

# Functional evaluation of the movement: incidence of dynamic knee valgus in bodybuilders and sedentary women

*Avaliação funcional do movimento: incidência do valgo dinâmico do joelho em mulheres praticantes de musculação e sedentárias*

*Evaluación funcional del movimiento: incidencia del valgo dinámico de rodilla en mujeres practicantes de la musculación y sedentarias*

Racklayne Ramos Cavalcanti<sup>1</sup>, Vitória Regina Quirino de Araújo<sup>2</sup>, Danilo de Almeida Vasconcelos<sup>3</sup>, Windsor Ramos da Silva Júnior<sup>4</sup>

**ABSTRACT** | Movement evaluation is important and necessary to identify the risks of injury, enabling the elaboration of preventive and corrective exercise programs, aiming to improve the performance of functional activities and consequent well-being. This study aimed to analyze and compare the incidence of dynamic knee valgus in bodybuilders and sedentary women, as well as to identify the pain symptoms and the potential for injury associated with this biomechanical change. Sixty women were divided into two groups: bodybuilders and sedentary, aged 18 to 30. Data collection consisted of Functional Movement Screen (FMS) and the data were subjected to descriptive and inferential analysis. A total of 60% of sedentary women had dynamic knee valgus, with a predominance of bodybuilders (33.3%), showing an association between dynamic valgus and sedentary lifestyle ( $p < 0.03$ ). There was no association between pain and dynamic knee valgus ( $p > 0.06$ ) for both groups. 50.0% women and sedentary had a FMS score below six points, representing a high risk of injury. It is concluded that sedentary women are more predisposed to dynamic knee valgus, as well as greater pain symptomatology and greater risk of lower limbs injury.

**Keywords** | Physical Therapy Specialty; Knee Valgus; Movement.

**RESUMO** | A avaliação do movimento é importante e necessária para identificar os riscos de lesão possibilitando

a elaboração de programas de exercícios preventivos e corretivos, visando a melhora do desempenho das atividades funcionais e o consequente bem-estar. O objetivo deste estudo foi analisar e comparar a incidência do valgo dinâmico do joelho em mulheres praticantes de musculação e mulheres sedentárias, e identificar os sintomas algícos e o potencial de lesão associados a essa alteração biomecânica. Sessenta mulheres foram divididas em dois grupos: praticantes de musculação e sedentárias, com idade entre 18 e 30 anos. Os dados foram coletados utilizando-se o sistema *Functional Movement Screen* e foram submetidos a análises estatísticas descritiva e inferencial. O valgo dinâmico do joelho é apresentado por 60% das mulheres sedentárias, quando comparadas às mulheres praticantes de musculação (33,3%), demonstrando associação entre o valgo dinâmico e o sedentarismo ( $p < 0,03$ ). Não houve associação entre a dor e o valgo dinâmico do joelho ( $p > 0,06$ ) para ambos os grupos. Das mulheres sedentárias, 50,0% apresentaram escore FMS abaixo de seis pontos, representando alto risco de lesão. Conclui-se que mulheres sedentárias apresentam maior predisposição ao valgismo dinâmico do joelho, maior sintomatologia dolorosa e maior risco de lesão nos membros inferiores.

**Descritores** | Fisioterapia; Valgo de Joelho; Movimento.

Study developed in the Department of Physical Therapy of the Universidade Estadual da Paraíba (UEPB) – Campina Grande (PB), Brazil.

<sup>1</sup>Universidade Estadual da Paraíba (UEPB) – Campina Grande (PB), Brazil. E-mail: racklayne.r@gmail.com. Orcid: 0000-0002-9765-9551

<sup>2</sup>Universidade Estadual da Paraíba (UEPB) – Campina Grande (PB), Brazil. E-mail: vitoriaquirino1@gmail.com. Orcid: 0000-0002-5044-2558

<sup>3</sup>Universidade Estadual da Paraíba (UEPB) – Campina Grande (PB), Brazil. E-mail: davasconcelos@yahoo.com.br. Orcid: 0000-0003-3491-0902

<sup>4</sup>Universidade Estadual da Paraíba (UEPB) – Campina Grande (PB), Brazil. E-mail: windsor.jr@gmail.com. Orcid: 0000-0003-1778-8669

Corresponding address: Racklayne Ramos Cavalcanti – Rua Manoel Porto, 455, Santa Rosa – Campina Grande (PB), Brazil – Zip Code: 58416-518 – Email: racklayne.r@gmail.com – Financing source: Nothing to declare – Conflict of interests: Nothing to declare – Presentation: Feb. 1<sup>st</sup>, 2018 – Accepted for publication: Apr. 12<sup>th</sup>, 2019 – Approved by the Research Ethics Committee of the Universidade Estadual Paraíba under opinion No. 58746116.2.0000.5187.

