Evaluation of Quality of life, Physical Activity and Nutritional Profile of Postmenopausal Women with and without Vitamin D Deficiency

Qualidade de vida, atividade física e perfil nutricional de mulheres na pós-menopausa com e sem deficiência de vitamina D

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Abstract

Introduction Vitamin D deficiency is associated with various diseases. Prevalent in Brazil, it can result from inadequate lifestyle habits.

Objective To demonstrate that postmenopausal women with vitamin D deficiency have worse quality of health, expressed as worse quality of life, lower levels of physical activity, and worse nutritional profile.

Methods Postmenopausal women answered questionnaires about physical activity and quality of life, provided a 24-hour food record, and had serum vitamin D levels measured.

Results Among the more active women, those who perform a daily average of one hour of physical activity had vitamin D levels above 20 ng/mL (76.9%), and those, which expose themselves to sunlight, had vitamin D levels above 30 ng/mL (34.6%). Meanwhile the percentages for the women who are less physically active and less exposed to sunlight were 42.2% and 8.9% respectively. Being more active and more exposed to sunlight resulted in a lower fat percentage. Serum vitamin D levels were not correlated with quality of life.

Conclusion Walking and gardening increased serum vitamin D levels and decreased the percentage of body fat. The limitations of the study prevented the impact of 25-hidroxyvitamin D on the quality of life and nutritional aspects of the women from being evaluated.

Keywords
- vitamin D
- menopause
- locomotor activity
- gardening

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Resumo

Introdução A deficiência de vitamina D está associada a diversas doenças. Prevalente no Brasil, pode ser consequência de hábitos de vida inadequados.

Objetivo Demonstrar que mulheres na pós-menopausa com hipovitaminose D têm pior qualidade de saúde, expressa por piores qualidade de vida, nível de atividade física e perfil nutricional.

Métodos Mulheres na pós-menopausa responderam a questionários sobre atividade física, qualidade de vida, registro alimentar de 24 horas, e tiveram os níveis séricos de vitamina D medidos.

Resultados Dentre as mulheres mais ativas, as que praticam em média 1 hora de atividade por dia apresentaram níveis de vitamina D superiores a 20 ng/mL (76,9%), e as que se expõem ao sol apresentaram níveis acima de 30 ng/mL (34,6 %). Já as mulheres menos ativas e menos expostas ao sol apresentaram respectivamente 42,2 % e 8,9%. Ser mais ativa e ter maior exposição solar significou ter menor percentual de gordura. O nível sérico de vitamina D não mostrou relação com a qualidade de vida.

Conclusão Caminhada e jardinagem aumentam os níveis séricos de vitamina D e diminuem o percentual de gordura corpórea. As limitações do estudo não permitiram avaliar o impacto da 25-hidróxi-vitamina D na qualidade de vida e nos aspectos nutricionais das mulheres.

Palavras-chave

- vitamina D
- menopausa
- atividade locomotora
- jardinagem

Introduction

Vitamin D is a hormone that has various organic functions, and is produced in the skin following exposure to sunlight, or obtained by eating foods such as fish, eggs and fortified milk.[1]

Observational studies have associated vitamin D deficiency as a risk factor for autoimmune, cardiovascular and metabolic diseases, infections, and malignancies.[2] Furthermore, muscle relaxation and contraction are impaired by vitamin D deficiency, and are associated with pain and muscle weakness, which can increase the risk of falls in the elderly population.[3]

Serum vitamin D levels vary according to the geographical region, type of food, lifestyle, age, race, presence or absence of diseases, and exposure to sunlight.[4–6]

In Brazil, despite the tropical climate with little seasonal variation and sufficient sunshine, vitamin D deficiency is prevalent. Studies have found inadequate concentrations in 42% of the elderly people living in the city of São Paulo, and in 24% of women with osteoporosis.[3,7] In healthy adolescents and young adults, the prevalence was of 60% and 50% respectively.[8,9]

Therefore, it is interesting to understand the reason behind this prevailing presence of individuals with vitamin D deficiency. Among the triggering factors, one can hypothesize that such individuals have a lifestyle that is inadequate for reaching and maintaining proper levels of said vitamin.

