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Assessment of distribution of plantar pressures and foot characteristics during walking in pregnant women

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Purpose: The main purpose of this research was to analyse the distribution of plantar pressures and foot characteristics during walking between weeks 27 and 36 of pregnancy. The secondary purpose was to test the effect of the customized orthopaedic shoes that were worn by the experimental group. *Methods*: Pregnant women (n = 73) were divided into 2 groups, control group (n = 38) and experimental group (n = 35) which completed 5 gait trials on a walkway (1.55m) at a self-selected velocity of gait, where force, pressure and remaining foot characteristics were sampled and displayed by Novel database pro m (version 25.3.24). *Results*: Analysis of foot characteristics did not reveal important changes. Analysis of the distribution of plantar pressures revealed few changes in the pre- and post-measurement of the experimental and control groups between weeks 27 and 36 of pregnancy. In the last measurement, there is a significant increase of peak pressure only in the midfoot area of the left foot (151.1 ± 41.2 kPa) and in the hindfoot area of the right foot (346.3 ± 104.1) of the experimental group. The control group exhibits similar pressure development for both of foot. *Conclusions*: Monitored parameters demonstrated in certain areas notably development of force and contact area. Results of foot characteristics did not reveal a significant changes. As both groups registered similar values in certain areas in a comparison of pre/post measurement characteristics, the influence of specific orthopaedic shoes cannot be conclusively demonstrated in the experimental group.

Key words: *pregnancy, foot, pressure, force*

1. Introduction

Pregnancy is a specific phase in women's lives, which has a considerable influence on the distribution of plantar pressures, forces and others foot characteristics. It caused by several factors, such as changes in the distribution of body mass, increasing weight gain, changes in sizes of contact areas of the foot [28] and velocity of gait. One of the most significant changes is body mass gain [20], [22]. Most of the anatomical changes relate to the pregnancy between the second and third trimesters of pregnancy [3]. Studies of pregnant women showed that pregnancy introduces significant changes in gait and plantar pressure distribution [28] at 38 weeks of gestation exhibited a significantly higher mean midfoot pressure than non-pregnant women. Development of the distribution of plantar pressure for both feet are not same in last the trimester [8]. For a dynamic assessment of the state the of foot, variables like peak pressure, maximum force and contact area of the foot are often commonly used [2], [12], [19], [25], [28]. Generally, an increase of plantar pressure is associated with foot pain in pregnant women [19],[10], [13], [28]. In addition, when women complained that their ordinary shoes are too tight, it resulted in foot discomfort because of increased foot length and forefoot width [5]. Therefore, the use of specific orthopaedic shoes customized changes due to plantar pressure and foot characteristics in pregnant women can bring new way to assess the state of foot during a pregnancy. The purpose of this research was to analyse the distribution of plantar pressure and foot characteristics during walking between 27 and 36 week of pregnancy and verify the influence of the specific orthopaedic shoes that were given to the experimental group.

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2. Materials and methods

Participants

Seventy-three out of 100 pregnant women participated in this study. The rest of the pregnant women (27) did not finish all measurements because of premature childbirth or health problems. All pregnant women were addressed based on advertising leaflets in the gynecological departments in Brno. The age [years], height [cm] and body mass [kg] of group are shown in Table 1. This group was divided into the experimental group (35 pregnant women) wearing specific orthopaedic shoes developed in cooperation between Masaryk University and J Hanák R, and the control group (38 pregnant women). The inclusion criterion was a low-risk pregnancy and the period before the third trimester, whereas the exclusion criteria included any orthopaedic or neurological disorders that could influence the gait. The measurements were conducted at the beginning of the 27th week of gestation (pre-measurement) and at the 36th week of gestation (post-measurement). Thirty-five of the subjects (experimental group) wore special biomechanical shoes during this period. Prior to the study, participants were informed about the measurement procedure and they signed an informed consent. The protocol was approved by the local ethical committee of the Faculty of Sports Studies, Masaryk University, Brno, Czech Republic.

