apunts

MEDICINA DE L'ESPORT

www.apunts.org

ORIGINAL ARTICLE

Physical exercise as complementary treatment in prostate cancer

Bernat C. Serdà[a]*, Pilar Monreal[b] and Arantza del Valle[b]

[a] *Department of Nursing, ECIS Research Group, University of Girona (UdG), Girona, Spain*
[B] *Department of Psychology, ECIS Research Group, University of Girona (UdG), Girona, Spain*

Received November 30, 2009; accepted January 17, 2010

KEYWORDS
Strength-endurance program;
Arterial hypertension;
Prostate cancer;
Urinary incontinence;
Quality of life

Abstract
Introduction: This article presents how physical exercise can be considered as a complementary treatment in prostate cancer. The article presents the design and implementation of a strength-endurance physical exercise program adapted to prostate cancer. The initial model corresponds to the guidelines of the American College of Sports Medicine (ACSM, 1998). Adapting and transforming the program included the most common symptoms relating to the illness and its treatments.
Material and methods: The study design is quasi-experimental. The sample consisted of 33 subjects in treatment phase. Study variables were anthropometric measures, strength-endurance, hypertension, fatigue, incontinence, pain and quality of life.
Results: After 24 weeks of the program, a significant improvement in the strength-endurance capacity was observed. This result was more evident in lower limbs. There were also improvements in hypertension, urinary incontinence and pain. In conclusion, the improvement in quality of life is due to the improvement of the functional and physical capacity of ill person.

*Author for correspondence.
E-mail address: bernat.serda@udg.edu (B. C. Serdà).

1886-6581/$ - see front matter

PALABRAS CLAVE
Programa fuerza-resistencia;
Hipertensión arterial;
Cáncer de próstata;
Incontinencia urinaria;
Calidad de vida

El ejercicio físico como terapia complementaria en el cáncer de próstata

Resumen
Introducción: Este artículo presenta el ejercicio físico como una terapia complementaria en el tratamiento del cáncer de próstata. En concreto presentamos el diseño e implementación de un programa de ejercicio físico de fuerza-resistencia adaptado al cáncer de próstata. El modelo base corresponde a la guía de la American College Sports Medicine Position Stand (ACSM, 1998). La adaptación y la transformación del programa incluyen los síntomas más habituales relativos a la enfermedad y a sus tratamientos.
Material y métodos: El diseño del estudio es cuasiexperimental, con una muestra de 33 participantes en fase de tratamiento. Las variables de estudio son las variables antropométricas, fuerza-resistencia, tensión arterial, fatiga, incontinencia, dolor y calidad de vida.
Resultados: Al finalizar 24 semanas de programa, se observa una mejora significativa de la capacidad de la fuerza-resistencia, más evidente en las extremidades inferiores. También mejora la hipertensión arterial, la incontinencia urinaria y el dolor.
Conclusiones: Estos resultados demuestran que la mejora de la calidad de vida viene mediada por la mejora de la capacidad física y funcional del enfermo.

Introduction

The lack of physical activity and the sedentary lifestyles of the population are responsible for health, social and economic problems. The main aim of the National Institute of Health (NIH) and the American College of Sports Medicine (ACSM) is the promotion of physical exercise in all population groups for the improvement of health and prevention of illness. The long term objectives are to enhance performance in the undertaking of daily activities and to reduce the risk of pathologies associated with a sedentary lifestyle, such as coronary pathologies, obesity, type 2 diabetes, hypertension, brain haemorrhage and cancer[1]. The recommendations are similar to those put forward by the American Heart Association and the Centres for Disease Control and Prevention (CDC)[2]. There are currently three general perspectives on the relationship between physical exercise and health: rehabilitative, preventative, and a perspective oriented to wellbeing. From the rehabilitative perspective, Airaska[3] found that physical exercise can be considered as an instrument for the recovery of the debilitated or damaged corporal function and the alleviation of its effects on the human organism. Physical activity may be compared to medication and seen as a therapy that is complementary to medical pharmacological treatment for pathologies such as coronary disease, obesity, type 2 diabetes, hypertension, brain haemorrhage and cancer.

This article focuses on the rehabilitative perspective of physical exercise in relation to prostate cancer for improvement of the quality of life (QoL) of subjects being treated for the illness.

The principal risk factor for prostate cancer is age (the average age for diagnosis is 75) followed by environmental influences and lifestyles[4]. The survival rate at 5-years is 76.5% and there is a very high rate of morbidity caused by treatments. For these reasons, the priority objective for social-health intervention in cases of men suffering prostate cancer is improvement in QoL[5].

QoL is a subjective, dynamic, multidimensional concept of modular paradigm and difficult measurement[6]. The QoL relative to cancer is a subjective experience of the illness that is contrasted with expectations, values and individual interests[7] and corresponds with the dialectic that is established between subjective and objective aspects. The result of this relationship determines the appreciation or satisfaction of the functioning of the patient with that which is perceived as possible or ideal[8].

The research corpus shows that the design and implementation of a strength-endurance exercise programme as a complementary treatment for the prostate cancer patient can reduce and even revert the physical and psychosocial degeneration and improve the QoL of the older male[9-11]. The majority of programmes are based on the general guidelines recommended by the American College Sports Medicine-Position stand that is aimed at the promotion of physical exercise in healthy individuals[12]. These programmes are not specifically adapted to the illness and its treatment; they are excessively generic, incomplete, inflexible and inefficient[13].

The effectiveness of the programme is subject to the management and control of the variables that determine the characteristics of the activity. These variables must be adapted and transformed in accordance with the most common symptoms identified in the process and treatment of prostrate cancer and the comorbidity of the older male[14]. The consideration of these aspects facilitates the compatibility of the strength-endurance programme and its promotion for the alleviation of the degeneration and incapacity caused by

the disease and its treatment[15]. A programme based on these characteristics would result in greater effectiveness in the development of muscular strength-endurance and be reflected in the quality of the patient's basic motor patterns[16,17], delaying the onset of fatigue, reducing the processes of osteopenia and osteoporosis provoked by association with the factors of age, hormone treatment and inactivity. This, in turn, would reduce the risk of the fall-fracture-dependence chain reaction often found in these debilitated patients[18], thereby improving the QoL and survival possibilities of the older male suffering from prostate cancer[19].