According to the World Health Organization (WHO), lifestyle is a set of habits and customs that are influenced, modified, encouraged or inhibited by the process of socialization, and have a major impact on health.[10,11]

Evidence has shown that changes in habits have a huge impact on the quality of life of individuals and of the population.[12,13]

Consequently, vitamin D deficiency in the Brazilian population can be considered due to inadequate lifestyle habits, and could serve as a marker of bad quality of health. We aimed to demonstrate that postmenopausal women with vitamin D deficiency have worse quality of health, expressed as worse quality of life, lower levels of physical activity and worse nutritional profile compared with women without vitamin D deficiency.

Methods

This study is a cross-sectional case-control study in which postmenopausal patients admitted at the outpatient menopause clinic of an institution in the city of São Bernardo do Campo, in the state of São Paulo, Brazil, during the period of January to July 2015, and were invited to participate in the study. The women selected were those who accepted to participate, signed the voluntary and informed consent form, and fulfilled the criteria of eligibility of the study. Said women filled in a registration form providing personal information and their past and present medical histories, answered questionnaires about physical activity, quality of life, and were referred to a nutritionist, who obtained a 24-hour food record from them and performed anthropometric measurements. The study was approved by the Research Ethics Committee of the institution.

In order to be included in the study, the women needed to be in the postmenopausal stage, and be able to read, understand and sign the voluntary and informed consent form.

Women taking vitamin D supplements at the time were not included in the study, neither were women who couldn't perform physical activities, had a questionable clinical history, or had been previously diagnosed with diseases that affect bone metabolism, such as primary hyperparathyroidism, Paget's disease, neoplasias, hypothyroidism or decompensated hyperthyroidism, kidney failure, as well as those taking lipid-lowering drugs and thyroxine, or taking medicines such as corticosteroids and calcium at the time.

Nutritional Evaluation

For the nutritional evaluation, the patients were told to fast (no food or liquids) for 4 hours before the test, and avoid excessive consumption of caffeine-rich foods. During the evaluation, anthropometric data was collected, such as weight (kg), height (cm), abdominal circumference (cm) and fat percentage (%).

The measurements were obtained using G-Tech digital scales, model Glass PRO (G-Tech International Co., Uijeongbu, Gyeonggi, South Korea), which were graduated (kg) and had coupled stadiometers (cm) to define weight and height respectively. The same digital scales defined the fat percentage (%). A graduated tape measure (cm) was used to measure the abdominal circumference. The body mass index (BMI) was calculated as the weight squared (kg^2) divided by the height (cm).

The nutritional evaluation of the patients was performed by a single nutritionist (FJO), who used the 24-hour food records and classified the patients in terms of those who had or had not eaten eggs and fish.

25-Hydroxycholecalciferol (25(OH) vitamin D) was quantified according to the routine procedure for patients at the outpatient menopause clinic, with a validity of 6 months; however, in the case of patients who had been previously tested for 25(OH) vitamin D, a 25(OH) vitamin D sample was collected during the interview with the nutritionist, and the result was subsequently analyzed. Following the evaluation of the results, the patients were divided into 2 groups: the sufficient group, which comprised those with 25(OH) vitamin D $\geq$ 20 ng/mL, and the efficient group, composed of the patients with 25(OH) vitamin D $<$ 20 ng/mL.

Questionnaires

The quality of life questionnaire used was the 36-item Short Form (SF-36) Health Survey, which has items subdivided into 8 domains: physical functioning; role limitations due to physical problems; pain; general health; vitality; social functioning; role limitations due to emotional problems; and mental health. Each domain is scored from 0–100, with 0 being the worst result for the domain, and 100, the best; this is called the Raw Scale, since the final value does not have a unit of measure.[14]

