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# Analiza chodu chorych na przewlekłą obturacyjną chorobę płuc

*Gait analysis of patients with chronic obstructive pulmonary disease*

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**Streszczenie:**

Celem pracy była analiza chodu chorych na POChP. Podjęto próbę odpowiedzi na pytanie, czy zdiagnozowana przewlekła obturacyjna choroba płuc ma wpływ na parametry chodu w trakcie 6 minutowego testu marszowego.
W badaniu wzięło udział 33 chorych na POChP: 27 mężczyzn i 6 kobiet, którzy przebywali na leczeniu stacjonarnym w Szpitalu Specjalistycznym MSW w Głuchołazach, w okresie od lutego 2011 do maja 2011 roku, którzy stanowili grupę badaną. Grupę kontrolą stanowiło 48 osób: 35 kobiet i 9 mężczyzn.
Stwierdzono że średnia dystansu uzyskana w grupie badanej wyniosła 538,97m ±176,32 m, natomiast w grupie kontrolnej 546,7m ±85,7 m. Chorzy na POChP w trakcie testu poruszali się z mniejszą prędkością, stawiali krótsze kroki w dłuższym czasie
Analiza wyników wykazała, że chorzy na POChP prezentowali pogorszone wartości wskaźników opisujących parametry chodu w trakcie 6 minutowego testu marszowego.

**Słowa kluczowe:**

analiza chodu, POChP, 6MWT

***Abstract***

*The aim of the study was the analysis of gait parameters of patients with COPD. It was decided to examine whether the diagnosed chronic obstructive pulmonary disease affects the gait parameters during a 6-minute walk test.*
*The research material consisted of 33 COPD in patients (27 males, 6 females) of MIAA Specialistic Hospital in Głuchołazy, who were treated there from February 2011 to May 2011. Control group consisted of 48 healthy (9 males, 35 females).*
*It was found that the average distance reached in the test group was 538,97m ±176,32m, while in the control group 546,7m ± 85,7m. Patients with COPD during the test were moving at a slower speed, achieved shorter steps during longer step time*
*Analysis of the results showed that COPD patients presented deteriorated the value of indicators describing the gait parameters during the 6-minute walk test*

***Key words:***

*gait analysis, COPD, 6MWT*

## Introduction

Walking and running constitute the two basic forms of human locomotion; walking is used more often than running. When the whole of human ontogenesis is considered, walking, also referred to as gait, is the form most used by humans, from the first steps until natural death. During a person's life the parameters of a person's gait change. A child moves differently to a mature individual or an older person [1]. During a person's life it is not only the gait pattern that changes, but also its components. Gait and mainta-

ining an upright body position are complex activities which require efficient cooperation by nervous, cardiovascular and respiratory systems as well as organs of vision and mobility.
Chronic obstructive pulmonary disease affects approximately 1% of the population and 1 in 10 Polish citizens over 40. Approximately 15 000 people die each year in Poland as a result of the disease or its complications. A typical symptom of a chronic obstructive pulmonary disease is a fully reversible airflow limitation through air passages. This limitation is usually progressive [2]. In patients with COPD, dyspnea reduces the ability to perform more strenous physical activity. As the disease progresses the dyspnea increases and further limits capacity for physical exertion. Also, due to the fear of dyspnea, patients tend to limit their own physical activity; this includes a reduction in mobility, itself an activity which previously was not considered to be difficult. A lot of research has been conducted on gait pathologies; numerous publications can be found presenting gait pathology categorised in accordance with existing diseases, including those of the nervous system and the musculoskeletal system. However, no comprehensive studies on gait analysis have been conducted, including the pace of gait, stride length and stride duration during physical activity performed by patients with COPD.

## Research foundations and aims

This paper aims to analyse the gait of patients with COPD during a 6-minute walk test. The authors measured the pace, stride length and stride duration.