The objectives of this article are:

- To present a programme of strength-endurance physical exercise, adapted to the needs of prostate cancer patients, in consideration of the significant variables detailed in studies with healthy or ill subjects with non-carcinogenic pathologies.
- To evaluate the physical and psychosocial results obtained after 24 weeks of the implementation of the programme.

Materials and methods

Locality and participants

After receiving approval from the Research Ethics Committee, the exercise programme was implemented at the Figueres Hospital (Girona, Spain), between October 2006 and October 2007.

Three conditions were required for patient inclusion:

- A histological diagnosis of prostate cancer, at any stage of its pathology, in the process of treatment.
- The undertaking of a medical examination in order to certify that the individual demonstrated no contraindications to the programme of exercise.
- The giving of informed consent by means of signature.

Exclusion criteria were the presence of any other pathology that contraindicated temporary or permanent participation in physical exercise activities, with absolute contraindications being groups III and IV of the New York Heart Association classification of cardiac disease, uncontrolled arterial hypertension, psychiatric illness and the inability to understand or speak Spanish.

Random sample selection

There were 36 participants. Selection was random, based on the clinical history number and the application of the SPSS v.15 program.

The exercise programme

The programme was designed for a period of 24 weeks: 16 weeks under the direct or indirect supervision of a physical education professional and 8 weeks of autonomous work by the patient. There were two 90-minute sessions per week which included 1 or 2 series of 8-12 repetitions of 10 correlative exercises for working the muscles of the quadriceps, pectorals, ischiotibials, deltoids, abdominals (antihypertensive), biceps, triceps, 2 dorsals and the pelvic floor. It also included pelvic floor awareness and control exercises and posterior strengthening of the weakened areas, based on exercises originating in, and making use of, the overflow energy of the healthy muscles. Intensity was between 50% to 70% of 8 RM, as previously calculated using the Lander test[20]. There was an incremental progression of repetitions, series and weight. Once the subject reached 12 repetitions of the second series, weight was increased, as long as the weekly weight increase was no more than 10% of 8RM. There was a strict limit of 70% of 8 RM to avoid the risk of testosterone secretion. Individual perception of the intensity of controlled exertion was based on a modified Borg CR-10[21] subjective exertion scale. The programme was therefore flexible and adapted to each subject in consideration of their functional capacity, stage of illness and symptomatology.

Initial and final evaluation

Evaluation of direct variables

The pre-test evaluation included: anamnesis, a socio-demographic questionnaire; an anthropometric study; the measurement of arterial tension; a questionnaire on treatment toxicity; visual analog scales of pain and urinary incontinence; a questionnaire on previous exercise habits based on the Godin test[22]; a sub-maximal step-test corresponding to the modified Canadian Aerobic Fitness Test (mCAFT)[23], controlling the frequency, arterial tension and the subjective perception of exertion with the Borg CR-10 scale. 1RM (Lander) was calculated by means of an estimation based on the Strength-endurance test of the trunk and lower limbs, in accordance with the ASEP protocol[24]. Questionnaires on QoL and Fatigue were also completed by the subjects.

The registration of anthropometric variables followed the protocol[25] and consisted of: weight; body mass index; waist-hip ratio; waist measurement; the sum of the seven skinfold measurements (pectoral, midaxillary, triceps, subscapular, abdominal, suprailium and thigh) and the percentage of fat mass, estimated by means of the Jackson and Pollock formula[26]. A biochemical analysis evaluated levels of free testosterone, blood lipids (total cholesterol, high and low density lipoproteins in cholesterol and triglycerides) and SAP levels.

QoL was measured wit the FACT-P, Functional Assessment Cancer Therapy Scale-Prostate [Range: 0-156] (4th version).

Fatigue was measured by means of the FACIT fatigue scale (4th version) [Range: 0-52].

Intensity of incontinence was evaluated by using a visual analog categorical scale of four categories from "0: not wet" to "10: completely soaked".

Pain intensity was measured with a visual analog numerical scale: "0: no pain" to "10: unbearable pain".

Strength-endurance was estimated from the total number of muscular contractions completed in a cycle of 22 repetitions/minute marked by a metronome (a Korg MA-30

model) programmed to 44 beats/minute and with a light weight.

Sub-maximal muscular exertion was considered as the maximum weight that the subject could lift for 8 repetitions whilst maintaining the correct posture. The weight used was 70% of the 8RM calculated from the results of the strength-endurance test, based on the Lander formula. The test involved two groups of muscles: those of the trunk, concentrating on the pectorals, using a horizontal bench; and the lower limbs, concentrating on the thighs, using a leg press. Maximum muscular strength was indirectly (hypothetically) calculated from the 8RM with the Lander formula[27]. This value allowed the calibration of individual exercise intensity in accordance with the programmed percentages.

Visceral abdominal fatty tissue was measured with a CT-scanner.

In week 24 the same variables were evaluated, with the exception of the anamnesis and the socio-demographic questionnaire.

Evaluation of co-variables

The following section explains the evaluation of the co-variables, including the integrated adherence model, symptoms relative to illness and the molecular observation unit.

The anamnesis identified the secondary symptoms relative to illness and treatment. These were triangulated with the symptoms registered in the clinical histories.

The design of the strength programme allowed a flexible adaptation to the symptom of urinary incontinence. The programme developed active retention strength and coordination of the striated muscles of the deep boundaries of the pelvic floor; this compensated for the malfunctioning of the damaged sphincters and resulted in greater continence control.

The adherence model was based on current models using variables identified in studies that were related to the taking of regular physical exercise. The model used included a didactic strategy, introduced in stages, which progressively increased autonomy, transferring control of the activity from the supervisor to the subject. The objective was that the subject would continue the programme at the end of the experimental phase. Support given during the programme ensured a focus on the most weakened variables. Perception of control and self-sufficiency were emphasised. Results were evaluated by means of the questionnaire devised by Godin[22].

The molecular observation unit evaluated the technical factors associated with strength-endurance activities. Observation guaranteed the health of the subject by reducing the risk of injury. The following factors were evaluated using the Likert scale: corporal posture at rest and in contraction; the biomechanics of contraction, including respiratory association; the correct completion of the programme; the transference of working load and the quality of the basic motor patterns in the process of ascending and descending in the step exercise [range: 0-30]. The comments of the observer were also considered. A weekly observation took place which was videoed. An average was calculated for the first phase of the programme (weeks 1-6) and the autonomous stage (weeks 18-24).