Table 1. Participants' characteristics

$n = 73$	Age [years]	Height [cm]	Weight [kg]		
			27 week	32 week	week 36
Mean	30.34	165.15	71.74	74.41	77.24
SD	4.78	22.41	11.84	11.87	12.38

* SD – Standard deviation.

Materials

All pedobarometric parameters were registered by Emed walkway – trademark of novel GMBH in Munich, Germany. (Emed-xl, platform size: 1,529 × 504 mm^2, sensor area: 1,440 × 440 mm^2, number of sensors: 25,344, sensor resolution: 4 sensors/cm^2, recording frequency: 100 Hz, measuring range: 10–1,270 kPa, pressure threshold: 10 kPa). Data were collected at the laboratory of kinanthropological research on the campus of Masaryk University of Brno, Czech Republic.

Methods

The motor task consisted of 5 gait trials where two footprints for each leg were always recorded. The participants started barefoot walking 3 m ahead of the pressure platform and finished the trial 1 m after the end of the platform in order to preserve acceleration and deceleration in gait. Participants walked at their own preferred velocity. Data was collected from all 5 valid gait trials. This cycle of 5 gait trials always consisted of 10 steps (five steps with the right/left foot). The experimental group was wearing specific orthopaedic shoes 1–2 weeks after first measurements. Based on random selection, chosen women have got 2 pairs of experimental shoes, 1 pair for home movement, 1 pair for movement in outside. The condition was that they had to wear shoes every day. Function of these orthopaedic shoes was to improve the distribution of plantar pressures under the longitudinal and transvers arches as well as support reduction of occurrence of finger deformities. Experimentally these shoes are given to pregnant women to detection changes of plantar pressure characteristics and foot characteristics during last trimester.

Data processing

All parameters were sampled using Novel database pro m (version 25.3.24), which is directly connected with the Emed-xl platform. Data is displayed at the moment of first contact of the foot with the platform to the end of walk. After collecting all data from pre/post measurements of the experimental and control groups, based on set default scripts, the data were statistically analysed. The first script processed data to these variables (foot characteristics): heel width [cm], foot length [cm], foot progression angle [°], arch index, hallux angle [°] and forefoot width [cm]. Wallace et al. [29] describe definitions of all these variables. Means and standard deviations from this script were assessed by the Cohen's d coefficient where the level of effect size was determined as follows: for a small effect size $d > 0.20$, for a medium effect size $d > 0.50$, for a large effect size $d > 0.80$ [6]. Cohen's d variables are expressed in absolute value. The second script processed data for ten predefined areas of the foot: hindfoot, midfoot, MH1-5 – metatarsal heads, big toe, second toe, toes 345 (Fig. 1) – with these variables: maximum force [N], peak pressure [kPa] and contact area [cm^2] where paired t-tests were used (level of statistical significance $p < 0.05$).

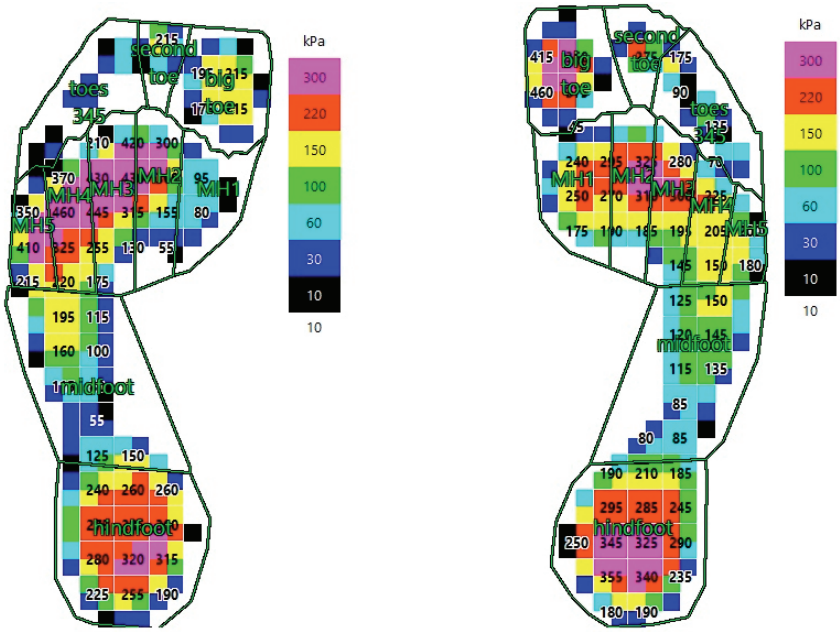

Fig. 1. Ten pre-defined areas of the foot by Novel database pro m (version 25.3.24)

