# 25 - DESCRIPTIVE STUDY OF TEMPORAL AND KINEMATIC GAIT PARAMETER IN YOUNG FEMALE ADULTS

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## INTRODUCTION

The human body is a system able to perform various movements, including walking, which is one of the most common skills and of great importance to human life, as it offers independence, thus making possible human locomotion (Estrazulas , et al., 2005).

This motion is called gait or walk, and aims at a forward displacement in which transfers the weight of one leg to another, enabling human locomotion (Ribas et al., 2007). The gait cycle consists of two steps (i.e.) if the step starts with the right foot the cycle ends when it touches the ground again. This cycle is divided into two main phases: the first contains the stance and swing phases and the second phase is the double support. The normal gait stance phase comprises about 60% of the gait cycle and is defined as the interval in which the foot of the reference member is in contact with the ground. The swing phase constitutes 40% of the gait cycle, and is where the reference member is not in contact with ground. The double support refers to the two intervals in a gait cycle in which body weight is being transferred from one foot to the other, and both feet are in contact with the ground during the same period of time (GAMBLE, 1998 ).

As the gait is a succession of repetitions of the step cycle, normal patterns are defined, however each person has its particular pattern of motion with acceptable levels with minimal energy expenditure, adequate stability and acceptable appearance. Gait cycles different from these pattern levels for some sensory or motor impairment, are considered pathological gait patterns (Estrazulas, et al. 2005; Ribas et al., 2007).

Tamporal and Kinematic biomechanical analysis attempts to measure and interpret some parameters involved in human walking, helping researchers to identify patterns and changes in the gesture of the movement (Baker, 2006). Therefore, there is a continuing demand for studies in this area, especially with regard to the assessment and characterization of gait, which directly involve physical therapy goals during rehabilitation interventions (Ribas, 2007).

Thus it is clearly necessary to understand normal walking patterns adopted by healthy individuals in an age group which gait development is considered mature, in order to study the biomechanical changes resulting from diseases situations. Therefore, this study aims to analyze the step temporal and kinematic parameters of young female adults while walking, such as step length and time, descriptive analysis of the joint angles of the lower limb (hip, knee and ankle) during the initial contact of the foot (stance phase) and at the end of the foot contact with the ground (push-off phase). In addition, there is a comparison within each subject to identify whether there are differences in the pattern of walking between three repetitions of the same motion gesture.

## METHODOLOGY

1.Study design and sample

The study design was cross-sectional and consists of a sample of 10 young female adults, aged between 18 and 23 years selected intentionally. Before starting, this study was approved by the Research Ethics Committee from State University of West Paraná-Brazil.

*1.1Inclusion criteria*

To participate the subjects should be female and have ages from 18 to 24 years.

*1.2Exclusion Criteria*

Subjects were excluded of study sample if:
a)They have been diagnosed with neurological disease.
b)Have severe gait disabilities, in which auxiliary orthesis are necessary for locomotion
c)Have visual deficits diagnosed and without correction.
d)Use drugs with documented effects on balance or gait
e)Have orthopedic diseases or musculoskeletal injuries.
f)Have vertigo and / or uncontrolled chronic vestibulopathy.
g)Reported pain of any kind that may influence the gait quality of.

*1.3Identification form*

An identification form was used write anthropometric data of the participants. The form contained identification data of the participants such as name, age, sex, height, lower limb size, body weight and data of their health conditions (diseases, injuries, medications utilized, etc.).

*1.4Walking Assessment*

The protocol for step assessment was based on the analysis of gait over a 8-meter walking platform specially built for the gait analysis. To familiarize the subject with the test, at least five simulations were performed, in which the subject should walk over the 8-meter platform. The subjects were instructed to walk barefoot and using the preferred comfortable walking speed (auto selected). Three cycles of full motion of one step in the middle of the course of 8 meters were recorded on a conventional video camera (Panasonic, Japan) positioned at 3.50 meters from the platform, with sampling frequency of 60Hz that was used to record the bidimensional kinematics of motion of the hip, knee and ankle in the sagital plane. The camera was positioned with its focus in front of the platform, in a standard height of 60 cm, so that it was possible to record images of the right lower limb and trunk. To determine the angles of hip, knee and ankle during the step of the right lower limb, a 5-marker biomechanical model of the lower

limb was adopted by fixing 5 markers (3 cm diameter) in the follow body positions: anterossuperior iliac spine, greater trochanter of the femur, the lateral interarticular knee line, lateral ankle malleolus and at the fifth metatarsal head. These markers were fixed to determine the angles of hip, knee and ankle during the step cycle.