Calculation of sample size and statistical analysis

The sample size calculated for the detection of a difference between groups of 5.0 points was the result of the FACT-P test (standard deviation [SD] = 9). The test was applied to two lines with an alpha risk of 5% and a beta risk of .05. The number of subjects required was 33. For paired data in the continuous variables that followed a normal distribution, the t Student-Fisher test was used with a number of degrees of liberty (n-1). For the continuous variables that did not follow a normal distribution the Wilcoxon or Man Whitney U non-parametric test for paired data was employed. The χ^2 test was used for the analysis of categorical variables. A multivariate model was designed with dimensions that integrated the QoL questionnaire. The significant variables of the multivariate model were studied and they explain the variation of the QoL test based on a multiple lineal regression model. The SPSS version 15 programme was used for the statistical analyses. Significance level was set at 5%.

Of the 46 subjects referred by the Urology service of Figueres Hospital, a sample of 36 subjects was selected for the study. Attendance at the sessions was over 93% (30 of 32 sessions). In the course of the study, 3 subjects left the programme due to cognitive problems, metastatic osseous pain and cardiac insufficiency. The CONSORT flow diagram illustrates the study sample procedure (Figure 1). At the end of the study (week 24) it was found that 100% of the sample had adhered to the activities, having been influenced by the variables: perception of control; self-sufficiency; identification with the therapy; control of incontinence and pain; and satisfaction (Figure 1 and Table 1).

Results

The results are presented as follows: Sections 1-7 deal with the results of the direct variables —anthropometric, cardiovascular efficiency at rest, cardiovascular efficiency at sub-maximal exertion, arterial pressure, muscle strength, QoL (FACT-P), urinary incontinence, fatigue and pain; Section 8 describes urinary incontinence and QoL; Section 9 considers the multivariate model of the dimensions that make up the QoL questionnaire; the results of the co-variants relative to adherence to the programme are given in Section 10 and results of the molecular observation unit are shown in Section 11.

1. Anthropometric variables

The anthropometric variables showed that at the start of the programme the subjects carried a concentration of abdominal fat. By the end of the programme there was a significant reduction of all measurements and typical deviations (Td) of the variables, with the exception of weight (Table 2).

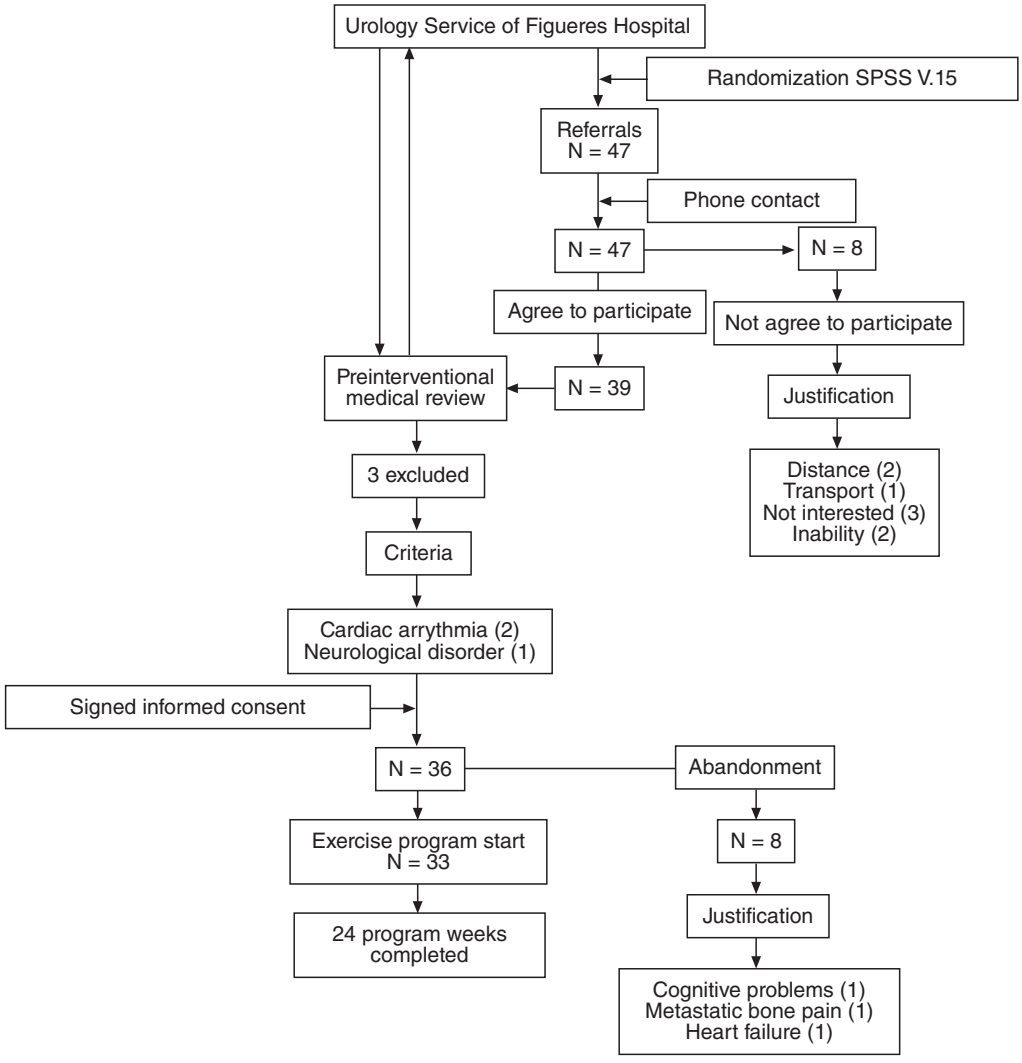

Figura 1 CONSORT flowchart.

There was a significant reduction in each of the seven skinfold measurements; the two that saw the greatest reduction were in the abdominal area —the suprailium registered an average difference of 6.22 and the abdominal skinfold registered an average difference of 5.91. The skinfold that registered the least difference was the pectoral (4.75).

2. Cardiovascular variables at rest

There was a significant fall in cardiovascular variables at rest. Table 3 details the changes registered for heart rate, systolic arterial pressure and diastolic arterial pressure at rest.

3. Cardiovascular efficiency variables at sub-maximal exertion

There was a significant lowering of the cardiovascular variables at sub-maximal exertion. The subjective perception of effort also registered a significant reduction, as did systolic arterial tension, while diastolic arterial tension fell, though not significantly (Table 4).