The physical activity performed was evaluated using the International Physical Activity Questionnaire. This questionnaire measures the time spent doing moderate or vigorous physical activity within the domains of work, transport, housework, indoors and in the garden, and leisure during a regular week, and classifies the interviewees as 'more active' (those who perform at least moderate physical activities during more than 150 minutes per week) and 'less active' (those who perform less than 150 minutes of physical activities per week). Gardening was evaluated in terms of the hours spent doing moderate or vigorous domestic activities in the garden or backyard. This questionnaire was developed as a means of measuring the physical activity performed worldwide, and has been shown to be an efficient tool, given that the measurements obtained from it are as good as other established self-reporting measurements of physical activity.[15]

For the purpose of analysis, the patients of this study were also classified as follows: 'more active and exposed' – patients that always walk, including walking as a means of transport and as physical activity, in addition to both moderate and vigorous activities performed in the garden, that is, outdoors, suggesting greater exposure to sunlight, for at least 420 minutes a week, that is, an average of 1 hour of activity per day; and 'less active and exposed' – those who perform less than 420 minutes of activity per week.

Statistical Analysis

The data obtained were organized on electronic spreadsheets using the Microsoft Excel 2007 software (Microsoft Corporation, Redmond, WA, US). The statistical analysis was performed using the WinSTAT software, version 2007.1 (R. Fitch Software, Bad Krozingen, Germany).

Normal distribution was tested using the Kolmogorov-Smirnov test. Continuous numerical data were presented in the form of mean average $\pm$ standard deviation. The categorical data were presented as frequency and percentage.

A comparison between the groups was performed using the Student's *t*-test for independent samples when the continuous numerical data followed a normal distribution and the Mann-Whitney U test when they did not follow normal distribution. For the categorical data, the comparisons were performed using the chi-squared test. A significance level of 5% was adopted.

Results

A total of 253 women were invited to participate in the study. Of these, 179 were not included: 50 already took vitamin D supplements; 3 did not accept to participate in the study; 94 took thyroxine or lipid-lowering drugs; 3 had been diagnosed with kidney failure; and 2 had altered bone metabolism. Of the 74 women included, only 71 were tested for 25 (OH) vitamin D levels.

Of the population studied, 32 women had insufficient vitamin D levels, and 39 had sufficient vitamin D levels. As shown in ►**Table 1**, the only significant difference between these two groups was garden activity, which was greater in those considered to have sufficient vitamin D levels.

►**Table 2** shows the data of the quality of life evaluation, and no statistically significant differences were observed between the sufficient and insufficient vitamin D groups.

The overall average found for serum 25(OH) vitamin D levels was 22.1 ng/mL. Of the white women, 15 (46.9%) were in the 'insufficient' group, and 26 (66.7%) were in the

Table 1 Comparisons between the 25(OH) vitamin D $<$ 20 ng/mL group and the 25(OH) vitamin D $\geq$ 20 ng/mL group for age, age of menopause, anthropometric measurements, fat percentage, total weekly walking time and garden activity

	25(OH) vitamin D $<$ 20 ng/mL	25(OH) vitamin D $>$ 20 ng/mL	
	n = 32	n = 39	
	Mean ± SD	Mean ± SD	p^*
Age (years)	54.8 ± 7.4	56.2 ± 7.1	0.433
Age of menopause (years)	46.3 ± 5.4	47.6 ± 5.6	0.322
Weight (kg)	68.8 ± 11.9	64.7 ± 11.6	0.152
Height (m)	1.53 ± 0.04	1.54 ± 0.05	0.395
BMI (kg/m^2)	29.3 ± 5.2	27.2 ± 4.8	0.081
Fat %	39.8 ± 6.4	37.1 ± 7.7	0.107
AC (cm)	97.7 ± 10.7	95.1 ± 11.6	0.335
Total weekly walking time (min)	199.4 ± 175.0	258.3 ± 226.4	0.232
Gardening (min)	103.0 ± 243.5	289.9 ± 385.4	0.007

Abbreviations: 25(OH) vitamin D, 25-hidroxyvitamin D; AC, abdominal circumference; BMI, body mass index; SD, standard deviation.
Note: $^*p < 0.05$: statistically significant.

