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HYSTERECTOMY IS ASSOCIATED WITH POSTMENOPAUSAL BODY COMPOSITION CHARACTERISTICS

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Summary. The impact of hysterectomy without oophorectomy and with no malignant purpose on body composition and postmenopausal weight gain was tested in 184 Viennese females aged between 47 and 57 years (mean 52·9). Hysterectomized women were significantly heavier than those who experienced a spontaneous menopause (controls). The amount of fat tissue, especially in the abdominal region, was significantly higher in hysterectomized women. Furthermore, they were reported to have experienced a significantly higher weight gain since menopause (9·1 versus 6·0 kg). No significant differences in bone mass were found. Psychological stress factors and hormonal changes following hysterectomy are discussed as possible causes of these differences.

Introduction

Hysterectomy is one of the most frequently performed major surgical procedures in women of reproductive age (Van Keep, Wildemeersch & Lehart, 1983). In the United States more than 600,000 hysterectomies are performed each year (Lepine *et al.*, 1997). The distribution of hysterectomies with no malignant purpose varies significantly between different countries (Coulter, McPerson & Vessey, 1988), but also within a population according to education, parity or ethnicity of the individual woman (Meilahn *et al.*, 1989). Furthermore, some studies indicate that the sex of the gynaecologist is significantly related to the frequency of hysterectomies (Domenighetti & Luraschi, 1985). Hysterectomy during reproductive life, however, is not only an artificial end of reproductive function; it also has several effects on women in later life. Hysterectomy has been found to result in a significant improvement in a range of symptoms such as pelvic pain, irregular bleeding, urinary symptoms, fatigue, psychological symptoms and sexual dysfunction (Carlson, Miller & Fowler, 1994). However, a limited number of women (less than 15%) in the same study reported new problems following hysterectomy including hot flushes, depression, a lack of sexual interest and weight gain. An increase in postmenopausal symptomatology in hysterectomized women was also reported by Hartmann *et al.* (1995).

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In contrast to the diverse effects of hysterectomy on well-being and climacteric symptomatology, only a few studies have considered the impact of hysterectomy on postmenopausal body composition. Carlson *et al.* (1994) reported a weight gain following hysterectomy in 12% of their probands. In a study by Ravn, Lind & Nilas (1995), hysterectomized women exhibited 2 to 11% more body fat than women who experienced spontaneous menopause, but no significant differences in bone mineral content or bone density were found. These findings corroborate the hypothesis that hysterectomy without oophorectomy does not reduce ovarian function or increase bone turnover and bone loss. Hysterectomy is an artificial kind of menopause and menopause is known to be associated with weight gain, increased adipose tissue and reduced bone mass in the majority of women. In contrast to natural menopause, which represents the end of a long physiological process, the climacteric or perimenopause, hysterectomy is a sudden and unexpected event for female physiology. Therefore the physiological reactions occur rapidly and powerfully. In the present study body composition differences were assessed between hysterectomized females whose uterus extirpation had no malignant purpose and a control group whose menopause occurred spontaneously.

Material and methods

Subjects

A total of 184 female probands aged between 47 and 57 years (mean 52·9) were examined at the Menox-Ambulatorium for the treatment of climacteric symptoms in Vienna over the period April 1994 to October 1995. All probands were already postmenopausal at the time of the investigation. The women were exclusively Caucasian and lived in Vienna or the urbanized suburbs of Vienna. All probands belonged to the social middle class of Vienna, i.e. had between 9 and 13 years of education. All had finished school and professional training. The sample was divided into two groups.

Group 1 comprised 54 women aged between 47 and 56 years (mean $\pm$ SD = 53·1 $\pm$ 3·3) who had reached menopause as a consequence of a hysterectomy. These probands were only admitted into the evaluation if: (1) the abdominal route had been used, (2) the operation had been performed for a non-malignant purpose (i.e. fibromas, meno- or metrorrhagias) and (3) at least one ovary had been conserved.

Group 2 comprised 130 patients between the age of 48 and 57 years (mean $\pm$ SD = 52·9 $\pm$ 2·9) of the Menox–Ambulatorium whose menopause had occurred spontaneously at a minimum of 1 year prior to the investigation.

All probands had consulted the Menox–Ambulatorium for treatment of acute menopausal symptoms or for osteoporosis prophylaxis. Proband characteristics are listed in Table 1.