4. Categorisation of arterial pressure variables in accordance with the JNC-6

In accordance with the Joint National Committee (JNC)[28] evaluation, there was a 50% fall in arterial hypertension (Table 5).

5. Description of muscular strength

The percentage increase in both endurance and 8RM was greater in the lower limbs than in the upper body. In the pectoral group, strength-endurance increased by 57.83% and 8RM by 22.76%. In the lower limbs musculature, strength-endurance increased by 61.45% and 8RM by 45.49% (Table 6).

Table 1 Clinical and epidemiological characteristics of the participants

Variable	Intervention group (n=33)
Age (years) $\bar{x}$ (DS) [range]	71.78 (7.22) [55-83]
Weight (Kg) $\bar{x}$ (DS) [range]	80.40 (11.60) [64.2-111.5]
BMI (Kg/m^2) $\bar{x}$ (DS) [range]	28.67 (2.99) [24.16-33.97]
Arterial tension (mm Hg)	
SAP $\bar{x}$ (DS)	150.25 (21.31)
DAP $\bar{x}$ (DS)	81.90 (11.03)
Heart rate at rest (beats/minute) $\bar{x}$ (DS)	74 (10.74)
TNM Tumour classification, n (%)	
Stage I	0 (0)
Stage II	13 (39.39)
Stage III	18 (54.54)
Stage IV	1 (3.03)
Unknown	1 (3.03)
SPA diagnosis (ng/mL) $\bar{x}$ (DS) [range]	17.95 (24.32) [2.84 a >100]
SPA at start of programme (ng/mL) $\bar{x}$ (DS) [range]	0.55 (1.36) [0.01-5.5]
Treatment, n (%)	
Surgical (P)	15 (45.45)
Hormonal (ADT)	15 (45.45)
Combined	
R + ADT	1 (3.03)
P + ADT	2 (6.06)
Socio-demographic questionnaire	
Civil status	
Married	30 (90.90)
Widowers	2 (6.06)
Single	1 (3.03)
Occupation	
Retired	31 (93.93)
Active	2 (6.06)
Previous aerobic exercise, n (%)	
Cat 1 ≥ 3 times per week	24 participants (72.72%)
Intense	1 participant (3.03%)
Moderate	11 participants (33.33%)
Light	12 participants (36.36%)
Cat 2 < 2 times per week	9 participants (27.27)
Intense	
Moderate	5 participants (15.15%)
Light	4 participants (12.12%)
Previous strength-endurance exercise, n (%)	0 (0)
≥ 3 times per week	0 (0)
< 2 times per week	0 (0)

BMI: body mass index; SAP: systolic arterial pressure; DAP: diastolic arterial pressure; SPA: specific prostate antigen; P: prostatectomy; ADT: androgenic deprivation therapy; R+ADT: radiotherapy combined with androgenic deprivation therapy; P+ADT: prostatectomy combined with androgenic deprivation therapy

Table 2 Anthropometric variables

Description of parameter		Pre-test		Post-test		Pre-test/post-test[a]		
Variables	n	x̄	Td	x̄	Td	x̄	Td	p*
Weight (Kg)	33	80.40	11.60	79.92	12.08	.478	1.89	.157
BMI (Kg/m^2)	33	28.67	2.99	28.20	3.06	.46	1.02	.007*
WHR	33	1.01	0.05	0.99	0.05	.02	.03	.003*
WM	33	104.46	8.68	101.90	8.97	2.56	2.49	≤ .001*
Σ7 skinfolds (mm)	33	219.76	44.17	180.30	37.10	39.46	31.09	≤ .001*
FM-7 (%)	33	40.87	15.18	28.96	11.42	11.90	10.59	≤ .001

[a] Changes observed in the 24 weeks of the intervention programme.
BMI: body mass index; WHR: waist-hip ratio; WM: waist measurement; Σ7 skinfolds: sum of the seven body skinfolds; FM-7 (%): fat mass, expressed as a percentage; Td: typical deviation; x̄: mean.
p*: significance value p<.05.

Table 3 Cardiovascular variables at rest

Description of parameter		Pre-test		Post-test		Pre-test/post-test[a]		
Variables	n	x̄	Td	x̄	Td	x̄	Td	p*
HR-R	33	74.00	10.74	71.96	11.59	2.03	8.79	.02*
SAP-R	33	150.25	21.31	139.96	18.65	10.28	16.16	.001*
DAP-R	33	81.90	11.03	78.65	10.28	3.25	11.61	.062

[a] Changes observed in the 24 weeks of the intervention programme.
HR-R: heart rate at rest (beats/min); SAP-R: systolic arterial pressure at rest (mmHg); DAP-R: diastolic arterial pressure at rest (mmHg); Td: typical deviation; x̄: mean.
p*: significance value p<.05.

Table 4 Cardiovascular parameters in the sub-maximal strength test

Description of parameter		Pre-test		Post-test		Pre-test/post-test[a]		
Variables	n	x̄	Td	x̄	Td	x̄	Td	p*
$HR_{sub\text{-}max}$	24	122.83	16.98	115.58	19.51	7.25	19.42	.040*
$SAP_{sub\text{-}max}$	24	180.58	22.29	172.79	25.81	7.79	20.66	.039*
$DAP_{sub\text{-}max}$	24	90.16	14.96	83	9.95	7.16	16.88	.029*
$Borg_{sub\text{-}max}$	24	5.08	1.742	4.375	1.61	0.70	1.6	.02
VO_{2max}	30	16.16	8.04	22.26	5.73	6.10	5.07	< .001

[a] Changes observed in the 24 weeks of the intervention programme.
p*: significance value p<.05.
$HR_{sub\text{-}max}$: sub-maximal heart rate (beats/min); $SAP_{sub\text{-}max}$: sub-maximal systolic arterial pressure (mmHg); $DAP_{sub\text{-}max}$: sub-maximal diastolic arterial pressure (mmHg); $Borg_{sub\text{-}max}$: Borg sub-maximal scale of subjective perception of exertion; $VO_{2\,max}$: maximum oxygen consumption [ml kg^{-1} min^{-1}]; Td: typical deviation; x̄: mean.

6. Quality of life

The average FACT-P variable showed a significant increase by the end of the programme (Table 7).

7. Urinary incontinence, fatigue and pain

There was a significant reduction in incontinence and pain. The fall in levels of fatigue was not significant (Table 8).