'sufficient' group, with no statistical difference between the two groups ($p = 0.093$). The intake of fish and eggs was not different ($p = 0.252$) in the comparison between the women in the groups of insufficient and sufficient vitamin levels, and 4 (12.5%) and 9 (23.1%) women had eaten fish and eggs respectively.

In the evaluation of walking + garden activities > 420 minutes/week, a statistically significant difference ($p < 0.05$) was observed between the insufficient and sufficient groups, wherein 6 women (18.8%) and 20 women (51.3%) performed this activity respectively.

In the comparison between the 'less active and exposed' and 'more active and exposed' groups, shown in ►**Table 3**, it was noted that the latter had greater total weekly walking time, garden activity, 25(OH) vitamin D levels, and a lower fat percentage, all differences being statistically significant ($p < 0.001$). Weight and BMI, although lower in the 'more active and exposed' group, showed no significant differences ($p = 0.08$ and $p = 0.07$ respectively).

In ►**Table 4**, the quality-of-life evaluation data are shown, and no statistically significant differences were observed between the 'less active and exposed' and 'more active and exposed' groups.

There were 17 (37.8%) white women in the 'less active and exposed' group, and 13 (50.0%) in the 'more active and exposed' group ($p = 0.316$). There were 8 women (17.8%) who reported fish and egg intake in the 'less active and exposed' group. and 5 (19.2%) in the 'more active and

Table 2 Quality of life evaluation of the 25(OH) vitamin D $<$ 20 ng/mL group and the 25(OH) vitamin D $\geq$ 20 ng/mL group

	25(OH) vitamin D $<$ 20 ng/mL	25(OH) vitamin D $>$ 20 ng/mL	
	n = 32	n = 39	
	Mean ± SD	Mean ± SD	p^*
Physical functioning	75.6 ± 23.1	78.1 ± 22.3	0.580
Role limitations due to physical problems	57.0 ± 42.7	73.7 ± 37.6	0.092
General health	55.1 ± 19.1	52.8 ± 19.9	0.808
Pain	52.8 ± 22.5	54.9 ± 20.7	0.617
Vitality	58.9 ± 20.7	53.7 ± 15.3	0.282
Social functioning	73.9 ± 26.7	72.6 ± 25.5	0.644
Role limitations due to emotional problems	62.5 ± 46.2	69.2 ± 42.8	0.554
Mental health	67.5 ± 23.3	63.3 ± 19.4	0.328

Abbreviation: SD, standard deviation.
Note: $^*p < 0.05$: statistically significant.

Table 3 Comparisons between the 'less active and exposed' and 'more active and exposed' groups for age, age of menopause, anthropometric measurements, fat percentage, and physical activity

	Less active and exposed	More active and exposed	
	n = 45	n = 26	
	Mean ± SD	Mean ± SD	p^*
Age (years)	55.1 ± 6.8	56.5 ± 8.0	0.424
Age of menopause (years)	46.5 ± 6.1	47.8 ± 4.3	0.359
Weight (kg)	68.3 ± 10.7	63.4 ± 13.2	0.088
Height (m)	1.54 ± 0.05	1.54 ± 0.05	0.692
BMI (kg/m^2)	29.0 ± 4.4	26.7 ± 5.8	0.076
Fat %	39.9 ± 5.5	35.5 ± 9.0	0.028
AC (cm)	97.5 ± 10.1	94.1 ± 12.9	0.212
25(OH) vitamin D (ng/mL)	19.7 ± 7.9	26.2 ± 7.7	0.001
Total weekly walking time (min)	143.2 ± 102.6	385.0 ± 247.5	< 0.001
Gardening (min)	41.3 ± 56.0	490.0 ± 430.8	< 0.001

Abbreviations: 25(OH) vitamin D, 25-hidroxyvitamin D; AC, abdominal circumference; BMI, body mass index; SD, standard deviation.
Note: $^*p < 0.05$: statistically significant.

exposed' group, but no difference was observed between them ($p = 0.879$).