## Research material and methods

The study comprised 33 patients with COPD, including 27 male and 6 female respondents, with a mean age of 65.7 ±10.4 years. The respondents were patients of the MSW Specialist Hospital in Glucholazy between February 2011 and May 2011. The patients selected to participate in the study during spirometry and physical performance and mobility examination test obtained results qualifying them to pulmonary rehabilitation (model B or C) [3, 4]. The control group comprised 48 healthy individuals, including 35 female and 9 male respondents, with a mean age of 58.7 ±11.8 years.
All patients participated in a 6-minute walk test. The 6MWT is considered to be a simple and relatively reliable performance test [5]. Because it is so simple it may serve as an efficient tool in evaluating the rehabilitation results or in qualification of patients for a specific rehabilitation model. The distance of the walk performed during the test was 30 m. From the 5th meter, there was a four-meter GaitRite mat placed in the corridor. Data collection was automated. The first measurement was done at 5 meters, next measurements every 60 metres. Due to the range of obtained test results it was decided that the variations of parameters throughout the duration of the test would be observed. Further analysis was to include 3 measurements

taken at 3 points during the test duration; the first at the beginning of the test, the second half-way through (approximately in the 3rd minute) and the last being recorded at the end of the test. The equipment used included a stopwatch, a copy of the Borg scale, a blood pressure monitor and a stethoscope.

Blood pressure, heart rate and shortness of breath were recorded before the test. The respondents received all necessary instructions regarding proper movement during the test. The patients were asked to move barefoot along a designated path at the fastest pace possible. They were instructed to walk across the mat located in the main part of the corridor. Blood pressure, heart rate and shortness of breath were measured again following test completion.

Gait analysis was performed with a GaitRite mat which measures the pace of gait, stride length and stride duration. The mat was 4 meters long; its active surface consisted of 14.000 sensors [Fig.1].

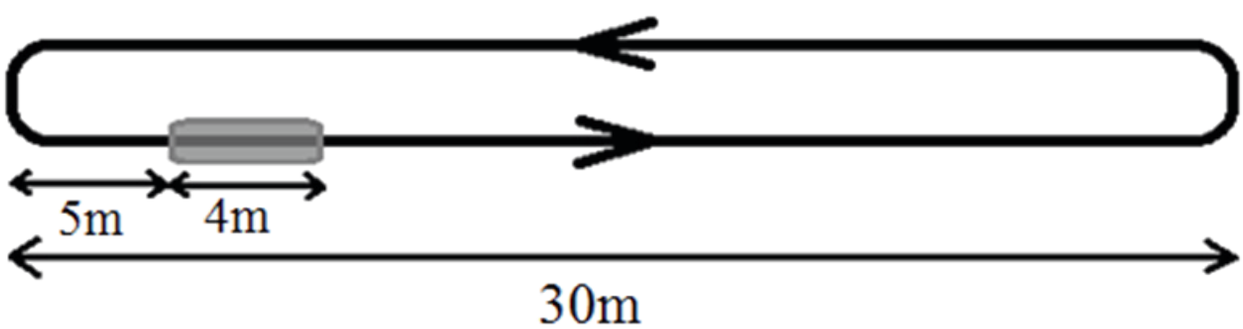


**Fig 1. The draft of movement of the respondent during the test**

The results were gathered in an Excel spreadsheet and then subjected to statistical analysis with Statistica V EN V.9.1 software. The basic descriptive characteristics of measurable data include the arithmetic mean, standard deviation, minimum and maximum value, median with the upper and lower quartiles, range and extreme.

Analysis of the results commenced by determining that the distribution of the parameters researched was normal in both groups. In order to compare the parameters of gait within one group and study the variations between the two groups, analysis of variance for the repeated measurements and Tukey post-hoc HSD test were used. Coefficient levels of $p < 0.05$ were considered statistically significant in the statistical tests used. The data gathered was presented in tables and graphs.

## Results

The analysis of the results included determining mean values of the specific parameters of gait in the 6-minute walk test performed by both groups [Tab.1, 2]. It was found that the average distance in the research group was 538.97 m ±176.32m, while in the control group this value was higher at 546.7 m ±85.7m.

**Table 1. The indicators of various gait parameters recorded in the specific tests in the research group.**

| | Pace [m/s] | Lenght of a stride [cm] | Time ofa stride [s] |
|---|---|---|---|
| Test 1 | 161.3 ±17.9 | 76.2 ±6.4 | 0,47 ±0,03 |
| Test 2 | 152.5 ±18.6 | 73.8 ±7.2 | 0,49 ±0,04 |
| TTest 3 | 155.9 ±20.0 | 74.4 ±6.7 | 0,48 ±0.04 |

**Table 2. The indicators of various gait parameters recorded in the specific tests in the control group**

| | Pace [m/s] | Lenght of a stride [cm] | Time ofa stride [s] |
|---|---|---|---|
| Test 1 | 169,2 ±22.7 | 78.5 ±8.4 | 0.47 ±0.04 |
| Test 2 | 163.2 ±16.2 | 77.8 ±7.5 | 0.48 ±0.03 |
| Test 3 | 169.4 ±22.0 | 78.3 ±7.5 | 0.47 ±0.06 |

In order to study the variations in the pace of gait in the research and control groups, Tukey HSD test was used; no statistically significant differences were recorded [Fig. 2, 3].
The analysis of the changes in the length of a stride in both groups did not find statistically significant changes [Fig. 4, 5].