3. Results

Foot characteristics

The means and standard deviations (SD) were calculated from all left and right feet of experimental and control group divided into pre and post measurement (Tables 2–5). Greater changes in effect size were recorded in the heel width area for both groups, where the medium effect size is revealed only in the comparison of right foot pre and post measurements in the experimental group (d = 0.50). Approximately the same values of the small effect size can be seen in the area of forefoot width (d = 0.36). Areas like foot progression angle [°], Arch index, hallux angle [°] are nearly without important change. Values of the effect size are expressed in Tables 6 and 7.

Table 2. Experimental group – comparison of values: heel width [cm], foot length [cm], foot progression angle [°], arch index, hallux angle [°] and forefoot width [cm] of pre and post measurement of left foot

		Heel width [cm]	Foot length [cm]	Foot progression angle [°]	Arch index	Hallux angle [°]	Forefoot width [cm]
Left foot	Mean	5.5	25.2	6.3	0.21	2.9	9.4
Pre-measurement	SD	0.4	1.1	3.8	0.06	7.7	0.5
Left foot	Mean	5.7	25.5	6.8	0.21	3.5	9.6
Post-measurement	SD	0.5	1	4.4	0.06	8.4	0.6

Table 3. Experimental group – comparison of values: heel width [cm], foot length [cm], foot progression angle [°], arch index, hallux angle [°] and forefoot width [cm] of pre and post measurement of right foot

		Heel width [cm]	Foot length [cm]	Foot progression angle [°]	Arch index	Hallux angle [°]	Forefoot width [cm]
Right foot	Mean	5.5	25.1	8.4	0.21	4	9.5
Pre-measurement	SD	0.4	1.1	3.4	0.06	8.4	0.5
Right foot	Mean	5.7	25.5	8.9	0.22	4.2	9.7
Post-measurement	SD	0.4	1.1	3.5	0.05	9.6	0.6

Table 4. Control group – comparison of values: heel width [cm], foot length [cm], foot progression angle [°], arch index, hallux angle [°] and forefoot width [cm] of pre and post measurement of left foot

		Heel width [cm]	Foot length [cm]	Foot progression angle [°]	Arch index	Hallux angle [°]	Forefoot width [cm]
Left foot	Mean	5.5	25.7	5.8	0.21	2.6	9.4
Pre-measurement	SD	0.5	1.2	4.8	0.06	6.5	0.5
Left foot	Mean	5.7	26	5.9	0.21	2.2	9.6
Post-measurement	SD	0.5	1.2	4.6	0.06	7.9	0.6

Table 5. Control group – comparison of values: heel width [cm], foot length [cm], foot progression angle [°], arch index, hallux angle [°] and forefoot width [cm] of pre and post measurement of right foot

		Heel width [cm]	Foot length [cm]	Foot progression angle [°]	Arch index	Hallux angle [°]	Forefoot width [cm]
Right foot	Mean	5.5	25.6	7.9	0.21	1.9	9.6
Pre-measurement	SD	0.5	1.1	4.2	0.06	7.2	0.6
Right foot	Mean	5.7	25.8	7.6	0.21	1.3	9.7
Post-measurement	SD	0.5	1.1	4.2	0.06	7.3	0.6

Table 6. Experimental group – comparison of pre and post measurements of left/right foot expressed in the level of the effect size

Cohen's *d* value	Heel width [cm]	Foot length [cm]	Foot progression angle [°]	Arch index	Hallux angle [°]	Forefoot width [cm]
Left foot: comparison of pre/post measurement	0.44	0.29	0.12	0	0.07	0.36
Right foot: comparison of pre/post measurement	0.5	0.36	0.14	0.18	0.02	0.36