In order to obtain more information on patient history all women were interviewed using a standardized questionnaire regarding menopausal complaints, menstrual history and hormone replacement therapy. Furthermore, they were asked to report weight changes since menopause. For women with spontaneous menopause, body weight before menopause was based on retrospective self-report. In contrast, in hysterectomized women premenopausal body weight was determined using the clinical recollection of weight status before hysterectomy.

Table 1. Proband characteristics

	Hysterectomy		Spontaneous menopause		
	Mean	SD	Mean	SD	t value
Chronological age	53·1	3·3	52·9	2·9	1·28 n.s.
Age at menopause	48·3	4·1	48·1	3·6	0·13 n.s.
Years since menopause	5·4	3·5	4·9	2·8	0·09 n.s.

Body composition evaluation

Body composition was estimated by dual-energy X-ray absorptiometry (DEXA; Hologic Corp.). This views the body as consisting of soft tissue, i.e. fat and lean tissue, and bone. It measures total body bone mineral content and density (g/cm^2), fat mass and lean body mass with a precision (coefficient of variation) of 9%, 4·7% and 1·5% respectively. The precision for abdominal fat mass and fat percentage is 4·3% and 3·4% respectively (Slosman *et al.*, 1992; Svendson, Hassager & Christiansen, 1995). The extinction of X-rays, which is tissue-dependent, is measured and absolute and relative fat mass and lean body mass are determined. The scanner uses an X-ray source, an internal wheel to calibrate bone mineral content and an external Lucite and aluminium phantom to estimate the percentage of fat in each soft tissue sample scanned. Simultaneously with the measurement of the skeleton, the percentage of fat is determined from the ratio of attenuation of the lower energy (70 kVP) to that of the higher energy (140 kVP) of the beam. This is calculated for all non-skeleton pixels. The scan time takes less than 7 min. Radiation doses were relatively low, below 0·1 mSv. Default software readings provided lines positioned to divide separate body compartments such as head, trunk, arms and legs. The trunk or upper body region was delineated by an upper horizontal border below the chin, vertical borders between the trunk and the arms and a lower border formed by oblique lines passing through the colli femuri. The lower body or leg region was defined as the area below the lower body of the trunk. For description and quantification of the body fat distribution, i.e. the relation of upper and lower body fat, the fat distribution index (FDI) was used.

$$\text{FDI} = \text{upper body fat/lower body fat.}$$

According to this index, fat distribution can be classified as gynoid (FDI $<$ 0·9), intermediate (FDI 0·9–1·1) and android (FDI $>$ 1·1) (Kirchengast *et al.*, 1997b).

The body mass index (BMI) (body weight (kg)/stature (m) square) was calculated to describe the weight status of individuals, and the categories defined by the WHO report (1995) were used:

BMI below 18·49 kg/m^2 = thin
BMI 18·5–24·99 kg/m^2 = normal weight
BMI 25·00–29·99 kg/m^2 = overweight grade 1
BMI 30·00–39·99 kg/m^2 = overweight grade 2
BMI above 40·00 kg/m^2 = overweight grade 3

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Table 2. Body weight and hysterectomy

	Hysterectomy		Spontaneous menopause		
	Mean	SD	Mean	SD	t value
Stature (cm)	165·4	5·4	164·3	5·6	1·19 n.s.
Premenopausal body weight (kg)	67·4	10·5	66·0	8·7	1·43 n.s.
Postmenopausal body weight (kg)	76·8	12·1	71·9	10·9	2·63 $p<0{\cdot}01$
Postmenopausal BMI	28·3	4·3	26·2	4·4	2·12 $p<0{\cdot}05$
Weight gain since menopause (kg)	9·1	7·1	6·0	5·7	2·89 $p<0{\cdot}01$

Statistical analyses

Statistical analyses were carried out using SPSS for Windows (Microsoft Corp.) according to Bühl & Zöfel (1996). In order to normalize the data and make parametric tests applicable the *z*-scores of all data were calculated first. After computing descriptive statistics such as means, standard deviations, medians and ranges, Student's t-tests were performed to test group differences with respect to their statistical significance. The association between hysterectomy and weight status was tested using cross tabs (Pearson chi-squares). In order to confirm the impact of stature, age and time since menopause on postmenopausal weight gain, a multiple regression analysis and a multifactorial analysis of variance were calculated.