**RESUMEN** | La evaluación del movimiento se hace importante y necesaria para la identificación de los riesgos de lesión, posibilitando la elaboración de programas de ejercicios preventivos y correctivos, buscando la mejora del desempeño de las actividades funcionales y el consiguiente bienestar. El objetivo de este estudio fue analizar y comparar la incidencia del valgo dinámico de la rodilla en mujeres practicantes de musculación y mujeres sedentarias, e identificar los síntomas álgicos y el potencial de lesión asociados a esa alteración biomecánica. Sesenta mujeres fueron divididas en dos grupos: practicantes de musculación y sedentarias, con edad entre 18 y 30 años. Los datos fueron recolectados a través del sistema *Functional Movement Screen*

y sometidos a análisis estadístico descriptivo e inferencial. El valgo dinámico de la rodilla fue presentado por el 60% de las mujeres sedentarias y por el 33,3% de las mujeres practicantes de musculación, demostrando asociación entre el valgo dinámico y el sedentarismo ( $p < 0,03$ ). En los dos grupos no hubo asociación entre el dolor y el valgo dinámico de la rodilla ( $p > 0,06$ ). De las mujeres sedentarias, el 50% presentó puntuación FMS menor que seis puntos, representando alto riesgo de lesión. Se concluye que las mujeres sedentarias presentan mayor predisposición al valgo dinámico de la rodilla, mayor sintomatología dolorosa y mayor riesgo de lesión en los miembros inferiores.

**Palabras clave** | Fisioterapia; Valgo de la Rodilla; Movimiento.

## INTRODUCTION

The population has sought ways to improve their health conditions and quality of life<sup>1</sup>. Among the widely publicized alternatives, bodybuilding is the practice most sought after by individuals of different age groups and socioeconomic classes and by both genders<sup>2</sup>, since it works specific muscle groups in the most varied types of movements, using numerous specialized equipment<sup>3</sup>. Despite the importance of physical activity in maintaining a healthy standard of living, its inadequate practice or accompanied by unprepared professionals can determine the increase in the frequency of injuries<sup>4,5</sup>, making bodybuilders susceptible to musculoskeletal, ligamentous and cartilaginous lesions<sup>5,6</sup>.

Among the most affected body segments during bodybuilding, the knee presents high incidence, due to its low intrinsic stability, depending on muscle and ligament structures for its stabilization<sup>6</sup>. Between the factors that predispose to the lesions in this joint, we highlight the dynamic valgus, which is characterized by the misalignment of the lower limb in the frontal plane, caused by the adduction and medial rotation of the hip, being directly influenced by the body structure and the stabilizing inability of the external rotator muscles of the hip, specifically the gluteus medius, in the performance of functional movement patterns<sup>7-9</sup>. Females presented biomechanical differences in lower limb movement pattern when compared to men, due to anatomical and physiological factors, such as wider pelvis, delayed activation of the medial musculature of the knee, lower joint stiffness and body mass, contributing to a higher incidence of valgus observed in this gender<sup>10</sup>.

The identification of dynamic valgus is very important to prevent knee joint injuries, as well as for the prescription of adequate physical activity for the body biomechanics of each individual. Thus, in 1997, a Functional Movement Screen (FMS) was created by Cook et al.<sup>11</sup>, which emerged as an option to analyze the quality of movement from a functional point of view, based on muscular imbalances and body compensations that can cause musculoskeletal injuries. This tool is capable of assisting in the screening for injury risk and the identification of movement patterns that can be corrected or stabilized with adequate training, offering the means to recognize and improve any weak segments that compromise the body and its healthy movement<sup>11</sup>.

