a weight loss program in prostate cancer patients prior to robotic assisted radical prostatectomy (RARP) surgery using DXA to assess change in body composition.

2.0 METHODS

2.1 Patients

Between 2016 and 2018, 78 men with prostate cancer attending a single urology clinic in Perth, Western Australia, were referred by a single urologist, prior to RARP, to an external allied health clinic specialising in exercise and nutrition programs for persons with chronic conditions including cancer. Patients undertook a weight loss program supervised by certified allied health professionals (Accredited Practising Dietitian (APD) or Accredited Exercise Physiologist (AEP)) prior to receiving a RARP. The urologist referred patients who were overweight or obese, as defined by a waist circumference ≥ 94 cm [30] at the initial consultation following a confirmed prostate cancer diagnosis. Of the 78 patients referred to the weight loss program, a pre or post DXA scan was not available for 32 patients (declined scan, insufficient time before surgery) and 3 patients did not undertake a RARP. As a result, 43 patients were included in the analysis. The study was approved by the Human Research Ethics Committee at Edith Cowan University (ID: 18832).

2.2 Measurements

Body composition was assessed by DXA at the initial and final nutrition consultations prior to RARP. Body weight, waist circumference, and systolic and diastolic blood pressure were monitored at weekly scheduled appointments with an APD or AEP.

2.2.1 Body composition

Whole body fat mass (FM, kg), lean mass (LM, kg), and body fat percent (%), and regional trunk FM (kg), visceral FM (g), and appendicular skeletal muscle (ASM, kg) were assessed by DXA (Horizon W, Hologic Inc., Waltham, MA, USA). ASM was calculated as the sum of upper and lower limb LM [31]. Visceral FM estimated from DXA scanning has been shown to be strongly associated with that derived from computed tomography [32].

2.2.2 Anthropometric and blood pressure measures

Body weight was measured using a calibrated electronic weight scale (Model #22089, SECA, Germany) and height using a wall-mounted stadiometer (Livingstone International Healthcare Pty Ltd, Australia), with body mass index (BMI) calculated from weight divided by height in meters squared (kg/m^2). Waist circumference was measured following standard procedures [33]. Systolic and diastolic blood pressure were measured using a sphygmomanometer (Model #HEM-907, Omron, Japan) with the patient in a seated position after a minimum of 15 minutes of conversing with an APD.

2.2.3 Surgical outcomes

Written medical notes from the patient's urologist were reviewed to determine the number and type of adverse side effects recorded during and up to 1-month post RARP (identified by the urologist as undesirable events during and post-surgery). Erectile dysfunction was not considered a side effect if it was evident pre-surgery. Incontinence was defined as an ongoing concern up to 1-month post-surgery with patients continuing to use at least one continence pad daily [34].

2.3 Data collection process

Data used in the analysis were obtained from the urology clinic and allied health clinic. At the initial consultation with the urologist, patients provided consent for their information to be used in future research projects. A secondary consent form was also completed at the initial consultation at the allied health clinic. Patient age (years), cancer stage (TNM), smoking status (yes/no), alcohol intake (number of standard drinks/day), medications, comorbidities, information related to the surgical procedure and side effects were obtained from the urology clinic, while DXA scans were obtained from the allied health clinic. Records from nutrition

consultations were also reviewed, providing information on weekly measurements of weight, waist circumference, and blood pressure.

2.4 Weight loss program

The weight loss program was a collaborative initiative between the urology clinic and allied health clinic to ensure safe practice of rapid weight loss required for surgery. Patients were referred by their urologist to the external allied health clinic where they attended weekly appointments. The program was part of the urology clinic's standard of care for overweight and obese patients prior to RARP and designed to induce rapid weight loss by reducing FM, yet maintaining LM, while meeting exercise and micro- and macronutrient requirements. Patients participated in the program for up to 12 weeks, although this was dictated by surgery date, client willingness to continue with the program, or target weight being reached. The standard clinic protocol required patients to begin losing weight before a surgery date was scheduled, however, prostate cancers that showed aggressive signs requiring immediate attention were scheduled for surgery without evidence of weight loss. Nevertheless, these patients were still required to initiate the program prior to surgery. Compliance to exercise and diet were monitored through attendance of nutrition consultations with APD, where a weekly weigh-in was completed to ensure patients were consistently losing weight. Barriers to completing exercise and diet and continued encouragement to comply with program guidelines were also addressed during weekly sessions using behaviour change techniques such as motivational interviewing and cognitive behavioural therapy. In addition to implementing exercise and nutrition changes, the clinic protocol required patients who smoked to cease.