Results

Weight status and hysterectomy

Hysterectomized women were on average taller than women who experienced spontaneous menopause, but this difference was not statistically significant. Similarly, mean body weight prior to hysterectomy or menopause was greater for hysterectomized women, but not significantly so. However, a significant difference was found in postmenopausal body weight: hysterectomized women were heavier ($p<0{\cdot}01$) and had a significantly higher BMI ($p<0{\cdot}05$). In addition, hysterectomized women had a significantly greater self-reported weight gain since menopause than women whose menopause had occurred spontaneously ($p<0{\cdot}01$). The average weight increase in hysterectomized women was 9·1 kg, while in females with spontaneous menopause the average weight gain since menopause was 6·0 kg (see Table 2). The results of the multiple regression analysis revealed that weight gain after menopause was not related significantly to height, chronological age and time since menopause. The significant differences in postmenopausal weight gain between women with spontaneous menopause and hysterectomized women were, according to the results of MANOVA analyses, not due to the insignificant group differences in height, age and time since menopause (see Table 3). Nevertheless, after controlling the differences in weight gain for potential confounders such as stature, premenopausal weight, chronological age and duration of menopause the level of significance fell from $p<0{\cdot}01$ to $p<0{\cdot}05$ (see Tables 2 and 3).

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Table 3. MANOVA analysis

Analysis of variance	df	Mean^2	F value	
Weight gain				
Hysterectomy	1	145·1	3·9	$p < 0{\cdot}05$
Stature height	1	80·2	2·4	n.s.
Premenopausal body weight	1	66·5	2·1	n.s.
Chronological age	1	144·9	3·0	n.s.
Time since menopause	1	4·2	0·1	n.s.
BMI				
Hysterectomy	1	18·8	3·8	$p < 0{\cdot}05$
Stature height	1	60·2	3·1	n.s.
Premenopausal body weight	1	39·8	2·6	n.s.
Chronological age	1	17·7	2·9	n.s.
Time since menopause	1	56·9	2·4	n.s.
FDI				
Hysterectomy	1	3·12	3·9	$p < 0{\cdot}05$
Stature height	1	4·49	2·7	n.s.
Premenopausal body weight	1	3·96	2·4	n.s.
Chronological age	1	0·35	2·2	n.s.
Time since menopause	1	0·13	0·8	n.s.
Total fat %				
Hysterectomy	1	38·5	3·5	$p < 0{\cdot}05$
Stature height	1	111·3	3·1	n.s.
Premenopausal body weight	1	95·4	2·9	n.s.
Chronological age	1	67·3	2·2	n.s.
Time since menopause	1	26·2	0·9	n.s.

According to the BMI categories of the WHO, 64 women (34·9%) could be classified as normal weight; 78 probands (42·7%) corresponded to the category overweight grade 1; and 41 women (22·4%) were overweight grade 2. No proband could be classified as underweight (BMI below 18·5) or obese (BMI > 40·00). Comparison of the two proband groups yielded significant differences. As shown in Table 1, the percentage of normal weight was significantly higher ($p < 0{\cdot}05$) within the group with spontaneous menopause. The percentage of women in the category overweight grade 2 (BMI 30·00–39·99) was significantly higher in the hysterectomized group (see Table 4).

Body composition and hysterectomy

As shown in Table 4, hysterectomized females surpassed women whose menopause occurred spontaneously in nearly all parameters describing the absolute and relative amount of body fat. Statistically significant differences between the two proband groups occurred for the absolute and relative amounts of upper body fat (trunk), and the absolute and relative fat mass of the total body.

Regarding body fat distribution, the fat distribution index, which relates upper to

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Table 4. Postmenopausal weight status and hysterectomy

	Hysterectomy	Spontaneous menopause
Normal weight (BMI $<25{\cdot}00$)	24·5%	39·2%
Overweight grade 1 (BMI 25·00–29·99)	41·5%	43·1%
Overweight grade 2 (BMI 30·00–39·99)	34·0%	17·7%
Chi-square = 6·79 ($p<0{\cdot}05$)		