Therefore, this study aimed to analyze and compare the incidence of dynamic knee valgus in bodybuilders and sedentary women, as well as to identify the pain symptoms and the potential for injury associated with this biomechanical alteration. It was hypothesized that women who practice bodybuilding would have a low incidence of dynamic knee valgus compared to sedentary women.

## METHODOLOGY

It is a descriptive, comparative and cross-sectional study. Data were collected during November, 2016, in a medium-sized gym, specialized in muscle training, in the city of Campina Grande/PB and in the multifunctional laboratories of the Physical Therapy Department of the Universidade Estadual da Paraíba (UEPB). Sixty apparently healthy female participants, aged between 18-30, participated in this study and were divided into

two groups: bodybuilders (group 1) and sedentary (group 2). To be included in the sample, women who practice bodybuilding should have the established age group and practice bodybuilding regularly, for at least three months, three times a week. To make up the group of sedentary women, they should be without regular physical activity for at least three months. Those that presented musculoskeletal lesion, comorbidities or surgical history in lower limbs (LL) that prevented or limited the evaluation were excluded from the sample.

A data sheet containing sociodemographic, anthropometric data (body mass, height) and history of previous diseases in the participants' LL were used to characterize the sample. Information was requested from group 1 about the practice of physical activity, such as: time of bodybuilding practice, weekly frequency and injury occurrence during practice time. With the individual in the orthostatic position, in the immediate rest after performing the FMS tests, the visual analogue scale (VAS) was applied to evaluate joint or muscle pain in the LL of both groups.

In order to evaluate the movements, FMS was used, which consists of seven tests that assess the stability of the trunk, the movement range and the quality of the symmetry during the realization of basic functional movements. It consists of seven functional tests: deep squat, hurdle step, in-line lunge, shoulder mobility, active straight leg raise, trunk stability push up and rotary stability. For this study, only the three initial tests were performed, since these are directed to the lower limbs.

For each test, the scores range from 0 to 3 points, being the score based on the quality of the movement, the presence of asymmetries and the difficulty to complete the test. Score 3 was assigned when the individual was able to perform the functional movement pattern perfectly; score 2, when the individual was able to perform the functional movement pattern, but with some compensations; score 1 for the individual unable to complete the functional movement pattern; and score 0 for the individual who presented pain when performing the movement. Finally, the scores of each test were summed<sup>11</sup>.

FMS has a total score of 21 points (maximum score of 3 points for each of the 7 tests), and it is expected

that the individual will achieve a minimum score of 14 points (score of 2 points in each test) for a low risk of injury<sup>11</sup>. In this study, using only 3 of the 7 FMS tests, the value of 9 points (maximum score of 3 times 3 tests) was considered as total score, corresponding to the evaluated items, considering 6 points (score 2 in each test) the minimum score for low risk of injury.

To better understand the research participant and aiming to assess a better result, the tests were performed three times, using the highest score obtained. Between each repetition, the participant would rest for a minute. It is noteworthy that all tests were performed before the bodybuilding practice, for group 1.

The material used was the FMS ruler (dimensions 150 cm × 15 cm, parallel bars of 80 cm in length and a stick of 100 cm in length), being conducted by only a nonblind evaluator. To consider the use of videos to give a score would be a limitation of the test, since FMS is a tool designed to provide a live performance classification<sup>12</sup>. Thus, no camera was used for further analysis.

The data were analyzed based on the interpretation of the results obtained through the FMS evaluation and comparing them with the existing literature. Numerical data were analyzed using descriptive statistics (mean and standard deviation) and inferential statistics. In order to verify the influence of the variables (age, height, body mass index, pain and dynamic knee valgus) between groups, the multivariate analysis of variance (Manova) was used, and, for comparative analysis, the t test was used for independent samples. For all the statistical tests, the software SPSS (Statistical Package for Social Science) version 19.0 was used, and the level of significance <0.05.

## RESULTS

Data regarding age and body mass index (BMI) did not show significant differences, reflecting a homogeneous sample and not influencing the values obtained during the evaluation (Table 1).