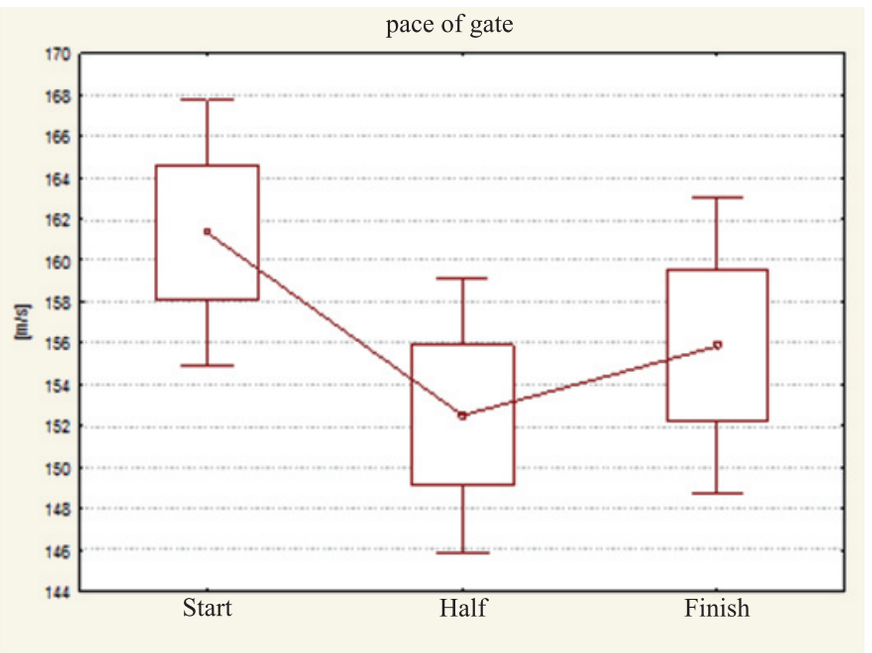


**Fig 2. Mean values of the pace of gait in the research group**

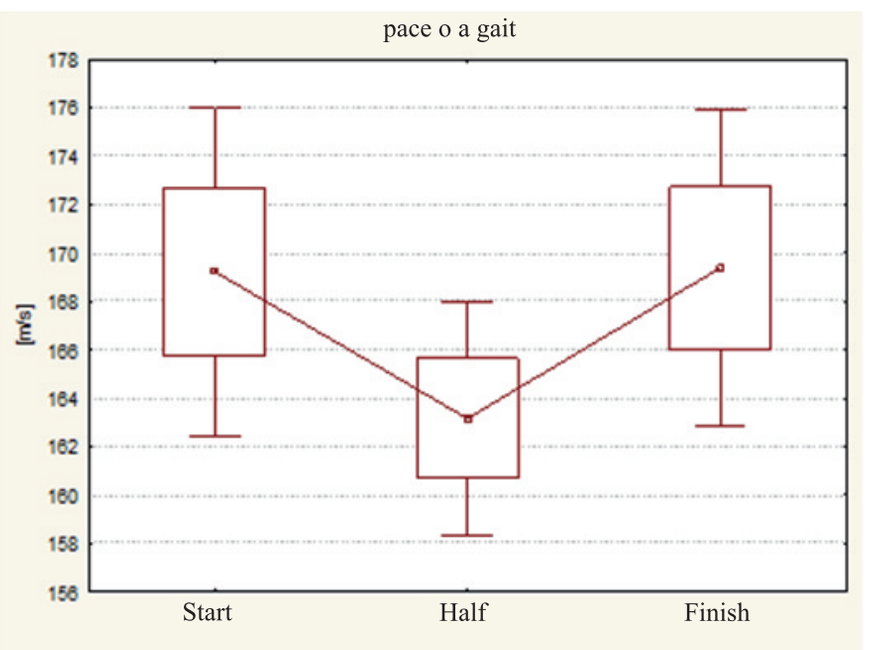


**Fig 3. Mean values of the pace of gait in the control group**

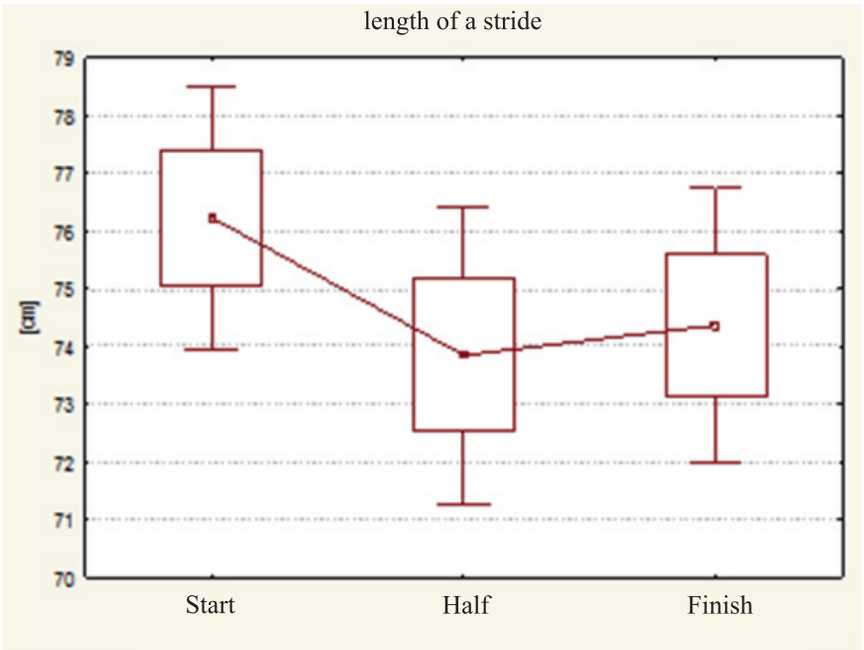


**Fig 4. Mean values of the length of a stride in the research group**

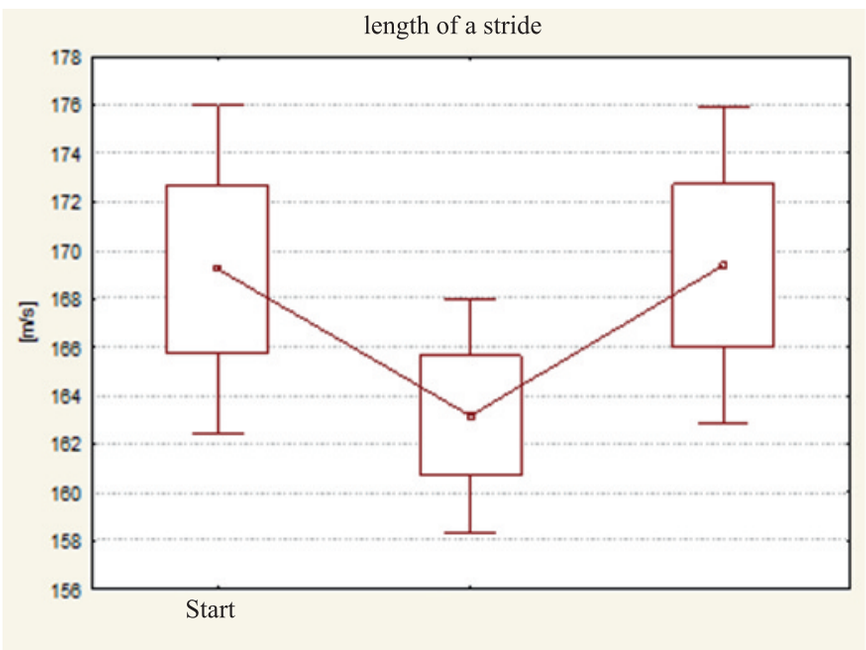


**Fig 5. Mean values of the length of a stride in the control group**

Stride duration during the test also remained statistically similar in both groups [Fig. 6, 7].

It is worth noting that, in both groups, the trend in the indicator variation seems identical. With an increase in distance, the pace of gait decreases, thereby reducing stride length and increasing stride duration; towards the end of the test, however, most respondents accelerated. It seems that this phenomenon might be associated with the instructions provided during the test, informing the respondents about the passing time. This might provide additional motivation for the respondents.