Table 5. Body fat and hysterectomy

	Hysterectomy		Spontaneous menopause		
	Mean	SD	Mean	SD	t value
Trunk fat mass (in kg)	18·9	6·5	14·3	6·1	2·22 $p<0{\cdot}05$
Left leg fat mass (kg)	6·1	1·6	5·9	1·7	0·71 n.s.
Right leg fat mass (kg)	6·3	1·6	6·1	1·7	0·59 n.s.
Left arm fat mass (kg)	1·9	0·4	1·7	0·5	1·93 n.s.
Right arm fat mass (kg)	1·9	0·6	1·8	0·6	1·13 n.s.
Head fat mass (kg)	0·9	0·1	0·8	0·1	1·96 n.s.
Total fat mass (kg)	34·0	9·4	30·1	9·4	2·09 $p<0{\cdot}05$
Head fat %	18·9	0·8	18·7	0·8	1·67 n.s.
Left arm fat %	54·4	7·1	53·2	8·2	0·84 n.s.
Right arm fat %	52·3	6·9	51·9	7·3	0·78 n.s.
Trunk fat %	41·6	9·3	38·1	9·2	2·14 $p<0{\cdot}05$
Left leg fat %	46·3	5·4	46·5	5·9	−0·24 n.s.
Right leg fat %	46·2	5·9	46·9	5·8	−0·81 n.s.
Total fat %	43·9	6·4	39·7	6·5	2·16 $p<0{\cdot}05$
Fat distribution index	1·39	0·50	1·21	0·44	2·05 $p<0{\cdot}05$

lower body fat, was significantly higher in hysterectomized women, i.e. they had significantly more abdominal than femoral–gluteal fat (see Table 5).

According to the results of multivariate analyses, the impact of hysterectomy on BMI, fat distribution (FDI) and total fat percentage – the most important variables describing weight status and amount of body fat – was independent of potential confounders such as stature, premenopausal weight, chronological age and time since menopause (see Table 3).

In addition, concerning lean body mass, hysterectomized women surpassed the control group in all somatometric parameters. Significant differences between the two proband groups were observed for the lean body mass of the legs and the whole body (see Table 6). No significant group differences were observed for bone mass (bone mineral content, BMC) (see Table 6).

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Table 6. Fat-free body mass and hysterectomy

	Hysterectomy		Spontaneous menopause		
	Mean	SD	Mean	SD	t value
Lean head (kg)	3·3	0·4	3·2	0·3	1·60 n.s.
Left arm lean (kg)	1·4	0·3	1·4	0·2	1·70 n.s.
Right arm lean (kg)	1·7	0·3	1·7	0·3	1·22 n.s.
Trunk lean (kg)	21·7	2·2	21·2	2·2	1·52 n.s.
Left leg lean (kg)	6·5	0·8	6·2	0·8	2·07 $p < 0·05$
Right leg lean (kg)	6·7	0·9	6·3	0·8	2·86 $p < 0·01$
Lean total (kg)	41·4	4·1	39·9	3·9	2·31 $p < 0·05$
BMC head (g)	473·9	63·6	477·4	91·8	−0·26 n.s.
BMC arm left (g)	135·9	31·5	131·6	24·7	0·97 n.s.
BMC arm right (g)	155·3	28·4	147·6	23·5	1·66 n.s.
BMC trunk (g)	641·5	1000·1	616·4	101·3	1·53 n.s.
BMC left leg (g)	450·0	57·2	437·9	62·0	1·23 n.s.
BMC leg right (g)	457·9	59·7	443·7	63·2	1·41 n.s.
BMC total (g)	2313·7	262·9	2246·7	296·9	1·44 n.s.

Hormone replacement therapy

Hormone replacement therapy did not appear to have a significant impact on weight increase and body fat development during postmenopause. Thirty-two females (58·6%) from the hysterectomized group and 71 (54·7%) from the spontaneous menopause group took an oestrogen/gestagen combination for more than 1 year postmenopause. However, neither in hysterectomized nor in spontaneous menopausal women were any significant differences in weight or body composition parameters observed between females who were on HRT and those who never were on HRT.

Discussion

Menopause and postmenopause represent critical periods for body weight regulation in females (Ley, Lees & Stevenson, 1992; Wang *et al.*, 1994). The majority of women report a weight gain of around 5 to 10 kg following the cessation of menstrual function, i.e. menopause. This weight gain is caused by a decrease in energy expenditure due to decreased physical activity and a lower basal metabolic rate, accompanied by unchanged energy intake (eating behaviour) with advancing age (Albanese, 1980). In addition, the drastic hormonal changes that occur during menopause are thought to be responsible for body weight instability during this phase of life. In particular, oestrogen-dependent changes in fat cell metabolism in different anatomical regions seem to be responsible for the characteristic changes in body fat distribution in menopausal women (Rebuffe-Scrive *et al.*, 1985, 1986). The female type of fat distribution, with a higher amount of lower body fat (hips, thighs) in relation to the upper body region, changes into the more masculine variant of fat distribution, the so-called android or centralized fat distribution, with a higher amount of upper body fat in the abdominal area in relation to the lower body (Ley *et al.*, 1992; Kirchengast *et al.*, 1997a). Unfortunately, in women this age- and endocrine-caused fat patterning is associated with several metabolic complications: the so-called ‘metabolic syndrome’ (Sjöström, 1996). The metabolic syndrome constitutes a risk factor for the development of cardiovascular diseases, hyperlipidaemia, hypertension, insulin resistance and diabetes mellitus. Furthermore, an association between centralized fat patterning and colon cancer and mamma carcinoma has been suggested (Hansen, 1996). The ‘malign’ centralized fat distribution is also associated with hyperandrogenicity in young women (Sjöström, 1996) and with overweight and obesity independent of age and menopausal status (Kirchengast *et al.*, 1997a). The metabolic syndrome associated with overweight and centralized fat patterning increases morbidity and mortality in females. Therefore the prevention of overweight and weight gain associated with menopause and postmenopause is one of the major concerns of recent menopause research.