Kinematic data like step duration, average speed, stride length and size and joint angles were recorded (1) during the initial contact of the foot with the floor, also named as Support Phase (SP) and (2) during the final step stage in which the foot makes contact with the floor (push-off phase), also named Impulse Phase (IP). The temporal and kinematics of step were then calculated based on the movement over time recorded by video camera using the software Kinovea v. 0.8.15.

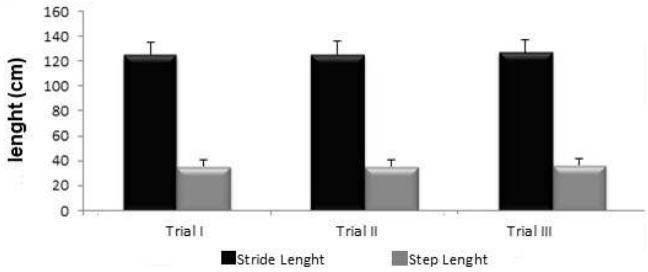
In this study descriptive analysis of stride length and time were performed together with the descriptive analysis of joint angles found in AF and FI phases. The analysis of variance (ANOVA one way) followed by post hoc Bonferroni test was used to identify possible differences between the three step repetitions. Statistical analysis was performed using the statistical package SPSS v. 17 (Statistical Package for Social Sciences) adopting = 0.05.

**RESULTS AND DISCUSSION**

The mean values found in the duration for performing the stride were 0.73 seconds while for the step 0.39 seconds were required. The average length of stride and step were: 125.8cm and 35.9cm, respectively. The average values for the hip angles were 166° (SP) and 188° (IP).The knee mean angle mean values were 177° (SP) and 151° (IP). The ankle angles were 120° (SP) and 123° (IP).

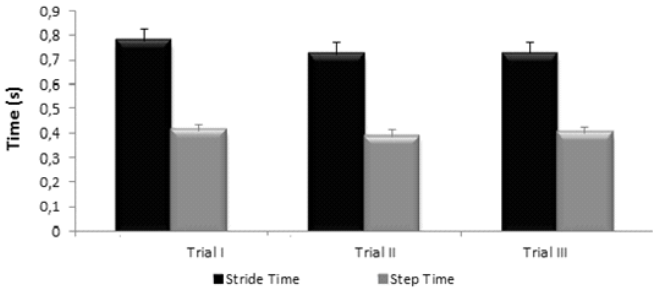
There were no significant differences between the repetitions analyzed. The average length of stride and step were similar between repetitions, suggesting that the sample group maintained the same walking pattern (Figure 1).

**Figure 1** - Average length of stride and step in the performed trials.




The average time required to perform the step (duration) also proved to be quite similar while comparing the three repetitions performed (Figure 2). Thus, showing that there are no significant changes in the walking patterns of subjects.

**Figure 2** - Mean Time and the last step in each of the repetitions




Regarding joint angles during SP and IP phases, we found no significant differences between repetitions analyzed, Figures 3 and 4. Thus, as expected, there was no learning effect between trials or other any other changes related to the gait pattern.

**Figure 3** - Average value of the angle of the hip, knee and ankle during the SP found.

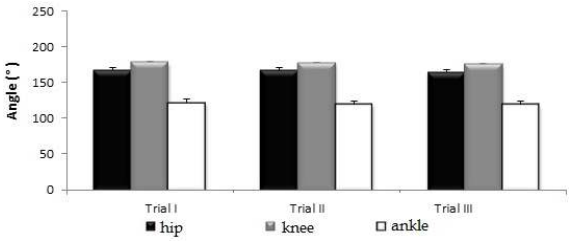



Figure 3 - The wide bars represent the mean values for the angles of hip, knee and ankle during SP. The smaller bars represent the standard deviation values of the sample.