Patients were prescribed 90 minutes of moderate intensity aerobic exercise to complete daily at 60-80% of their age-predicted maximum heart rate (using the formula: 220 - age), if patient owned a wearable heart rate monitor, or at an intensity where they could still hold a

conversation. Intensity was not recorded. Moderate intensity aerobic exercise was chosen to minimise injury risk, optimise compliance, and maximise caloric expenditure over the pre-operative period. Resistance training was not required, although it was permitted if a patient had been undertaking this exercise mode prior to referral to the clinic. The exercise prescription was personalised to patient preference for aerobic type and target duration (example one: three, 30-minute bouts of walking per day; example two: 90 minutes of cycling per day; example 3: 30 minutes of swimming and 60 minutes of walking per day). Patients were provided access to fitness facilities under the supervision of an AEP while undertaking the program, or if they preferred, patients could perform exercise at home, outdoors, or their own local recreational facility.

An APD prescribed a very low-calorie diet of ~3360 - 4200 kJ consumed per day consisting of the following recommendations: 1) 3 very low-calorie diet meal replacement products consisting of shakes, bars, or soups (KicStart; Optifast; Dr MaCleod's) consumed throughout the day according to the preferred eating pattern of the patient (example one: 1 product for breakfast, 1 for lunch, 1 for dinner; example two: 1 product for breakfast, ½ product mid-morning, ½ product lunch, ½ product dinner, ½ product after dinner); 2) at least 2 cups of low starch vegetables (defined as < 4g carbohydrate per 100g) or salad per day; 3) optimisation of fluid intake calculated based on body weight [35]; and 4) optimisation of daily protein (1.0 - 1.07 g/kg body weight/d according to age related recommendations) (from late 2017 only) [35]. Additional permitted food and drink items included miso soup or low starch vegetable soups (excluding soups with cream), sauces in small amounts, herbs and spices, sugar free lollies and gum, diet jelly, artificial sweeteners, lemon and lime juice, tea/coffee with no sugar and minimal milk, diet soft drink, and diet cordial. Patients were instructed to refrain from consuming all other foods and drinks with emphasised restriction on fruit juice, alcohol, and sugar-sweetened drinks. Patients continued with this nutrition program until their scheduled

surgical appointment at which time nutrition advice was provided by the urologist for how to prepare for surgery.

2.5 Statistical analysis

Statistical analyses were conducted using IBM SPSS version 25 (SPSS Inc., IBM Corp, Armonk, NY, USA). Normality of the distributions were assessed using the Kolmogorov-Smirnov test. To examine differences pre- to post-intervention Student's paired t-tests were used or the Wilcoxon signed-rank test, as appropriate. Associations between variables were assessed using Pearson's correlation or Spearman's rank correlation, as appropriate. Data are presented as mean ± standard deviation (SD), median and interquartile range [IQR], or number (percentage). Tests were two-tailed and statistical significance was set at $p < 0.05$.

3.0 RESULTS

Forty-three men aged 47 to 80 years were included in the analysis and their clinical characteristics are presented in Table 1. The majority of men had a Gleason score of 7 (76.7%), had their cancer contained within the prostate (86.0%), and a BMI range of 23.9 – 37.9 kg/m^2; no patients were current smokers. Patients spent a median [IQR] of 29 [24 - 35] days undertaking the weight loss program as indicated by number of days between DXA scans. This included a median [IQR] of 5 [4 - 6] nutrition consultations with 81.4% of patients attending all scheduled weekly appointments. The most common reasons for missing an appointment were holiday or work.