This study suggests that hysterectomy has a strong influence on postmenopausal weight status and body composition characteristics. Hysterectomized women experienced a significantly higher postmenopausal weight gain than those who had a spontaneous menopause (9·1 kg versus 6·0 kg on average). It is well known that heavier women are more likely to under-report their previous weight than lighter women, but in all hysterectomized women weight was clinically documented before hysterectomy and only these values were considered as relevant in the present study. According to the results of MANOVA analysis, hysterectomy had a major effect on higher weight gain in females experiencing an artificial menopause. The percentage of severely overweight postmenopausal women (BMI > 30·00) was significantly higher among hysterectomized women (34·0% versus 17·7%). Furthermore, the MANOVA analyses yielded an independent effect of hysterectomy on the total fat percentage and the fat distribution index. Since body composition varies with body weight it is not surprising that hysterectomized women showed a significantly higher total body fat mass, especially in the upper body region. This result and the significantly higher fat distribution index indicate that hysterectomy is associated with a greater risk for development of the centralized or ‘male’ fat distribution pattern, which is associated with all the adverse metabolic effects mentioned above. Furthermore, hysterectomized women exhibited a significantly higher amount of lean body mass than women with spontaneous menopause; mean bone mass was also higher, but not significantly so. These results are in accordance with the findings of Ravn *et al.* (1995), who discovered a slightly increased bone mass and a significantly increased fat mass in hysterectomized women. The slight increase in bone mass may be explained by increased oestrogen synthesis in more corpulent women who have a greater amount of subcutaneous fat tissue. The higher the amount of fat tissue, the higher the rate of conversion of androgens to oestrogens; this is because of extraovarian oestrogen synthesis taking place in the subcutaneous fat tissue (Perel & Killinger, 1979; Cleland, Mendelson & Simpson, 1985). But what factors are responsible for the higher amount of fat tissue in hysterectomized women? Hysterectomy is – like all surgical procedures – associated with stress factors, the removal of the uterus signalling a ‘loss of womanhood and attractiveness’ for many women (Bunker *et al.*, 1977). Negative psychological reactions to hysterectomy have been recognized since the early seventies (Polivy, 1974). Psychological stress may result in increased calorie intake. On the other hand, hormonal factors may be responsible for the observed changes in body composition. Hysterectomy is assumed not to have any adverse effects upon the function of the ovaries, if conserved (Whitelaw, 1958; Ranney & Abu-Ghazaleh, 1977). Nevertheless, during the past 10 years there has been a change in the awareness of the consequences of extirpation of the uterus *per se*. It appears that the removal of the uterus leads to a loss of ovarian hormone synthesis, even if the ovaries are conserved (Siddle, Sarrel & Whitehead, 1987; Riedel, Lehmann-Willenbrock & Semm, 1986). During hysterectomy, arterial blood flow to the ovaries is reduced by about 50% (Janson & Janson, 1977; Wrdrzynsky, 1985; Riedel *et al*., 1986). This is caused by ligation of both arteriae uterina. This reduced blood supply to the ovaries may lead to a reduction in hormone synthesis by the ovaries, and the resulting abrupt decrease in oestrogen level may be responsible for the weight gain observed following hysterectomy. It may also result in a significantly higher amount of body fat, especially in the abdominal region. The consequence is the development of centralized fat distribution, which is known to be strongly associated with the development of the metabolic syndrome. Although a centralized fat distribution is typical for postmenopausal women, the results of this study indicate that hysterectomy increases the fat distribution index and so the amount of centralized fat. Considering the adverse effects of this kind of fat patterning, hysterectomy may be cited as one of the risk factors for its development.

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