



Perceived changes in the university students' health behavior after participating in the study on wearing high-heeled shoes

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Abstract

Introduction: Wearing high-heeled shoes (HH) is a wide-spread practice among Western women, maintaining popularity despite its harmful potential. We examined the main motivation behind wearing HH in female students, as well as the possible change to wearing HH among the research participants. **Methods:** Thirty university students (N=30 females, age 21.8±2.09 years; weight: 55.7±4.05 kg, height: 1.66±0.03 m, BMI: 20.34±1.41 kg.m⁻², shoe size: EU 36–38), who rarely wore HH. The participants wore HH for no longer than 6 hours per month during the period two past years. The SonoSens Monitor Analyzer system (Gefremed, Chemnitz, Germany) was used to observe participants' posture when walking and movements in individual sections of their spines. In a comparative experiment, the correlation between variables recorded when walking in two types of shoes was identified. The first pair of shoes (HH) had 7 cm heels whereas the second were flat sport shoes (FS). **Results:** The evaluation of participants' spines and posture when walking in HH and FS revealed significant differences ($p < 0.05$). The evaluation of the initial and follow-up surveys indicates that the main motivation for wearing HH among the test group was to increase their attractiveness and respond to social expectations. After participating in the research and becoming aware of its outcomes and issues, the test group's attitude to wearing HH has changed. **Conclusions:** In regards to good posture and spinal health, this study has raised some awareness amongst its participants, and has therefore proved to be a significant positive influence.

Keywords: high heeled shoes; attractiveness; women; harmful impact; posture; spine

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INTRODUCTION

For humans, appearance is very important. In today's society, almost every individual pays attention to their physical appearance - as well as fashion, regardless of their sex. Paying attention to one's own physical appearance can often make for a feeling of positivity and satisfaction in one's self. However, it is not the only reason why people are motivated to change their appearance. Harmful physical influence is a common side-effect of the beautifying and attractiveness-increase process, although people are often aware of it.

By means of their appearance, the person demonstrates to other people not only their physical selves, but their identity and priorities as well. Since it is important for us to integrate into the social environment and life around others, we adapt our self-presentation and self-evaluation of our body and appearance accordingly. Physical appearance plays a role in a variety of social contexts. From a young age, people tend to be categorized based on their appearance, although at the same time, they deny that this aspect may influence their judgement [1]. Parents and peers may influence the development of a person's body image by projecting their contemporary beauty ideals onto their close ones, thus forcing them, directly or indirectly, to follow it. This appearance model relates to one's mental image of their own body at a given time and this ideal may or may not correspond with the opinions of others [2]. The multi-dimensional nature of a body image includes one's perception of their own body as well as the development of attitudes related to their own physical appearance [3]. Satisfaction - or its lack thereof - with body image, results from the subjective evaluation of one's own body and its overall physical attractiveness. A personal attitude towards one's self has been studied for centuries, but a universal concept still does not exist [2]. The pressure put on women in terms of their appearance is related to social life in broader terms. A prevailing opinion in society is based on the notion that women are recognized, admired and perceived as sexually attractive and desirable if they adapt to certain visual models. Everyday life often confirms this opinion in practice [4]. As a result, many women assume that they will be more successful and loved by their partners if they improve their body image [3]. In terms of survival within a group, it is better to respect its rules and requirements - it is easier and more advantageous to modify one's body image instead of standing out due to their appearance [5]. The social recognition of women depends upon their appearance, especially their physique, much more than the social recognition of men. From childhood, beauty is of greater social importance for girls than their mental attributes and skills and beauty also receives more attention [1]. A woman's appearance is judged much more harshly than that of men. A woman's social recognition is more significantly intertwined with her physical appearance. Women are gradually coming to accept this social standard and focusing on their bodies to comply with the cultural beauty standard. If a woman considers herself attractive, she confirms her female identity [3]. Society tends to respond more favorably to attractive people. Since women are judged based on their appearance, they are also inclined to evaluate themselves based on it; research shows that this evaluation is often overly critical. In their attempts to achieve an unrealistic ideal of female bodily beauty, adolescent girls often opt for harmful practices [6]. Wearing HH represents one way that women's attractiveness can be increased, and because of this HH are regularly worn by a considerable proportion of women [7]. In modern society, HH have become a symbol of modern (heteronormative) female sexuality (8). Research confirms that HH make women more attractive in men's eyes [9, 10]. A study confirms that HH bring psychosexual benefits to women, but are detrimental to their health [7].

The influence of media on society and women's body image

Clothing style follows the development of fashion, therefore, the way the beauty ideal has been changed over time. The body image can be actively formed or passively accepted. Modern clothing helps improve our self-confidence. In general, a person feels better, more able, and self-confident if they are wearing nice clothes and shoes. It is the result of powerful social formation [1]. Undoubtedly, the perception of women's image has been influenced by the print media, mainly women's fashion magazines, since the beginning of the 20th century. Women's lifestyle-focused publications - supported today online as well - gradually reaches more women to promote information about aesthetics, fashion photography, and beauty advice to increase physical attractiveness. It influences

women's opinions, and the physical appearance becomes the key component of identity for most of them [11]. The magazines not only present the beauty ideal to their readers, but also significantly promote it: They promote the "cult of femininity" and define how women should look [12]. The effort to achieve the beauty ideal in the magazines is enhanced by the assumption that if women strive to achieve the presented aesthetic standards, their physical attractiveness will improve, and they will gain previously missing sex-appeal. Improving women's physical attractiveness, seductiveness, and their sexual lifestyle in general are the topics most frequently addressed by the fashion magazines [13]. Mass media and popular culture are amongst the most powerful mechanisms influencing society. In the digital era, these means of communication have become the main participants responsible for information sharing, forming of ideas, value systems, and personal identities among individuals, thus fulfilling an important educational and socialisation purpose. Besides paying attention to the short-term influence of media, it is also necessary to investigate the long-term influence of media content that emerge gradually and take direct effect, without being consciously filtered [14].