Table 7. Control group – comparison of pre and post measurements of left/right foot expressed in the level of the effect size

Cohen's *d* value	Heel width [cm]	Foot length [cm]	Foot progression angle [°]	Arch index	Hallux angle [°]	Forefoot width [cm]
Left foot: comparison of pre/post measurement	0.4	0.25	0.02	0	0.06	0.36
Right foot: comparison of pre/post measurement	0.4	0.18	0.07	0	0.08	0.17

Plantar pressure characteristics

Analysis of the distribution of plantar pressures has revealed similar developments in the comparison of pre and post measurements of the experimental and control groups. Comparing the pre- and post- left foot measurements of the experimental group, an important increase of peak pressure in the midfoot area (151.1 ± 41.2 kPa) can be noticed. For the right foot, there is an important increase in the hindfoot area (346.3 ± 104.1 kPa). In the control group, there is a significant increase of peak pressure in the midfoot areas (149.7 ± 42.8 kPa) and hindfoot areas (359.5 ± 90.8 kPa) of the left foot. For the right foot, there is an important increase in the hindfoot area (344.9 ± 76.6 kPa). A significant increase of maximum force was revealed in the hindfoot area (523.6 ± 93.1 N) and in the areas of the medial metatarsal heads (MH2-188.1 ± 45.8 N, MH3-194.9 ± 42.0 N, MH4-128.1 ± 41.4 N), when comparing the pre and post left foot measurements of the experimental group. For the right foot, there is important an increase of maximum force in areas of the hindfoot (504.8 ± 92.5 N), first metatarsal head (MH1-163.2 ± 59.3 N) and big toe (161.7 ± 64.7 N).

Comparing the pre- and post- left foot measurements of the control group, a significant increase of maximum force in the hindfoot area (533.1 ± 86.7 N) and in the areas of the medial metatarsal heads (MH3-194.8 ± 42.8 N, MH4-124.0 ± 36.6 N) can be noticed. For the right foot, there is a significant increase of maximum force in the hindfoot area (526.5 ± 86.2 N) and in the areas of the metatarsal heads (MH2-183.4 ± 41.7 N, MH3-185.8 ± 43.0 N). The occurrence of significant increase of contact area (cm^2) was nearly same when comparing pre- and post-measurements of both feet of the experimental group much like in the comparison of the pre and post measurements of both feet of the control group. In general, there was a significant increase of contact area in the areas of the hindfoot, metatarsal heads and big toe. Results of plantar-pressure characteristics were compared based on a paired *t*-test with Novel database pro m (version 25.3.24). This software compared the measured data of all pre and post left feet and all pre and post right feet. The level of statistical significance was ($p < 0.05$). The values of these results are expressed in Tables 8–11.

Table 8. Experimental group – comparison of pre and post measurements of the left foot in ten pre-defined areas of a foot: hindfoot, midfoot, MH1–5 – metatarsal heads, big toe, second toe, toes 345. Statistically significant changes ($p < 0.05$) are marked with asterisk (*)