There were significant ($p < 0.001$) declines in FM (-5.0 ± 2.6 kg), percent body fat (-3.1 ± 2.5%), trunk FM (-3.4 ± 1.8 kg), visceral fat (-297 [375 – 245] g), LM (-2.4 ± 1.8 kg), and ASM (-1.2 ± 1.0 kg) from pre to post DXA scans (Table 2). Of the loss in FM, 68.5% of the reduction was the result of trunk FM loss. Individual responses to the program are shown in Figure 1. All patients lost total FM and trunk FM with only 5 patients (11.6%) showing an

increase in LM or ASM. Patients with a higher body weight at program initiation experienced a greater loss in weight, ASM, and LM ($r = -0.563$ to -0.727, $p < 0.001$), however, there was no association with loss in total FM ($r = -0.136$, $p = 0.386$), trunk FM ($r = -0.035$, $p = 0.824$). Further, age was not associated with any baseline body composition measure ($p = 0.098$ – 0.530) or change in body composition ($p = 0.112$ – 0.920). Based on BMI at baseline, 4 patients were considered 'normal weight', however, they attained a similar magnitude of loss in FM (-4.9 ± 2.7 kg) but less change in LM (-0.6 ± 1.3 kg) when compared to the values for all patients.

Total body weight (-7.3 ± 2.9 kg), BMI (-2.4 ± 0.9 kg/m^2), waist circumference (-8.3 ± 3.4 cm), systolic (15 ± 22 mmHg) and diastolic (-8 ± 10 mmHg) blood pressure all decreased significantly ($p \leq 0.001$) over the course of the diet and exercise program (Table 2). Those patients on the program for longer and who attended a greater number of consultations with the APD experienced a greater loss of body weight ($r_s = 0.669$; $p < 0.001$; $r_s = 0.436$; $p = 0.003$, respectively).

The most common adverse effects of surgery were urinary incontinence (67.4%) and erectile dysfunction (32.6%), followed by lymphedema (11.6%) (Table 3). Patients who experienced a higher number of surgery-related adverse effects also had higher body weight, FM, body fat percent, trunk FM, and visceral FM ($r_s = 0.335$ to 0.468, $p < 0.010$) post-intervention, prior to RARP. Change in FM and LM, and age were not associated with surgery-related adverse effects. There were no major adverse events recorded as a result of the dietary or exercise intervention. Minor adverse effects associated with the diet included hunger, headache, change in bowel habits, and light-headedness.

4.0 DISCUSSION

To our knowledge, this is the first evaluation of a weight loss program conducted as part of standard care procedures for overweight and obese patients prior to RARP within clinical practice. There were four important findings: 1) total body and regional FM were

significantly decreased, 2) lower absolute FM was associated with reduced number of surgery-related adverse effects, 3) decrease in FM was accompanied by a reduction in LM, and 4) improvements in blood pressure were observed.

Significant reductions in FM around the surgical region is of clinical significance as it provides a promising setting for a less complicated surgery [6, 2, 36]. We found a significant 16.3% reduction in total FM with an average loss of 5.0 ± 2.6 kg. The majority of this fat was lost in the abdominal region where nearly 80% was attributable to trunk and visceral fat with a resulting 8.3 ± 3.4 cm reduction in waist circumference. Henning et al. [27] completed a similar weight loss program in men prior to prostatectomy that consisted of an energy restricted diet (consuming 5000 - 6000 kJ/day) and 60 minutes of exercise per day, and found a significant reduction in total FM of 2.1 kg and gynoid fat by 1.4%, compared to a usual care control group. The more than 2-fold greater loss in FM achieved in our cohort and in a shorter period (29 vs. 51 days) was likely due to the more severe caloric restriction (~3000 - 4000 kJ/day) and greater amount of exercise (90 minutes/day) prescribed. However, in one pre-radical prostatectomy weight loss program [26], an increase in Ki67, a marker of tumour cell proliferation, in the intervention group compared to usual care was noted. Although the intervention group did reduce their FM by -3.1 ± 2.2 kg and LM by -1.2 ± 1.0 kg, this was not significantly different to the usual care control group, and no within group significances were reported. Consequently, the implications of this finding regarding tumour cell proliferation in response to rapid weight loss requires further examination.