►**Fig. 1** compares vitamin levels, stratified into four groups, for women classified as 'less active and exposed' and 'more active and exposed'. In the evaluation of the groups, none of the women in the 'more active and exposed' group had vitamin D levels below 10 ng/mL, while 57.9% of those in the 'less active and exposed' group had levels below 20 ng/mL. In general, Fig. 1 shows that an almost linear relationship between physical activity and sunlight exposure and vitamin D levels is found in the study population.

Discussion

The results of this study demonstrate that higher 25(OH) vitamin D levels and lower body fat percentage are exhibited by postmenopausal women who perform more physical activity and gardening in outside environments.

The time spent gardening was different between the groups with sufficient (> 20 ng/mL) and insufficient (< 20 ng/mL) 25(OH) vitamin D levels, being significantly higher in the first. In general, this activity is performed outdoors, which increases sunlight exposure and consequently increases 25(OH) vitamin D levels.

Exposure of the skin to sunlight is fundamental for the endogenous production of 25(OH) vitamin D, and explains the influence of outdoor physical activities on the best levels of said vitamin. Studies evaluating 25(OH) vitamin D levels have demonstrated that people admitted to hospitals and elderly people living in nursing homes have 25(OH) vitamin D levels that are considered to be insufficient.[16–18] Similarly, a research performed with Muslim Moroccan women, who

Table 4 Quality of life evaluation of the 'less active and exposed' and 'more active and exposed' groups

	Less active and exposed	More active and exposed	
	n = 45	n = 26	
	Mean ± SD	Mean ± SD	p^*
Physical functioning	76.3 ± 22.1	78.1 ± 23.6	0.516
Role limitations due to physical problems	65.6 ± 40.7	67.3 ± 41.1	0.792
General health	53.5 ± 22.6	54.7 ± 19.5	0.710
Pain	56.9 ± 19.1	48.5 ± 19.2	0.124
Vitality	54.3 ± 18.0	59.0 ± 18.0	0.418
Social functioning	73.7 ± 27.4	72.4 ± 23.6	0.624
Role limitations due to emotional problems	66.7 ± 45.5	65.4 ± 42.7	0.765
Mental health	65.2 ± 20.5	65.1 ± 22.8	0.938

Abbreviation: SD, standard deviation.
Note: $^*p < 0.05$: statistically significant.

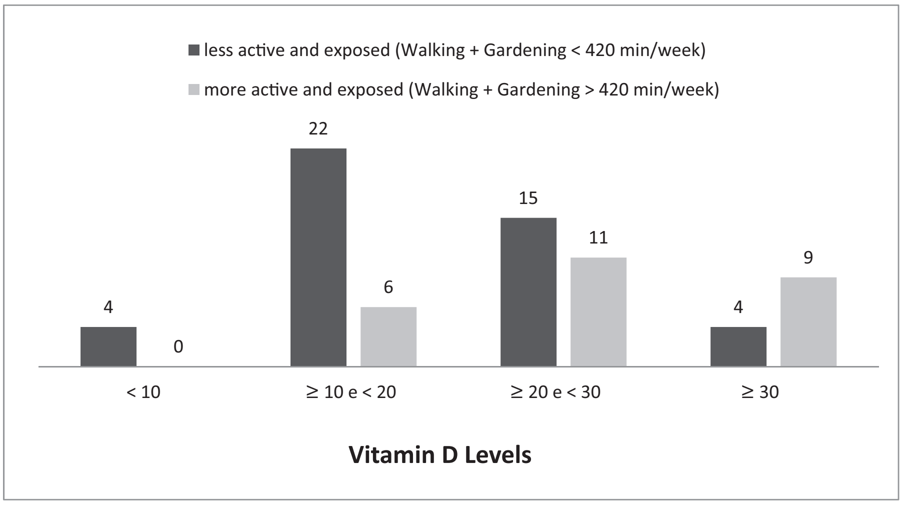

Fig. 1 Participant distribution according to 25(OH) vitamin D levels for the 'less active and exposed' (walking + gardening < 420 minutes/week) and the 'more active and exposed' (walking + gardening > 420 minutes/week) groups.

use a veils and have low exposure to sunlight, found that 91% of them had insufficient 25(OH) vitamin D serum levels.[5]

Women considered to be more active and more exposed to sunlight had higher 25(OH) vitamin D levels in comparison with women who were less active and less exposed to sunlight. The distribution of the various increasing 25(OH) vitamin D levels showed a negative correlation for the women who are 'less active and exposed,' and a positive correlation for the other group. It is noted that outdoors activities have a positive impact on 25(OH) vitamin D levels.