	Left foot pre-measurement			Left foot post-measurement		
	Maximum force [N]	Peak pressure [kPa]	Contact area [cm^2]	Maximum force [N]	Peak pressure [kPa]	Contact area [cm^2]
Hindfoot	501.3 ± 83.2(*)	345.4 ± 75.1	31.44 ± 3.0(*)	523.6 ± 93.1(*)	347.5 ± 75.1	32.72 ± 3.0(*)
Midfoot	125.5 ± 78.8	140.7 ± 52.0(*)	21.43 ± 7.1	133.2 ± 80.8	151.1 ± 41.2(*)	22.53 ± 7.2
MH1	147.4 ± 64.1	274.6 ± 140.0	11.28 ± 1.8(*)	150.8 ± 55.2	254.3 ± 102.6	11.79 ± 1.5(*)
MH2	176.8 ± 46.7(*)	394.4 ± 137.1	9.51 ± 1.3(*)	188.1 ± 45.8(*)	390.0 ± 119.2	9.97 ± 1.3(*)
MH3	183.7 ± 43.1(*)	371.9 ± 89.3	10.62 ± 1.3(*)	194.9 ± 42.0(*)	369.2 ± 76.1	10.91 ± 1.2(*)
MH4	118.1 ± 40.8(*)	276.1 ± 97.0	9.00 ± 1.0(*)	128.1 ± 41.4(*)	290.3 ± 84.0	9.32 ± 1.1(*)
MH5	54.0 ± 29.7	215.4 ± 151.6	5.59 ± 0.8	55.8 ± 30.6	211.4 ± 149.8	5.77 ± 0.9
Big toe	142.3 ± 53.4	416.6 ± 169.3	10.04 ± 1.8(*)	144.0 ± 61.9	393.4 ± 187.3	10.76 ± 2.2(*)
Second toe	25.9 ± 11.5	157.3 ± 66.1	3.76 ± 1.0	25.1 ± 11.6	150.7 ± 74.4	3.87 ± 1.13
Toes 345	26.1 ± 16.6	106.7 ± 54.1(*)	5.81 ± 2.2	23.4 ± 15.2	92.8 ± 49.0(*)	5.68 ± 2.62

Table 9. Experimental group – comparison of pre and post measurements of the right foot in ten pre-defined areas of a foot: hindfoot, midfoot, MH1–5 – metatarsal heads, big toe, second toe, toes 345. Statistically significant changes ($p < 0.05$) are marked with asterisk (*)

	Right foot pre-measurement			Right foot post-measurement		
	Maximum force [N]	Peak pressure [kPa]	Contact area [cm^2]	Maximum force [N]	Peak pressure [kPa]	Contact area [cm^2]
Hindfoot	481.6 ± 78.9(*)	326.5 ± 68.9(*)	31.19 ± 3.09(*)	504.8 ± 92.5(*)	346.3 ± 104.1(*)	32.77 ± 3.0(*)
Midfoot	132.0 ± 74.6	142.9 ± 48.4	21.90 ± 7.11	133.9 ± 70.5	149.1 ± 40.8	23.09 ± 6.95
MH1	146.6 ± 55.5(*)	271.6 ± 136.4	11.56 ± 1.66(*)	163.2 ± 59.3(*)	267.7 ± 112.5	12.27 ± 1.60(*)
MH2	177.6 ± 50.3	412.7 ± 192.3	9.52 ± 1.38	182.7 ± 47.4	395.6 ± 179.0	9.78 ± 1.28
MH3	180.3 ± 41.1	367.9 ± 105.9	10.77 ± 1.29(*)	187.4 ± 45.6	348.6 ± 84.1	11.12 ± 1.15(*)
MH4	116.8 ± 42.3	267.5 ± 96.1	9.02 ± 1.07(*)	119.2 ± 38.9	258.7 ± 78.6	9.31 ± 1.03(*)
MH5	54.4 ± 29.2	192.7 ± 114.7	5.64 ± 0.98(*)	50.9 ± 23.0	178.4 ± 119.5	5.86 ± 0.85(*)
Big toe	145.8 ± 59.5(*)	436.7 ± 198.8	10.34 ± 1.93(*)	161.7 ± 64.7(*)	451.7 ± 211.9	11.16 ± 2.12(*)
Second toe	29.9 ± 12.6	182.6 ± 74.4	4.00 ± 0.94	30.1 ± 12.4	177.8 ± 71.9	4.07 ± 1.13
Toes 345	33.3 ± 21.6	128.6 ± 64.6	6.36 ± 2.45	30.3 ± 21.3	115.6 ± 67.3	6.43 ± 2.72

Table 10. Control group – comparison of pre and post measurement of the left foot in ten pre-defined areas of a foot: hindfoot, midfoot, MH1–5 – metatarsal heads, big toe, second toe, toes 345. Statistically significant changes ($p < 0.05$) are marked with asterisk (*)