With the substantial reduction in FM, it appears that those patients with lower central and subcutaneous FM at the time of surgery experienced less surgery-related adverse effects during and following the procedure. This relationship must be carefully interpreted as although statistically significant, it was not the primary aim of this analysis and could not be compared to a BMI-matched, non-weight loss control group. As such, this finding should be considered

as hypothesis generating where further research should assess the benefits of weight loss on both acute and long-term surgery-related adverse effects inclusive of the effect weight loss has on cancer progression. However, in support of our findings Knipper et al. [7] in a study evaluating clinical outcomes of obese (BMI $\geq$ 30 kg/m^2) versus non-obese prostate cancer patients undergoing RARP or open-radical prostatectomy, also reported that obese patients had more complications peri-operatively for both surgical techniques. Additionally, older men receiving surgery are also at a higher risk of surgical complications [37]. Despite the broad age range (47-80 years) in the present study, age was not associated with number of surgery-related adverse events.

While the loss in FM in the current study was substantial, patients also lost a significant amount of LM (-2.4 ± 1.8 kg; 32% of total weight lost), despite the inclusion of an exercise requirement, albeit without emphasis on resistance training, and increased dietary protein intake. This is a concern given that patients post-surgery have been observed to lose LM as well. For instance, Singh et al. [25] reported that patients had a mean loss of 2.7 kg in LM 6-weeks post-prostatectomy. The loss in LM has been associated with poor long term weight management, longer hospital stays, increased risk of infection, and surgical complications [38, 39, 28]. The lack of monitored exercise via a written log, heart rate, or pedometer, or a supervised exercise component that included resistance exercise for all patients, are possible explanations for the significant loss in LM found in the current study compared to no loss in other pre-radical prostatectomy weight loss studies [27, 26]. Nevertheless, excess weight can act as a barrier to exercise for many individuals [40]. Therefore, despite the significant loss in LM, the act of rapidly losing weight may act as a facilitator and provide patients with increased confidence and self-motivation to continue or start an exercise program post-surgery, and contribute to increasing LM and maintaining a healthy weight [18, 41]. Consequently, the benefits of losing an average of 5 kg in FM may outweigh the negatives of the absolute loss in

LM. Long-term survivorship goals for prostate cancer patients who have undergone weight loss prior to RARP should therefore focus on increasing LM and transitioning to a sustainable diet and exercise regimen after recovery from surgery.

Weight loss is commonly accompanied with a reduction in blood pressure, another risk factor associated with CVD development [42]. Clinically significant reductions were evident in both systolic and diastolic blood pressure, similar to reductions obtained by medication [43]. A minimum 10 mmHg reduction in systolic blood pressure has been shown to reduce the occurrence of a cardiovascular event by 20% [44]. Although the baseline mean brachial systolic blood pressure was not considered hypertensive, patients were commonly taking prescribed blood pressure medication. Blood pressure control is also necessary for safe surgery. Sudden or prolonged hypo- or hypertension pre-, during- or post-surgery can place a patient at increased risk for longer hospitalisation, myocardial injury, and all-cause mortality [45-47]. For elective surgeries, a pre-surgery systolic blood pressure >180 mmHg, and/or consistent systolic blood pressure ≥160 mmHg in the primary care setting may result in postponement of surgery, although this is controversial [45, 48]. No participant had a systolic blood pressure ≥ 160 mmHg after the weight loss program, compared to 4 patients prior. Clinician communication was that many patients were able to cease antihypertensive medication, under the care of their general practitioner. This was not managed by the treating urologist and was, therefore, not recorded in this study. However, the cost savings from cessation of medication could offset the cost of a weight loss program conducted in the clinical setting and would be an interesting avenue for further research. Nevertheless, given the significant reduction in blood pressure observed, it is important that a patient’s blood pressure management plan is monitored by their general practitioner during rapid, pre-surgery weight loss as medications may need to be altered. This further highlights the importance of a multidisciplinary team when undertaking weight loss.