8. Categorisation urinary incontinence and the difference in the FACT-P QoL questionnaire

The variable of the categorical analog visual scale was categorised in two groups: Group 1 showed less improvement in urinary incontinence and Group 2 showed more improvement. The urinary incontinence variable was compared with the QoL (FACT-P) questionnaire before and after the programme. The average, according to the FACT-P

Table 5 Arterial pressure variables

Categories		Arterial pressure	Pre-test (n=33)		Post-test (n=33)	
		SAP/DAP (mmHg)	n	%	n	%
1	Optimal	<120 / and <80	5	15.15	5	15.15
2	Normal	120-130 / and 80-85	2	6.06	7	21.21
3	Normal-high AHT	130-139 / and/or 85-89	2	6.06	9	27.27
4	Stage 1	140-159 / and/or 90-99	5	15.15	3	9.09
5	Stage 2	160-179 / and/or 100-109	2	6.06	0	0
6	Stage 3	≥180 / and/or ≥110	0	0	0	0
7	ISH	≥140 /<90	17	51.51	9	27.27

All variables are values at rest. If SAP or DAP are in different categories, the recommended interval is the lowest indicated.
SAP: systolic arterial pressure; DAP: diastolic arterial pressure; ISH: isolated systolic hypertension; AHT: arterial hypertension; mmHg: millimetres of mercury.

Table 6 Changes in means and typical deviation (Td) of muscular strength

Description of parameter					Pre-test		Post-test		Pre-test-Post-test[a]		
Variables	Grup	Rang		n	$\bar{x}$	Td	$\bar{x}$	Td	$\bar{x}$	Td	p*
		Pre-test	Post-test								
Mend	Pec	[2-23]	[7-42]	31	12.83	5.20	20.25	7.87	7.41	6.97	<.001*
	LL	[8-50]	[10-90]	32	19.43	9.49	31.37	18.12	11.93	18.87	<.001*
8RM	Pec	[5.3-36.5]	[6.6-45.6]	32	21.66	8.38	26.59	8.91	4.93	4.37	<.001*
	LL	[6.6-135.4]	[10.7-159.6]	32	57.59	35.19	83.79	43.33	26.19	24.78	<.001*

[a]Changes observed in the 24 weeks of the intervention programme.
p*: significance value p<.05.
Mend: muscular endurance; 8RM: sub-maximal exertion, calculated using Lander formulas[1,20]; Pec: pectoral; LL: lower limbs; Td: typical deviation; $\bar{x}$: mean.
There was higher significance in muscular-strength endurance and sub-maximal exertion. The effect was greater in the lower limbs (Table 7). Lander Formula (1985): Weight raised (Kg) / [1.013 − 0.0267123 NR].

Table 7 Changes in means and typical deviation (Td) of FACT-P

Description of parameter			Pre-test		Post-test		Related differences[a]		
Questionnarie	Range	n	$\bar{x}$	Td	$\bar{x}$	Td	$\bar{x}$	Td	p*
FACT-P	[0-156]	33	107.11	19.91	116.5	17.14	9.39	16.55	0.003*

[a]Changes observed in the 24 weeks of the intervention programme.
p*: significance value p<.05.
FACT-P: QoL questionnaire on prostate cancer; Td: typical deviation; $\bar{x}$: mean.
Multivariate model of the dimensions that make up the dimensions of the FACT-P QoL questionnaire.

questionnaire, in Group 2 (more improvement) was higher ($\bar{x}$ =14.75) than the average for Group 1 ($\bar{x}$ = 2.95) (t of student = 2.15; p = .039) (Table 9).

9. Multivariate model of the dimensions of the FACT-P QoL questionnaire

The multiple lineal regression model (Table 10) analysed differences in post and pre-intervention values, for the QoL test and each of the dimensions. In addition, it considered the coefficient beta for each independent variable —if the sign was positive, the value of the variable had increased; if the sign was negative, the value of the variable had decreased. The variables of the multivariate model that were significant and explain the variation in the QoL test scores were: the general physical state of health; emotional condition and symptoms relative to prostate cancer. Non-significant variables were family and social environment and the fatigue scale. R^2 = .933%.

Table 8 Changes in means and typical deviation of urinary incontinence, fatigue and pain

Description of parameter			Pre-test		Post-test		Related differences[a]		
Questionnarie	Rang	n	$\bar{x}$	Td	$\bar{x}$	Td	$\bar{x}$	Td	p*
VAS-UI	[0-10]	33	3.79	2.54	1.03	0.918	2.75	1.88	.000*
FACIT	[0-52]	33	39.91	9.72	42.90	6.60	2.99	10.46	.110
VAS-P	[0-10]	33	4.57	2.41	2.66	1.79	1.90	1.25	≤ .001

[a]Changes observed in the 24 weeks of the intervention programme.
p*: significance value p <.05.
VAS-UI: visual analogue scale of urinary incontinence; FACIT: fatigue questionnaire; VAS-P: visual analogue scale of pain; $\bar{x}$: mean; Td: typical deviation.

Table 9 Urinary incontinence

Description of parameter			Related differences		T test for equality of means	
Questionnaire	VAS-C	n	$\bar{x}$	Td	t	p*
FACT-P DIF	1	(n=15)	2.95	14.58	−2.152	0.039
	2	(n=18)	14.75	16.50		

FACT-P DIF: the difference in the result of the QoL questionnaire between the final value on finalising the intervention and the initiation of the intervention. VAS-C: visual analogue scale of continence; Td: typical deviation; $\bar{x}$: mean. 1: less improvement in urinary incontinence; 2: more improvement in urinary incontinence.

Table 10 FACT multiple regression

FACT Questionnaire dimensions	T	Beta	p*
1. PWB: Physical wellbeing	2.528	.249	.018
2. SWB: Social and family wellbeing	1.170	.122	.252
3. EWB: Emotional wellbeing	3.769	.404	.001
4. PCS: Other concerns	3.909	.365	.001
5. FACIT: Fatigue scale	−3.19	−.028	.752
R^2 = .933%			

p*: significance value p <.05.

Table 11 FACT coefficients

FACT-P Questionnaire dimensions	T	Beta	p*
1. PWB: Physical wellbeing	3.32	.285	.002
3. EWB: Emotional wellbeing	4.54	.418	.000
4. PCS: Symptoms	4.56	.404	.000

p*: significance value p <.05.
PCS: in the QoL questionnaire, PCS refers to "other concerns", attributed to symptoms relative to illness and treatment.