	Left foot pre-measurement			Left foot post-measurement		
	Maximum force [N]	Peak pressure [kPa]	Contact area [cm^2]	Maximum force [N]	Peak pressure [kPa]	Contact area [cm^2]
Hindfoot	514.0 ± 81.7(*)	334.4 ± 74.8(*)	32.01 ± 2.89(*)	533.1 ± 86.7(*)	359.5 ± 90.8(*)	33.16 ± 3.38(*)
Midfoot	125.5 ± 82.4	135.2 ± 40.5(*)	21.49 ± 7.99	136.2 ± 86.5	149.7 ± 42.8(*)	22.98 ± 8.34
MH1	133.0 ± 55.6	232.9 ± 94.3	11.32 ± 1.56	138.1 ± 58.6	225.4 ± 74.3	11.63 ± 1.82
MH2	178.6 ± 40.5	414.9 ± 141.3	9.47 ± 1.36(*)	186.6 ± 43.7	397.4 ± 120.0	9.89 ± 1.43(*)
MH3	183.7 ± 44.9(*)	376.7 ± 89.6	10.49 ± 1.32(*)	194.8 ± 42.8(*)	369.6 ± 79.4	11.03 ± 1.35(*)
MH4	114.7 ± 37.3(*)	265.1 ± 72.8	9.08 ± 1.10(*)	124.0 ± 36.6(*)	275.4 ± 73.7	9.37 ± 1.13(*)
MH5	57.4 ± 29.6	225.2 ± 147.9	5.73 ± 0.99	58.0 ± 27.7	215.6 ± 125.4	5.90 ± 0.97
Big toe	146.4 ± 57.2	411.1 ± 188.5	10.34 ± 1.57(*)	151.7 ± 64.9	419.0 ± 185.1	10.93 ± 2.02(*)
Second toe	32.2 ± 14.6	185.3 ± 71.3	3.99 ± 1.03(*)	32.0 ± 16.1	181.2 ± 81.4	4.25 ± 1.24(*)
Toes 345	36.2 ± 23.1	132.6 ± 62.9	6.52 ± 2.52	34.7 ± 24.1	125.4 ± 62.9	6.82 ± 3.04

Table 11. Control group – comparison of pre and post measurement of the right foot in ten pre-defined areas of a foot: hindfoot, midfoot, MH1–5 – metatarsal heads, big toe, second toe, toes 345. Statistically significant changes ($p < 0.05$) are marked with asterisk (*)

	Right foot pre-measurement			Right foot post-measurement		
	Maximum force [N]	Peak pressure [kPa]	Contact area [cm^2]	Maximum force [N]	Peak pressure [kPa]	Contact area [cm^2]
Hindfoot	496.6 ± 88.2(*)	323.2 ± 80.6(*)	31.51 ± 3.14(*)	526.5 ± 86.2(*)	344.9 ± 76.6(*)	33.01 ± 3.42(*)
Midfoot	125.9 ± 75.4	138.2 ± 40.8	21.39 ± 8.41	129.9 ± 82.8	142.7 ± 44.1	22.24 ± 8.49
MH1	148.1 ± 66.7	246.2 ± 96.9	11.75 ± 1.85	158.8 ± 66.2	245.2 ± 82.8	12.08 ± 1.97
MH2	174.0 ± 45.9(*)	384.4 ± 118.3	9.59 ± 1.37(*)	183.4 ± 41.7(*)	378.1 ± 112.9	9.93 ± 1.30(*)
MH3	174.8 ± 42.5(*)	352.3 ± 83.8	10.65 ± 1.23(*)	185.8 ± 43.0(*)	349.2 ± 79.6	10.93 ± 1.26(*)
MH4	110.5 ± 36.3	258.5 ± 87.4	9.12 ± 1.00	115.1 ± 34.0	261.0 ± 75.3	9.32 ± 1.12
MH5	54.1 ± 26.2	202.9 ± 115.3	5.66 ± 0.95	52.0 ± 22.9	183.7 ± 93.0	5.83 ± 0.94
Big toe	163.3 ± 57.9	450.6 ± 188.7	10.77 ± 1.61(*)	169.9 ± 62.7	454.7 ± 199.1	11.45 ± 1.96(*)
Second toe	32.2 ± 10.9	198.9 ± 70.5	3.92 ± 0.93(*)	31.5 ± 10.7	186.7 ± 63.4	4.23 ± 1.12(*)
Toes 345	37.4 ± 23.4	141.7 ± 67.6(*)	6.85 ± 2.62	33.4 ± 22.6	122.5 ± 60.6(*)	6.88 ± 2.98