Table 1. Sample characterization

	Group 1		Group 2	
	(Mean ± standard deviation)	Frequency (absolute value -%)	(Mean ± standard deviation)	Frequency
Age (years old)	24.4±2.7	-	23.0±3.2	-
BMI (kg/m <sup>2</sup> )	23.3±9.8	-	21.2±8.9	-
Practice time (months)	18.1±13.8	-		-

(continues)

Table 1. Continuation

	Group 1		Group 2	
	(Mean ± standard deviation)	Frequency (absolute value –%)	(Mean ± standard deviation)	Frequency
<b>Weekly Frequency</b>				
3 times		10 (33.4%)		-
4 times		5 (16.7%)		-
5 times		15 (50.0%)		-
<b>Dominance</b>				
Left		2 (6.7%)		3 (10.0%)
Right		28 (93.3%)		27 (90.0%)

Through the three FMS tests, it was observed that, during the deep squat test, only 10% of the women practicing bodybuilding presented dynamic valgus, while in the sedentary women group, 43.3% presented the biomechanical alteration, showing higher incidence of dynamic valgus in this sample group. Although a discrete difference was observed, the incidence of dynamic valgus was higher in sedentary women during the hurdle step test, when compared to the incidence in the bodybuilders group. In the in-line lunge test, the incidence of dynamic valgus was higher among the sedentary women, if compared to the bodybuilders group.

Table 2. Comparison between the groups presenting dynamic knee valgus

Group	Presence of valgus		p
	Yes	No	
Bodybuilders	10 (33.3%)	20 (66.6%)	0.03
Sedentary	18 (60.0%)	12 (40.0%)	

When comparing the incidence of dynamic knee valgus between the groups, a higher frequency of biomechanical alteration was observed in the group of sedentary women, when compared to the group of bodybuilders, with a statistically significant difference ( $p=0.03$ ) between the groups confirming the hypothesis formulated.

Table 3. Presence of painful symptoms between groups

	Group 1		Group 2	
	(Mean±standard deviation)	Frequency	(Mean±standard deviation)	Frequency
<b>Presence of Pain</b>				
YES		5 (16.7%)		17 (56.7%)
NO		25 (83.3%)		13 (43.3)
<b>Sore side</b>				
None		25 (83.3%)		13 (43.3)
Left		3 (10.0%)		6 (20.0%)
Right		2 (6.7%)		11 (36.7%)
<b>VAS</b>	0.90±1.86		2.97±3.00	
<b>Pain in functional activities</b>				
To go up stairs		1 (2.7%)		3 (8.1%)
To go down stairs		1 (2.7%)		2 (5.4%)
To squat		1 (2.7%)		10 (27.0%)
To kneel		1 (2.7%)		4 (10.8%)
To sit for long time		1 (2.7%)		6 (16.2%)
To jump		-		2 (5.4%)
To run		1 (2.7%)		5 (13.5%)
To walk long distances		-		5 (13.5%)

When analyzing the pain symptoms (Table 3), 56.7% of group 2 complained of pain in the lower limbs, being more prevalent in the dominant limb. The percentage of painful symptoms of the group 1 members was only 16.7%.

When correlating the presence of pain with the incidence of dynamic valgus, 48.3% of the sample showed biomechanical alteration associated with pain symptoms, and there was no significant difference ( $p=0.06$ ) comparing

these variables, rejecting the hypothesis that the pain would be associated with the dynamic valgus of the knee.

Table 4. Association of the dynamic knee valgus presenting pain

Presence of valgus	Presence of Pain		p
	Yes	No	
Yes	14 (48.3%)	15 (51.7%)	0.06
No	8 (25.8%)	23 (74.2%)	

Table 5. Potential of injury

Score	Group 1	Group 2
≤5	2 (6.7%)	15 (50.0%)
≥6	28 (93.3%)	15 (50.0%)

Analyzing the potential for injury through the FMS score, it can be observed that 50.0% of group 2 presented a score below 6 points, which represents a high risk of injury in the lower limbs when compared to the score obtained by group 1, in which 6.7% of the sample obtained score below 6 points.

## DISCUSSION

Dynamic knee valgus has as a triggering factor of biomechanical changes in the foot, weakness of the pelvic muscles (core) and, mainly, weakness of the external rotator muscles of the hip<sup>6,13,14</sup>, which causes the contralateral pelvis to fall and the increase of the dynamic valgus during functional movements<sup>15</sup>. Such evidence was reproduced in this study, since sedentary women showed a higher incidence of dynamic knee valgus, as well as a greater predisposition to injury risk in the lower limbs.