New coefficients were obtained from the significant variables (Table 11).

10. Integrated adherence model

Adherence to the exercise programme was 100%. The results showed that the subjects autonomously continued with the exercise programme due to the perception of improvement in the symptoms of incontinence and pain and a general post-exercise session feeling of wellbeing. Perception of control, self-sufficiency and willpower variables were decisive in continuance in the long-term. Two variables not included in the model that should be mentioned are knowledge of the therapeutic dose and psychosocial distraction during the activity.

11. Molecular observation unit

The group average in the first phase, weeks 1-6, was 12.5 points. The average for the final, autonomous phase, weeks 18-24, was 24 points. The observations in the final phase highlighted the improvement in the quality of basic motor patterns, especially in coordination when ascending and descending in the mCAFT sub-maximal aerobic step test.

Discussion

The results show that strength-endurance exercise significantly improves the QoL of prostate cancer patients. The QoL questionnaire revealed improvements in the physical dimension (including reduction of pain), the functional dimension (including improved continence) and the emotional dimension.

There was clear and evident progress in the sub-maximal and strength-endurance variables. As in the work of Latham[17], it was noted that an increase in strength had a positive retroaction effect on the capacity, technical execution and quality of the basic motor patterns when walking and ascending-descending the step. This result was confirmed by both the changes identified in the periodic

checks of the molecular observation unit and the mCAFT sub-maximal aerobic step test.

The improvement in strength-endurance was superior to sub-maximal strength. In both cases, the improvement was greater in the lower limbs than the trunk. This result should be seen in the context of the fact that in older people, the natural physiological loss of strength usually occurs earlier in the lower limbs than in the upper body. Moreover, the increase in extensor strength in the lower limbs correlates with the increase in walking speed, self-perception and the restoration of balance[29]. This reduces the risk of fall and fracture and contributes to a general improvement of QoL[30].

The increase in strength correlates with the halting of the catabolic process in the muscular system and an improvement in the condition of sarcopenia that is aggravated by cancer. The recuperation of the muscular mass and the intensity and quality of the muscular contraction generates an efficient movement arc. These factors signal a general improvement in functionality and the ability and movement demanded by daily life activities, retarding the manifestation of fatigue and resulting in an improved self-perception of health by older people[31-33].

Age and hormone treatment are factors that provoke an accelerated loss of osseous mineral density[34]. A strength-endurance programme is an ideal therapy to retard the process of osteoporosis and reduce the risk of fractures, as exercise increases bone density, porosity and solidity[35]. Research has revealed a direct, proportional relationship between muscular-endurance exercise and osseous mineral density. This effect has also been identified in older people, although the degree of change depends on the initial condition of the bone structure[32].

Against this, it should be recognised that muscular-endurance exercise involves a greater risk of injury to soft tissue parts, mainly the tendinous intersections[36]. This risk is higher in people suffering illnesses and this underlines the importance of determining the most efficient exercise programme for obtaining the greatest benefits for the osseous and muscular structure and minimising the risk of injury.

The review of previous studies showed that the minimum duration of an exercise programme aimed at increasing osseous mineral density is 24 weeks[37]. The programme used in this study was 24 weeks and this overcomes one of the methodological limitations that have been identified in other similar studies[10]. The results obtained justify the effect of strength-exercise on osseous health, though the importance of the promotion of good nutritional habits, especially the ingestion of calcium, should not be forgotten[38].

The degeneration of muscular-skeletal capacity and, especially, the lower limbs is a cause of the fall-fracture-dependence triad of the older person. This risk increases enormously when the individual is in a fragile physical condition[29,39]. The impact of a fall on osteoporotic bone often results in fracture, with the consequent loss of mobility and the possible generation of post-fall syndrome due to functional dependence[40]. The initial effect or the exercise programme was improved muscular conditioning and this led to better osseous health. Osteomuscular improvement allows the older person to maintain autonomy and this reduces the risk of dependence that is often caused by cancer and the treatment of the disease[41-43].

Cardiovascular, metabolic and anthropometric decompensation is common in prostate cancer patients. The effect is provoked by the deficit in the secretion of testosterone. The pre-test phenotype of the participants in this study was Type II (android). The excess fat in the abdominal area was identified by waist girth, waist-hip ratio and the two biggest skinfolds —suprailium and abdominal. The inter-abdominal fat deposit directly correlated with the cardiovascular risk factors. If these indicators are not reverted they become morbimortality risk factors[44].

ACSM[12] aerobic type exercise is recommended for reducing obesity. The results of this study show that strength-endurance exercise is effective for improving tissue quality. The results showed a significant reduction in the anthropometric variables: BMI, waist girth, the sum of the seven skinfolds and the percentage of body fat. This result correlates with the cardiovascular improvements identified through the diminution of the variables: heart rate, arterial tension and the subjective perception of exertion (at rest and sub-maximal) although the exact significance of the relationship was not clearly defined. The post-test showed a greater capacity to exercise at a higher intensity and a more efficient post-exercise cardiovascular recovery. There was a gradual fall in arterial tension that was evident and significant from the sixth week of the programme. At the end of the first experimental phase the subgroup of subjects with hypertension was reduced by 50% due to the fall in systolic arterial pressure. Results further confirm that the programme had a significant antihypertensive effect on the systolic arterial pressure of the subgroup of subjects with hypertension[45] although it cannot be confirmed that the effect is long-term. The cardiovascular improvement corroborates the principle of the interrelationship between capacities: the improvements in strength-endurance and sub-maximal strength generated an adaptation in aerobic capacity registered in the variables of cardiovascular efficiency at rest and in the mCAFT sub-maximal fitness test. This was evidenced in a reduction of cardiovascular stress with more exercise and a lower subjective perception of the exertion required. More research is necessary in order to quantify the relationship between an exact degree of strength exercise and its effect on cardiovascular health.

The improvements in the anthropometric profile and cardiovascular response, as described above, are determinants in the overall progress of factors that are interrelated with the metabolic system. This effect was identified through the joint analysis derived from the reduction of the variables concerning lipids in the blood, arterial tension at rest and during activity, the reduction in abdominal obesity and improved glycaemia that indicated greater sensibility to insulin[46]. These results are in line with those of Warburton and confirm that improvements in the metabolic syndrome correlate with improvements in the functional dimension and the QoL of the older person[32].