**Figure 4** - Average value of the angle of the hip, knee and ankle found during the IP.

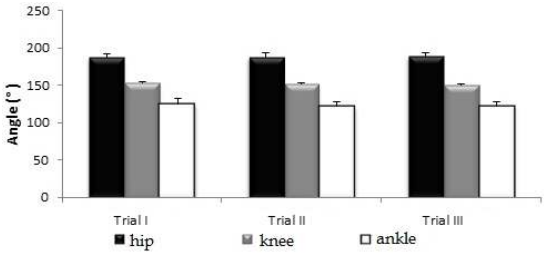



Figure 4 - The wide bars represent the mean values for the angles of hip, knee and ankle during IP. The smaller bars represent the standard deviation values of the sample.

The data indicated, therefore a very homogeneous group, with values very close to the normal, and may well represent the gait, stride and step kinematic values of a young control group.

**CONCLUSION**

The group analysis showed no statistical differences for any of the spatial and kinematic variables analyzed between the three gait trials, moreover, the values were within the range considered normal for the young age group studied. In this study it was possible to analyze the reference values of joint angles of the hip, knee and ankle while walking during the support and impulse phases in a group of healthy young female adults.

Therefore, stride and step kinematic values obtained were similar to normal findings in the literature and in the future will serve as controls for comparison in future studies using subjects in various conditions, such as elderly people or groups of individuals with neurological or orthopedic impairment of the normal gait pattern.

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**DESCRIPTIVE STUDY OF TEMPORAL AND KINEMATIC GAIT PARAMETERS IN YOUNG FEMALE ADULTS**

**SUMMARY**

The human body is a system capable of performing many movements, walking in is one of the most common performed skills. It is very important to undertand the normal walking pattern adopted by the young and healthy, in order to be able to study the changes resulting from pathological conditions. Therefore, this study aims to make a descriptive analysis of kinematic and temporal parameters of one step thoughout a walking condition. The variables analyzed were the joint angles of the lower limb, duration and step length of young female adults. In addition, the study compares whether there are differences in the walking pattern among three repetition trials of the step gesture. Ten women aged between 18 and 23 years participated in the study which consists of recording the step biomechanical variables while walking. No significant differences were found between the three step trials analyzed. The values found for the stride duration and length were 0.73 s. and 125.86 cm respectively. Concerning the step duration and length were found 0.39 s. and 35.93 cm. The mean values for the hip were 166° and 188°; for the knee 177° and 151° and for the ankle angle 120° and 123° in the stance phase and in the impulse phase, respectively.

**KEYWORDS:** kinematics, human gait, angle of gait.

**DESCRIPTION DE L'ÉTUDE ET PARAMÈTRES CINÉMATIQUE EN TEMPS DE MARS DEJEUNES FEMMES**

**RÉSUMÉ**

Le corps humain est un système capable d'effectuer de nombreux mouvements, la marche en eux est une des compétences les plus couramment effectuées. Il est très important de connaître le schéma normal de marche adopté par le si jeuneet en bonne santé qu'ils peuvent ensuite étudier les changements résultant deconditions pathologiques. Par conséquent, ce document vise à faire une analyse descriptive des paramètres cinématiques et temporelles caractérisant les angles des articulations du membre inférieur dans le cycle de la marche des jeunes individus. De plus, nous avons cherché à déterminer s'il existe des différences dans la structure de marche entretrois répétitions du mouvement geste. Dix femmes âgées entre 18 et 23 ans ont participé à l'étude qui a analysé les trois derniers cycles complets sur une distance de 8 mètres à pied, les données ont été analysées et la longueur du temps nécessaire pour effectuer une étape et foulée. De même, les angles de la hanche, du genou et la cheville lors de la phase d'appui et de phase de propulsion. Aucune différence significative n'a été trouvée entre lesdonnées analysées et les valeurs trouvées pour la dernière fois de 0,73s à 125,86cm de distance du passé, pour l'étape 0.39 de temps s. et la taille de pas 35,93 cm. En ce qui concerne les valeurs moyennes pour les angles, l'angle de la hanchemoyenne était de 166 ° dans la phase d'appui et de 188 ° en phase est lancée. Pour les valeurs de l'angle moyen au genou dans la phase d'appui sont de 177 ° et laphase de propulsion de 151 °. Pour les valeurs d'angle de cheville ont été trouvés à 120 ° et 123 ° de phases de soutien et de l'élan, respectivement.