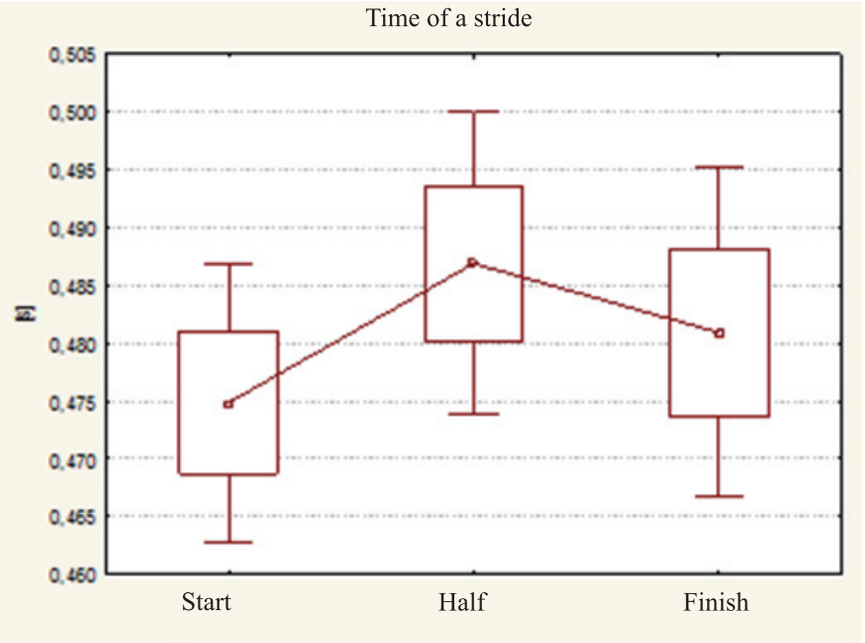


**Fig 6. Mean values of the time of a stride in the research group**

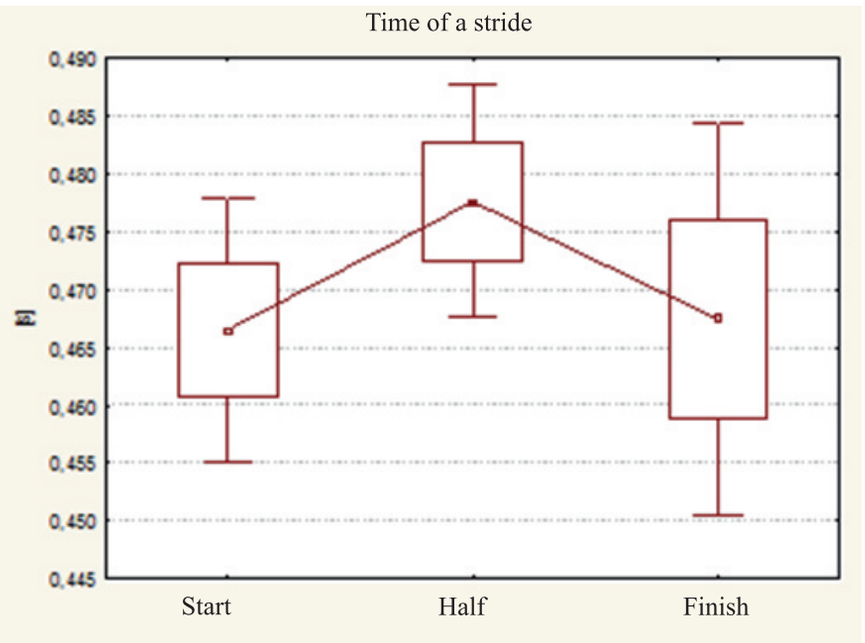


**Fig 7. Mean values of the time of a stride in the control group**

Additionally, mean values of the measured parameters for both groups were compared. The respondents from the control group achieved statistically significantly better results than the respondents with the disease [Fig. 8, 9, 10].