4. Discussion

The purpose of this research was to analyse the distribution of plantar pressure and foot characteristics (FC) during walking between 27 and 36 week of pregnancy and to test the effect of the customized orthopaedic shoes that were worn by the experimental group. Based on the effect size in the pre and post measurements of both feet in both, the measurements of foot characteristics have revealed rather moderate changes in heel width, foot length and forefoot width variables only [11]. On other hand, a similar study performed by Wetz et al. [30] has found a statistically significant increase in foot length, width and volume, when measurements were made at the beginning of each trimester. Alvarez et al. [1] have not found significant changes in the length or forefoot width of the feet in the period of the 13th and 35th weeks of pregnancy. The physiological and biomechanical variability of pregnancy is the reason for these different results [9]. Based on a categorization of arch index (AI) values [4], [18] the midfoot area is located in the dispersion of normal values (0.21 to 0.26) for both groups. However, our results of AI values are on the edge with pes cavus (AI ≤ 0.21). Paradoxically, Ojukwu et al. [21] in their research have shown that pregnant women have higher arch indexes, indicating pes planus, than

nulliparous women. This finding is more suitable to the general context of the condition of the foot during pregnancy. Changes in foot progression angle are completely negligible. We recorded an insignificant increase of this angle for both feet in comparing pre and post measurements, but this increase is irrelevant. The size of foot progression angle (FPA) of both groups is located in the healthy range according to several studies [16], [17], [27] and is not externally rotated [23]. Hallux angle value has not shown any differences among the two groups in comparing pre and post measurements. In addition, the range of this angle absolutely indicates that there is no hallux valgus [15], [26]. Plantar pressure characteristics (PPC) have revealed more significant changes when compared with (FC), but on the other hand, the development of monitored variables (PPC) in several areas is similar when comparing the experimental and control groups in last the trimester [14]. Elsayed et al. [7] in their study have not even found significant differences in the distribution of plantar pressures in selected areas between pregnant and non-pregnant group. Based on analysis of previous studies, Ribeiro et al. [24] have found out that there is a increase of plantar loads under the forefoot area and Nyska et al. [19] have shown in his study of comparing pregnant and non-pregnant women during standing that a larger increase of plantar pressures are seen especially under the the fifth metatarsal head, while authors Gaymer et al. [10], Fan et al. [8], Bertuit et al. [2], on the other hand, have primarily registered a significant increase of pressure during pregnancy in the midfoot area and Ribeiro et al. [25] have registered that the plantar loads were redistributed from the rearfoot (decrease) to the midfoot and forefoot (increase) during walking throughout pregnancy. It seems to be that changes in distribution of plantar pressures throughout the pregnancy are more dependent on the specific individual properties of the measured group. However, in our study, we have registered a significant increase of peak pressure only in the areas of hindfoot and midfoot for both groups. Generally, we registered an important increase of maximum force in the areas of the hindfoot and medial forefoot [25], with the exception of the right foot of the experimental group. The most changes in the increase of contact area was registered when comparing pre/post measurements for both groups, especially for the experimental groups. This can be understood as an effect of the specific orthopaedic shoes. Varol et al. [28] connect larger contact area with increased foot pain, but on the other hand, larger contact area does not allow to occur higher peak pressures, which can be an explanation for our results.

5. Conclusions

In selected areas, monitored parameters demonstrate development of force, pressure and contact area in common with foot characteristics. Based on these measured characteristics for both groups, a comparison of pre and post measurements register similar values in certain areas and therefore the effect of specific orthopaedic shoes cannot be conclusively demonstrated in the experimental group. One limitation of this study could be the length of the measurement period. This research can be useful in solving problems in the dynamic analysis of gait in pregnant women.

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