In recent years, observational studies have associated adequate vitamin D levels as a protective factor for various diseases, leading to increased monitoring of the serum levels of said vitamin and preventative supplementation.[2] However, the determining mechanisms of these apparent benefits are unclear, and even the supplementation thereof can be considered to be dependent on the evaluated outcome.[19,20] Furthermore, it is questioned whether low serum levels could be a marker for poor quality of health, with the recommendation being to improve the lifestyle habits prior to the supplementation, a more suitable therapeutic approach.[2,19,20]

It is also highlighted that women with greater sunlight exposure spend more time performing physical activities and have less body fat, which are two factors classically associated with protection against cardiovascular diseases, several cancers and even mental diseases.[2] Consequently, since 25(OH) vitamin D levels also increased as a result of greater sunlight exposure, one can infer that an adequate level of 25(OH) vitamin D is a characteristic of people with a healthy lifestyle and, consequently, with a lower incidence of the aforementioned diseases.

The population of more active and exposed women, as expected, also spent more time walking, more time gardening, and tended to have lower BMIs. Interestingly, physical activity and gardening were related to better quality of health.[21–23] As such, a lower percentage of body fat, lower weight and BMI are considered to be markers of better quality of health.[23] It is also inferred that serum 25(OH) vitamin D levels could be a marker of quality of health in the population of this study.

In the evaluation of the relationship between quality of life and serum 25(OH) vitamin D levels or performing physical activities outdoors, no difference was observed between the groups. The sample size could be an explanation for the lack of relationship, considering that evidence has shown that physical activity, gardening and 25(OH) vitamin D are associated with better quality of life.[24–26]

We highlight that, although there is no significant difference between the 25(OH) vitamin D $>$ 20 ng/mL and the 25 (OH) vitamin D $<$ 20 ng/mL groups, the domain 'role limitations due to physical problems' shows a tendency toward women with lower 25(OH) vitamin D levels. Women with physical problems supposedly find it more difficult to perform physical activities outdoors, and therefore have lower 25(OH) vitamin D levels. However, one cannot discard the possibility of the opposite being true, making it difficult to explain this result.

The average 25(OH) vitamin D serum level found in the population of this study was 22.1 ng/mL. Despite the lack of consensus in the literature regarding the ideal serum level,[19] the majority were considered to have sufficient levels. In the city of São Paulo, the majority of the elderly population (58%), men and women, have sufficient 25(OH) vitamin D serum levels, using 25ng/mL as a reference value.[3]

The nutritional approach was direct and objective, and was performed by a single nutritionist, which is one of the strong points of this study. In order to evaluate a diet rich in 25(OH) vitamin D, the intake of fish and eggs was taken into consideration. It was noted, however, that the majority of participants do not eat a good quantity of these foods, jeopardizing the evaluation. However, it is noted that out of the 13 women who ate eggs and fish, 9 had better 25(OH) vitamin D levels, corresponding to 23.1% of the 39 women with 25(OH) vitamin D $>$ 20 ng/mL.

Among the limitations of this study, we can cite the reduced number of participants included. The reason for this was the large number of postmenopausal women admitted at the outpatient menopause clinic who were taking 25(OH) vitamin D supplements or medicines that could interfere in the result.

In conclusion, this study demonstrates that outdoors physical activity is associated with higher 25(OH) vitamin D serum levels and decreases the percentage of body fat in postmenopausal women. The limitations of the study prevented the impact of 25(OH) vitamin D on the quality of life and nutritional aspects of the women from being evaluated.

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