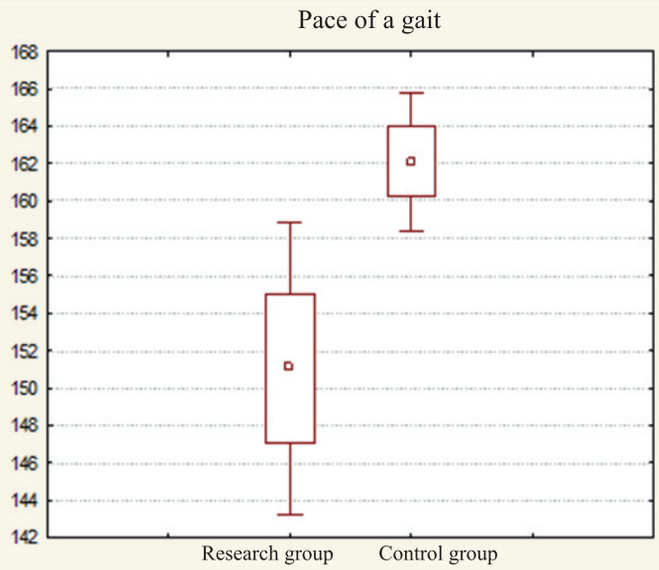


**Fig 8. Differences in the pace of gait**

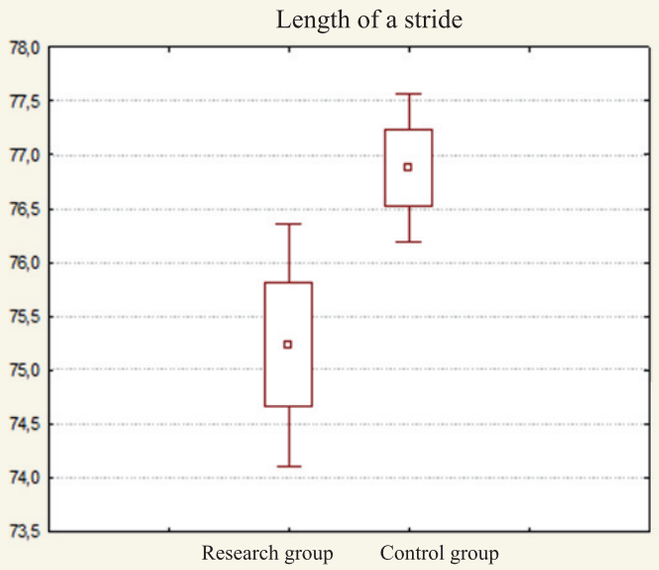


**Fig 9. Differences in the length of a stride**

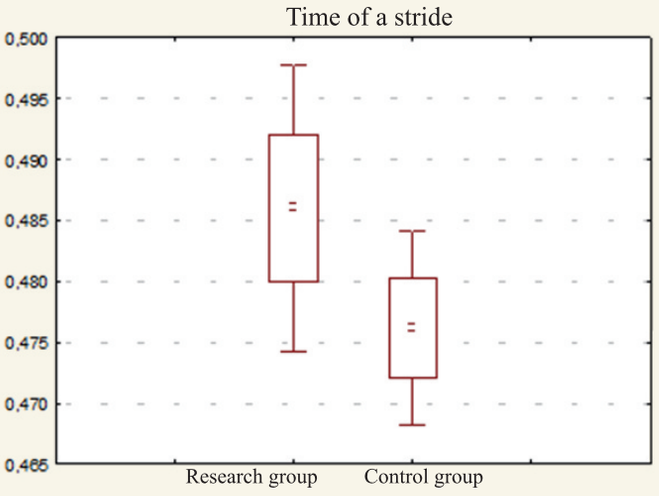


**Fig 10. Differences in the time of a stride**

## Discussion

The systemic effects of COPD, apart from a general inflammatory response, include a deteriorating condition and reduced performance capacity of patients associated with impaired activity of skeletal muscles [6], combined with their reduced mass and other bioenergetic disorders [7]. This is particularly evident in the lower limbs [8]. Many scientists have researched quadricep muscle dysfunction in COPD patients [9, 10, 11]. They argue that both strength and stamina of this muscle is significantly lower than is recorded for healthy respondents of a similar age. It is interesting that the strength of quadriceps correlated significantly with the performance capacity of patients with COPD.

In their studies Butcher et al. undertook the experimental evaluation of coordination and its particular manifestation, namely the process of maintaining balance in a standing position. COPD patients manifest significant shortcomings in the implementation specific mo-

tor tasks compared to healthy respondents, including disorders of the process of maintaining balance [12]. This is of particular importance due to the fact that this process ensures the efficient performance of other, more complex motor tasks, including the walk.
Priest et al., studied the changes in the pace of gait in healthy US citizens in two age groups: 80 ±9 and 23 ±2 years. The first test involved walking at a given distance at a pace that was comfortable for the respondent; during the other test the respondents were asked to perform an additional task at the same time. In both groups, the respondents walked at a lower pace while trying to perform an additional task [13].
It seems that, due to changes in performance capacity in patients with COPD, the gait parameters change. To understand the exact fluctuation of these changes, the gait parameters would have to be measured by video throughout the whole duration of the test.

## Conclusions

1. Statistically significant variations in the gait parameter values between the two groups were recorded.
2. The highest values for these variations were recorded for the pace of gait.

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