The programme managed to reduce, control and revert symptoms of incontinence, fatigue and pain. This effect was achieved by the capacity of the programme to adapt to the most common symptoms associated with the illness and its treatment. For example, in relation to incontinence, the strength programme included the management of three consecutive phases: the sensory perception of the pelvic floor; strengthening; and irradiated overflow exercises from the healthy musculature to the atrophied and damaged muscles of the pelvic floor. This model, organised in phases and adapted to the symptom of incontinence, achieved a significant improvement in the QoL of the subgroup affected by urinary incontinence, as compared with the non-affected sub-group or the results of similar programmes that were not able to be adapted to symptoms[47]. The specific mechanisms that mediate the improvement are consciousness and continence control. This result may have had a further, positive impact on other dimensions of the QoL questionnaire, for example, recovery of social network.

The American Society of Clinical Oncology (2008), confirm that QoL is a strong and independent indicator in cancer survival. In this study, the dimensions of the QoL questionnaire that saw a significant improvement were personal functional capacity, emotional wellbeing and the dimension that included symptoms relative to the illness (incontinence, pain and fatigue). From the first phase of the programme, a contextualised study for the multi-disciplinary promotion of the variables that correlate with adherence was undertaken; the basis of the study being older men suffering from prostate cancer and their socio-familial environment. This construct did not consider adherence exclusively as a final value of the study but as contingent support offered in the experimental stage, in relation to the weakest variables concerning perception of control, self-sufficiency and perception of improvement. It is clear that this encouraged the autonomous continuance of the programme once the experimental phase was complete —the adherence level was 100%. It is worth noting that other (new) significant variables that should be integrated into the model are knowledge of the therapeutic dose and psychosocial distraction.

A global consideration of the results leads us to the controversy and debate concerning the effectiveness of population screening and diagnosis of prostate cancer based on the SAP test. This also raises the question of the need for low-risk prostate cancer treatment; a question that is justified by the chain of joint or sequential risk factors that determine the metabolic syndrome of the older male being treated for prostate cancer. In this study, we have identified: overweight, arterial hypertension (with isolated systolic hypertension), high heart rate at rest, high cholesterol, an increased level of high density lipoproteins, excessive saturated fats in the diet and a sedentary lifestyle. The combination of these factors significantly increases the risk of cardiovascular illness[48]. If, to this profile, we add the secondary effects of the illness and its treatment, such as urinary incontinence, sexual dysfunction or impotence, fatigue, distress, social isolation etc., it can be seen that the impact of prostate cancer treatment on the QoL of the sufferer is greater than the impact of the illness itself. We conclude this section with a reference to Traish, who commented that the identification of these factors exposes the dark, silent and unknown face of androgen deprivation treatment[49].

Conclusions

- The strength-endurance programme is a natural, non-invasive intervention that is economical and effective and can complement socio-health attention and treatment.
- Long term metabolic decompensation supposes a high risk of cardiovascular pathologies. These risks are aggravated by cancer treatment, both in terms of expectancy and QoL. Given this situation, proactive health initiatives are justified as they may ameliorate secondary effects and the risks generated by cancer treatment as well as leading to improvements in physical and functional capacity and the general health of the patient.
- The strength programme led to improved strength-endurance and sub-maximal strength capacity. The general improvement in strength was greater in the lower limbs than in the trunk. There was a transfer of strength to aerobic capacity and to basic motor pattern skills. Functional progress had a positive effect on all other QoL dimensions.
- The programme reduced cardiovascular risk through the diminution of the anthropometric variables, above all, the percentage of fatty tissue (especially in the abdominal area) and the level of arterial tension.
- The programme had an antihypertensive effect that was most evident in the subjects that suffered hypertension. There was a significant effect on systolic arterial pressure from the sixth week of the programme.
- The results justify the flexibility and capacity of the programme to adapt to the symptoms of urinary incontinence, fatigue and pain. The reduction in the intensity of these symptoms led to improvements in the psychological and social wellbeing of the subjects.
- There was a significant improvement in the cardiovascular variables at rest and at sub-maximal exertion and in the subjective perception of strength.
- The results confirm that the programme is valid, sustainable and the best intervention aimed at the older male suffering from prostate cancer. This type of programme allows direct control of the vital signs of life and reduces the risk of dyspnoea and falling. Furthermore it allows for immediate treatment in the case of emergency.

Conflict of interest

The authors have no conflicts of interest.

References

1. Booth FW, Gordon SE, Carlson CJ, Hamilton MT. Waging war on modern chronic diseases: primary prevention through exercise biology. J Appl Physiol. 2000;88:774-87.

2. Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, Franklin BA, et al. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. Med Sci Sports Exerc. 2007;39:1423-34.
3. Airaska D. Actividad física y salud. 2002. Available in http://sobreentrenamiento.com/PubliCE/Index.htm.
4. Hsing AW, Devesa SS. Trends and patterns of prostate cancer: what do they suggest? Epidemiol Rev. 2001;23:3-13.
5. Fallowfield L. The quality of life: The missing measurement in health care. London: Horizon Books; 2008.
6. de Haes JC, van Knippenberg FC. The quality of life of cancer patients: a review of the literature. Soc Sci Med. 1985;20:809-17.
7. Ferrans CE. Development of a conceptual model of quality of life. Sch Inq Nurs Pract. 1996;10:293-304.
8. Cella DF, Tulsky DS. Quality of life in cancer: definition, purpose, and method of measurement. Cancer Invest. 1993;11: 327-36.
9. Culos-Reed SN, Robinson JL, Lau H, O'Connor K, Keats MR. Benefits of a physical activity intervention for men with prostate cancer. J Sport Exerc Psychol. 2007;29:118-27.
10. Segal RJ, Reid RD, Courneya KS, Malone SC, Parliament MB, Scott CG, et al. Resistance exercise in men receiving androgen deprivation therapy for prostate cancer. J Clin Oncol. 2003; 21:1653-9.
11. Carbonell A, Aparicio V, Delgado M. Involución de la condición física por el envejecimiento. Apunts Med Esport. 2009;162:98-103.
12. ACSM. American College of Sports Medicine Position Stand. Exercise and physical activity for older adults. Med Sci Sports Exerc. 1998;30:992-1008.
13. Serdà B. Evaluación de los efectos de un programa de ejercicio físico individualizado sobre la calidad de vida, la incontinencia urinaria, la fatiga y la resistencia muscular con enfermos de cáncer de próstata. Girona: Universitat de Girona; 2009.
14. Courneya KS. Exercise interventions during cancer treatment: biopsychosocial outcomes. Exerc Sport Sci Rev. 2001;29:60-4.
15. Serdà B, Monreal P, Del Valle A. Estudio de la relación entre el ejercicio físico, el cáncer y la calidad de vida: una revisión bibliográfica y conceptual. Revista de Psicología del Deporte. 2009; in press.
16. Latham N, Anderson C, Bennett D, Stretton C. Progressive resistance strength training for physical disability in older people. Cochrane Database Syst Rev 2003;(2):CD002759.
17. Latham NK, Bennett DA, Stretton CM, Anderson CS. Systematic review of progressive resistance strength training in older adults. J Gerontol A Biol Sci Med Sci. 2004;59:48-61.
18. Bliuc D, Nguyen ND, Milch VE, Nguyen TV, Eisman JA, Center JR. Mortality risk associated with low-trauma osteoporotic fracture and subsequent fracture in men and women. JAMA. 2009;301:513-21.
19. Higano CS. Management of bone loss in men with prostate cancer. J Urol. 2003;170 (6 Pt 2):S59-S63.
20. Lander J. Maximum based reps. NSCA Journal. 1985;6:60-1.
21. Borg G. Psychophysical scaling with applications in physical work and the perception of exertion. Scand J Work Environ Health. 1990;16 (Suppl 1):55-8.
22. Godin G, Shephard RJ. A simple method to assess exercise behavior in the community. Can J Appl Sport Sci. 1985;10: 141-6.
23. Weller IM, Thomas SG, Gledhill N, Paterson D, Quinney A. A study to validate the modified Canadian Aerobic Fitness Test 1. Can J Appl Physiol. 1995;20:211-21.
24. Brown E, Weir P. Journal of Exercise Physiology-online 20014:1-23. Available in http://faculty.css.edu/tboone2/asep/Brown2.doc
25. AAPHERD. The American Alliance Physical Fitness Education & Assessment Program. American Alliance for Health, Physical Education, Recreation, and Dance (AAPHERD); 1988.
26. Jackson AS, Pollock ML. Generalized equations for predicting body density of men. Br J Nutr 1978;40:497-504.
27. Jiménez ADPA. Application of the 1RM estimation formulas from the RM in bench press in a group of physically active middle-aged women. Journal of Human Sport and Exercise online 2008.
28. Joint National Committee on Detection EatoHPJV. The Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. Arch Intern Med. 1997;21(157):2413-46.
29. Tinetti ME, Williams CS. The effect of falls and fall injuries on functioning in community-dwelling older persons. J Gerontol A Biol Sci Med Sci. 1998;53:M112-9.
30. Buchner DM. Physical activity and quality of life in older adults. JAMA. 1997;277:64-6.
31. Salem GJ, Wang MY, Young JT, Marion M, Greendale GA. Knee strength and lower- and higher-intensity functional performance in older adults. Med Sci Sports Exerc. 2000;32:1679-84.
32. Warburton DE, Gledhill N, Quinney A. Musculoskeletal fitness and health. Can J Appl Physiol. 2001;26:217-37.
33. Ringsberg K, Gerdhem P, Johansson J, Obrant KJ. Is there a relationship between balance, gait performance and muscular strength in 75-year-old women? Age Ageing. 1999;28:289-93.
34. Hurley BF, Hagberg JM. Optimizing health in older persons: aerobic or strength training? Exerc Sport Sci Rev. 1998;26:61-89.
35. Gregg EW, Pereira MA, Caspersen CJ. Physical activity, falls, and fractures among older adults: a review of the epidemiologic evidence. J Am Geriatr Soc. 2000;48:883-93.
36. Kolt GS, Hume PA, Smith P, Williams MM. Effects of a stress-management program on injury and stress of competitive gymnasts. Percept Mot Skills. 2004;99:195-207.
37. Wolff I, van Croonenborg JJ, Kemper HC, Kostense PJ, Twisk JW. The effect of exercise training programs on bone mass: a meta-analysis of published controlled trials in pre- and postmenopausal women. Osteoporos Int. 1999;9:1-12.
38. Evans WJ. Exercise and nutritional needs of elderly people: effects on muscle and bone. Gerodontology. 1998;15:15-24.
39. Fiatarone MA, O'Neill EF, Doyle N, Clements KM, Roberts SB, Kehayias JJ, et al. The Boston FICSIT study: the effects of resistance training and nutritional supplementation on physical frailty in the oldest old. J Am Geriatr Soc. 1993;41:333-7.
40. Buchner DM, Cress ME, de Lateur BJ, Esselman PC, Margherita AJ, Price R, et al. The effect of strength and endurance training on gait, balance, fall risk, and health services use in community-living older adults. J Gerontol A Biol Sci Med Sci. 1997;52:M218-24.
41. Kamel HK, Iqbal MA, Mogallapu R, Maas D, Hoffmann RG. Time to ambulation after hip fracture surgery: relation to hospitalization outcomes. J Gerontol A Biol Sci Med Sci. 2003; 58:1042-5.
42. Kamel HK. Sarcopenia and aging. Nutr Rev. 2003;61(5 Pt 1):157-67.
43. Suh TT, Lyles KW. Osteoporosis considerations in the frail elderly. Curr Opin Rheumatol. 2003;15:481-6.
44. Martínez-Hervas S. Perímetro cintura y factores de riesgo cardiovascular. Revista Española de Obesidad. 2008;6:97-104.
45. Hagberg JM, Montain SJ, Martin WH III, Ehsani AA. Effect of exercise training in 60- to 69-year-old persons with essential hypertension. Am J Cardiol. 1989;64:348-53.

46. Dunstan DW, Daly RM, Owen N, Jolley D, De Court, Shaw J, et al. High-intensity resistance training improves glycemic control in older patients with type 2 diabetes. Diabetes Care. 2002;25:1729-36.
47. Palmer MH, Fogarty LA, Somerfield MR, Powel LL. Incontinence after prostatectomy: coping with incontinence after prostate cancer surgery. Oncol Nurs Forum. 2003;30:229-38.
48. Traish AM, Saad F, Guay A. The dark side of testosterone deficiency: II. Type 2 diabetes and insulin resistance. J Androl. 2009;30:23-32.
49. Traish AM, Saad F, Feeley RJ, Guay A. The dark side of testosterone deficiency: III. Cardiovascular disease. J Androl. 2009;30:477-94.