Our analysis has several strengths. The utilisation of DXA scans demonstrated clinically relevant changes in FM and its distribution that can occur between diagnosis and surgery. This multidisciplinary, clinically run program resulted in a high level of patient engagement and adherence with over 80% of patients attending all scheduled appointments and all patients losing FM. However, there are several limitations which must be acknowledged. The absence of a control group prevented the ability to make comparisons to a non-weight loss group (current standard care). Patients were given the choice to complete a self-directed exercise and nutrition regime post-surgery, which did not include follow-up body composition measures, or continue with a supervised programme. The majority of patients selected self-directed lifestyle changes post-surgery, as such, follow-up body composition data were not available. Not all patients completed the final DXA close to their surgery date, therefore, the post-program DXA scans may not reflect body composition at time of surgery. It should also be noted that DXA may not be readily accessible to clinicians and patients due to the cost involved of the equipment and for some patients, such as the morbidly obese, DXA scanning may not be suitable. All data were collated from clinical notes designed to satisfy information on health status for the attending practitioner. As such, the patients' compliance to exercise and nutrition requirements, as well as their physical function and quality of life, were not assessed by questionnaire but in conversation during the weekly nutrition consultation where weigh-ins showed consistent weight loss suggesting patients made significant lifestyle changes. Future studies should collect compliance data to better establish pre-surgery weight loss guidelines. Further, the intervention emphasis was on creating a large energy deficit with fat loss as the primary goal, however, this compromised LM which is a negative outcome. Whether, LM can be maintained or enhanced through targeted resistance training incorporated into the intervention needs to be determined.

4.1 Conclusion

In summary, this study completed within clinical practice demonstrated the efficacy of a significant reduction in FM, with additional improvements in blood pressure, while undertaking a weight loss program prior to RARP. Obese patients are at high risk of poor surgical outcomes as well as comorbidity development and weight lost prior to RARP may be a viable strategy to improve patient outcomes and comorbidity risk profile. Future interventions should address this through incorporating supervised resistance training and optimisation of protein intake to help minimise the loss of muscle and increase protein metabolism. Future research should consider the translation of this clinically undertaken weight loss program as it could be impactful in other obese populations with chronic diseases, especially those who are morbidly obese. Consideration should also be given to exploring the effect that improving obesity status pre-surgery has on radical prostatectomy side effects and recovery, long-term health benefits and diet and exercise behaviours, and cancer progression and recurrence.

CRediT author statement:

Rebekah L. Wilson: Formal analysis, investigation, data curation, writing – original draft, visualisation

Tom Shannon: Conceptualization, methodology, resources, writing – review and editing, project administration,

Emily Calton: Conceptualization, methodology, resources, writing – review and editing,

Daniel A. Galvão: Writing – review and editing, supervision

Dennis R. Taaffe: Writing – review and editing, supervision

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Philippa Lyons-Wall: Writing – review and editing, supervision

Robert U. Newton: Writing – review and editing, supervision

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Ethical approval: Ethical approval was gained from Human Research Ethics Committee at Edith Cowan University (ID: 18832). All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent: Two informed consent forms were obtained from all individual participants included in the study after attending the urology clinic and allied health clinic, respectively.

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Table 1. Patient characteristics.