The results found in this study agree with the aforementioned studies, demonstrating that the strengthening of the muscles through the practice of bodybuilding proved to be effective for the development and maintenance of adequate body biomechanics<sup>16</sup>. On the other hand, sedentary individuals are more likely to trigger musculoskeletal dysfunctions due to the imbalance between the muscular forces exerted on the knee joint, which causes joint misalignment and a greater predisposition to injury of this joint in the basic daily functional activities<sup>8,17</sup>.

The incidence of dynamic knee valgus was higher in sedentary women, corroborating the study<sup>18</sup> that observed that proper practice and the right intensity of physical exercise provide better functional integrity of the knees in bodybuilders, protecting, stabilizing and allowing a good myoarticular function of this articulation.

It is noteworthy that the alterations in the LL alignment generate a series of functional impairments, increasing the risk of ligament injuries, compression syndromes, patellofemoral syndrome, joint pain and reduced performance in functional activities<sup>13,19</sup>. In this sense, physical therapy has an indispensable role in the prevention and treatment of these biomechanical alterations by awareness and postural correction techniques, stretching and muscular strengthening of the

structures involved, eliminating patterns of compensatory movements and improving the alignment of this joint.

Concerning painful symptoms, when asked which functional activity the pain was most frequent, group 2 complained of pain when crouching, sitting for prolonged periods of time and running or walking for long distances. The values found in group 1, which contemplated the various functional activities, were not significant enough, but require the attention of the professionals that follow them in order to avoid future symptoms. These results reinforce the importance of the muscular strengthening of the involved structures for the best performance of these functional activities.

When correlating the presence of pain with the incidence of dynamic valgus, there was no statistically significant difference between these variables, corroborating the already performed study<sup>20</sup> that aimed to verify the relationship between the q-angle with pain intensity and functional capacity, not finding any relationship between knee valgus and these variables. The results were similar to those found in the literature<sup>21</sup> when verifying if the increase of the q-angle would lead to increased knee pain.

Considering the potential for injury, studies show that by the FMS total score it is possible to characterize the risk for future injuries, with a higher score being related to the lower propensity to injury, and lower scores increase the risk of injuries<sup>12,22-24</sup>. The results found in the study highlight the importance of practicing physical activity for body well-being, and strength training is one of the most effective methods for maintaining muscle strength, function and health. The low scores identified are reflections of inadequate movement patterns<sup>22,24</sup> and care in the indication and prescription of the exercise is necessary, respecting the limitations of each individual<sup>16</sup> to obtain gains in physical activity.

The muscular strengthening provided by bodybuilding practice has proved to be an effective method for the acquisition and/or maintenance of the good balance of the body biomechanics, as well as for the prevention of osteomioarticular lesions. In the same way, the FMS is presented as an effective evaluation method to prevent injuries and performance analysis during physical and sports activities<sup>12</sup>. Therefore, it is essential the role of the physical therapist to know the mechanisms of injury and in the accomplishment of a detailed physical evaluation, in order to base the application of the therapeutic exercises and propose the most appropriate interventions for each individual.

This study had some limitations. Considering its transversal nature, the fact that it did not evaluate the



bodybuilders before beginning the practice and could not follow them hampered more definitive conclusions. It may be biased because the researcher was not blinded. The shortage of literature to support the study was a difficulty. In this case, further investigation on the application of FMS as an adjuvant evaluation method to the physical therapy treatment of osteomioarticular dysfunctions is suggested.

## CONCLUSION

In conclusion, it was observed that sedentary women have a higher incidence of dynamic knee valgus when compared to women practicing bodybuilding. The biomechanical alterations in the sedentary women became more evident in a qualitative way through the postures adopted during the FMS tests; and quantitatively due to the lower score obtained, reflecting a considerable risk of lesions in the lower limbs of this population.

The muscular imbalance and delayed activation of the hip posterolateral complex, responsible for the increase of the q-angle, may be predisposing factors for the sedentary women in this study to have greater occurrence of dynamic knee valgus, as well as greater painful symptomatology in the daily functional activities, leading to patterns of compensatory and inadequate movements, unlike the bodybuilding participants.

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