**MOTS-CLÉS:** cinématique, la démarche humaine, l'angle de la marche.

**DESCRIPCIÓN DEL ESTUDIO Y PARÁMETROS DE TIEMPO CINEMÁTICO DE MARZO DE MUJERES JÓVENES**

**RESUMEN**

El cuerpo humano es un sistema capaz de realizar muchos movimientos, andando en ellos es una de las habilidades que más se realizan. Es muy importante conocer el patrón normal de caminar adoptada por la tan joven y saludable, que más tarde pueden estudiar los cambios resultantes de las condiciones patológicas. Por lo tanto, este trabajo tiene como objetivo hacer un análisis descriptivo de los parámetros cinemáticos y temporales que caracterizan el ángulos de las articulaciones de las extremidades inferiores en la forma de andar de las personas jóvenes. Además, hemos tratado de identificar si existen diferencias en el patrón de caminarentre las tres repeticiones del movimiento gesto. Diez mujeres de entre 18 y 23 años participaron en el estudio que analizó tres últimos ciclos completos sobre una distancia de 8 metros a pie, los datos fueron analizados y el tiempo necesario para realizar un paso y paso. Además, los ángulos de cadera, rodilla y tobillo durante la fase de apoyo e impulsar la fase. No se encontraron diferencias significativas entre los datos analizados yencontrar los valores de la última vez que fueron de 0,73 s a 125,86 cm del pasado,para el paso de tiempo 0,39 s. y el tamaño del paso 35,93 cm. En cuanto a los valores medios de los ángulos, el ángulo de la cadera promedio fue de 166° en la fase de apoyo y 188° en la fase es el impulso. De los valores medios del ángulo de rodilla se encuentra en la fase de apoyo fueron177º y la fase de impulso de 151°. Para los valores de ángulo de tobillo se encontraron 120° y 123° de las fases de apoyo y el impulso, respectivamente.

**PALABRAS CLAVE:** la cinemática, la marcha humana, el ángulo de la marcha.

**ESTUDO DESCRITIVO DE PARÂMETROS TEMPORAIS E CINEMÁTICOS DA MARCHA DE MULHERES JOVENS**

**RESUMO**

O corpo humano é um sistema capaz de realizar inúmeros movimentos, dentro deles a deambulação é uma das habilidades mais comuns. É se suma importância conhecer o padrão de caminhada normal adotada por indivíduos jovens e saudáveis para que se possa posteriormente estudar as alterações decorrentes de estados patológicos. Portanto, esse trabalho tem por objetivo fazer uma análise descritiva cinemática de parâmetros temporais e uma caracterização dos ângulos articulares do membro inferior no ciclo da marcha de indivíduos jovens. As variáveis analisadas foram o comprimento e o tempo necessários para realização de um passo e da passada. Bem como, os ângulos articulares do quadril, joelho e tornozelo, durante a fase de apoio e a fase de impulso. Além disso, buscou-se identificar se existem diferenças no padrão da caminhada entre três repetições do gesto de movimento. Dez mulheres com idades entre 18 e 23 anos participaram do estudo que consistiu em registrar as variáveis biomecânicas do passo ao caminhar. Não foram identificadas diferenças significativas entre os entre os três ensaios analisados. Os valores para o tempo da passada foram de 0,73s, para a distância da passada 125,86cm, para o tempo de passo 0,39s. e para o tamanho do passo 35,93cm. Com relação os valores médios encontrados para os ângulos, a média do ângulo do quadril foi de 166°, na fase de apoio e de 188°, na fase se impulso. Para o ângulo do joelho os valores médios encontrado na fase de apoio foram de 177° e na fase de impulso de 151°. Para o ângulo do tornozelo os valores médios encontrados foram de 120° e 123° para as fases apoio e de impulso, respectivamente.

**PALAVRAS CHAVES:** cinemática, marcha humana, ângulos da marcha.