Variable	Patients (N = 43)
Age (years), mean ± SD	66 ± 7
Height (m), mean ± SD	1.78 ± 0.07
Total body weight (kg) mean ± SD	91.7 ± 12.5
Daily alcohol intake (number of standard drinks/day), median [IQR]	2 [0 – 2]
Number of medications, median [IQR]	3 [1 – 4]
Number of comorbidities [a], median [IQR]	2 [0 – 3]
Number of nutrition consultations, median [IQR]	5 [4 – 6]
Days between pre/post DXA scan, median [IQR]	29 [24 - 35]
Days between post DXA and surgery, median [IQR]	7 [2 - 21]
Gleason score, N (%)	
Gleason 7	33 (76.7)
Gleason 8	2 (4.7)
Gleason 9	8 (18.6)
T stage 2, N (%)	21 (48.8)
T stage 3, N (%)	16 (37.2)
Positive lymph involvement, N (%)	6 (14.0)
Radical prostatectomy [b], N (%)	26 (60.5)
Radical prostatectomy + lymph node resection [b], N (%)	17 (39.5)
Adjuvant radiation and androgen deprivation therapy, N (%)	1 (2.3)
Positive surgical margins (n = 39) [c], N (%)	2 (5.1)

[a] Type of comorbidities: Arthritis, chronic obstructive pulmonary disease, CVD, depression/anxiety, diabetes, dyslipidaemia, gastroesophageal reflux disease, glaucoma, other cancer, Peyronie's disease, peripheral neuropathy, sleep apnoea, thyroid condition. [b] A total of 23 (53.5%) surgeries involved full or partial nerve sparring, with a further 1 (2.3%) including an umbilical hernia repair. [c] Four patients did not have surgical margin data recorded, rendering n=39 patients' data available for inclusion.

Table 2. Body composition, anthropometric, and blood pressure measures of prostate cancer patients undergoing weight loss pre-RARP.

	Pre-intervention	Post-intervention	Mean change	P-value
DXA derived measures				
Total body weight (kg)	91.7 ± 12.5	84.4 ± 11.1	-7.3 ± 2.9	<0.001
Total fat mass (kg)	30.7 ± 6.7	25.7 ± 6.5	-5.0 ± 2.6	<0.001
Body fat percent (%)	33.2 ± 3.6	30.1 ± 4.4	-3.1 ± 2.5	<0.001
Trunk fat (kg)	18.0 ± 4.2	14.6 ± 4.2	-3.4 ± 1.8	<0.001
Visceral fat (g)	1216 [1014 – 1505]	877 [758 – 1150]	-	<0.001
Total lean mass (kg)	57.9 ± 6.7	55.5 ± 5.7	-2.4 ± 1.8	<0.001
ASM (kg)	25.0 ± 3.3	23.8 ± 2.9	-1.2 ± 1.0	<0.001
Anthropometric and blood pressure measures				
Body mass index (kg/m^2)	29.4 ± 3.4	27.0 ± 2.8	-2.4 ± 0.9	<0.001
Waist circumference (cm) (N = 39) [a]	108.3 ± 8.2	100.0 ± 7.3	-8.3 ± 3.4	<0.001
Systolic blood pressure (mmHg) (N = 28) [b]	138 ± 17	123 ± 16	15 ± 22	0.001
Diastolic blood pressure (mmHg) (N = 28) [b]	79 ± 9	70 ± 11	-8 ± 10	<0.001

[a] Four patients did not have waist circumference recorded at their initial and/or final nutrition consultation, rendering n=39 patients' data available for inclusion. [b] Similarly, fifteen patients did not have brachial blood pressure recorded at their initial and/or finial nutrition consultation, rendering n = 28 patients' data available for inclusion.

Table 3. RARP related adverse effects experienced during surgery and up to 1-month post-surgery in men who had completed a pre-RARP weight loss program.

Adverse effect (N = 43)	Number (%)
Incontinence	31 (72.1)
Erectile dysfunction	15 (34.9)
Lymphedema	5 (11.6)
Pain	3 (7.0)
Surgery difficulty [a]	2 (4.7)
Constipation	2 (4.7)
Poor wound healing	1 (2.3)
Cardiac concerns	1 (2.3)
Neuropraxia	1 (2.3)
Herpetic neuralgia	1 (2.3)
Urinary tract infection	1 (2.3)

[a] Unexpected difficulty during surgery.

Figure legend:

Figure 1: Waterfall plots of individual participant changes in, A) whole body fat mass, B) trunk fat mass, C) whole body lean mass, and D) appendicular skeletal muscle mass, after a pre-RARP weight loss program.