Health effects of HH

A number of scientific studies addressed the consequences of wearing HH in terms of positional changes and balance. Results indicate effects of a chain response that starts in the lower limbs and leads to the spine [15]. In comparison to standing barefoot, when HH are worn, both the head and thoracic spine shift in the posterior direction, changing the overall posture, rising pelvic movement towards retroversion and the distance between the knee and ankle joints decrease [16]. In relation to walking in HH, the research mainly addressed its effect on the lumbar lordosis. The deepening of the lordosis in the transition from standing into walking was observed [17]. Other authors claim that when walking in HH, the lumbar lordosis straightens in women who do not normally wear HH; however, the lordosis increases in those frequently wearing HH [18]. If HH decrease the lordosis, further pressure shifts can occur in the lumbar area. On the contrary, if the long-term wearing of HH contributes to increased lordosis in the lumbar part of the spine, it can be accompanied by changes in muscles and ligaments along with a potential increase in fatigue and pain [15]. The main compensation mechanisms when walking in HH include the adaptation of the pelvis' position and movement instead of the shape of the lumbar lordosis [16]. The majority of studies in this area have identified increased muscle activity in the lower part of the back while wearing HH, which increases proportionally to the height of the heels [19,20]. A significant increase in the m. erector spinae activity in the area of the fourth lumbar vertebra (L4) when walking in HH is a consequence of the compensation mechanisms aimed at maintaining stability. They concluded that walking in HH affects the lumbar lordosis in the long-term perspective. It results in typical manifestations of muscular imbalance such as the Lower-Crossed Syndrome caused by muscle and ligament overload due to bad posture [17].

This study is dedicated to HH as a contemporary phenomenon of today's fashion. Wearing HH is a wide-spread model of behaviour among Western women, persisting in the popularity despite its harmful potential. Although taste can be fairly variable in culture as well as fashion, it may reflect certain basic human attributes related to attractiveness in the eyes of the opposite sex. More and more women are opting for HH [15,21]. However, a large amount of research indicates that the frequent wearing of HH can lead to an entire range of health complications. Although this is a relatively well-known fact, HH remain popular across all Western society [22]. The goal of this research was to identify the main motivation of wearing HH in a group of young women and to analyse the spine and posture changes when using HH in comparison to FS. The research was also aimed at finding out whether these participants plan to wear HH as frequently as before despite the experience with the spine and posture measurement results.

METHODS

Participants

Thirty women aged 20 to 30 (N=30 females, age 21.8±2.09 years; height: 1.66±0.03 m; weight: 55.7±4.14 kg; BMI: 20.34±1.41 kg/m², shoe size: EU 36–38), who rarely wore HH. The participants wore HH for no longer than 6 hours per month during the period two past years. Only healthy subjects

who have never had any serious accidents and do not suffer from any major illness that could have influenced or created a bias in the research results were included in the study. The study was approved by the institutional Ethics Committee and all participants read and completed an informed consent form. The consent complied with the provisions of the Helsinki Declaration and other generally binding legislation on personal data protection on both.

Design and procedures

For three days, the posture of the participants was observed. The participants were familiar with the measuring design and signed the informed consent form. Before the measurements were taken, anthropometric data was collected - weight (Electronic scale, Amboss, New York, USA), height (Antropometr A 213, Trystom, Olomouc, Czech Republic), age, and foot size, and a survey was administered among the participants. After 6 months, a follow-up survey was administered among the same participants. When taking part in the follow-up survey, participants were already familiar with the way wearing HH affects the posture.

In the survey form the women were asked the following nine close dichotomous questions:

1. Do you think men like women wearing HH more?
2. Do you feel more attractive in HH?
3. Do you think women should wear HH for special and celebratory occasions?
4. Do you think that the etiquette requires women to wear HH on special or celebratory occasions?
5. Do you wear HH to appear taller?
6. Do you wear HH because you feel it improves your figure?
7. Do you think wearing HH is harmless?
8. Do you think wearing HH has more advantages than disadvantages?
9. Can you imagine to stop wearing HH completely?

The participants could answer only “yes” or “no”. All answers were recorded. The questions (1–6) were aimed at finding out the motivation for their previous decision to wear HH. The last 3 questions (7–9) was aimed at finding out whether their participation in the research, including a demonstration how HH affects the body, influenced the participants to change their attitude towards wearing HH. After the interview, all participants proceeded to undergo an experiment during which they walked on a treadmill (inSPORTline Genesis, Slovakia) at two speeds $v_1=0.97\text{ms}^{-1}$ and $v_2=0.56\text{ms}^{-1}$. Most participants chose walking speed v_1 as the most pleasant one. We opted for v_2 (very slow speed) on purpose, as the goal was to examine posture at the speed at which women often walk at social events and before they gain enough skill walking in HH. The SonoSens Monitor Analyzer system (Gefremed, Chemnitz, Germany) was used to observe the movements in individual sections of their spines as well as the participant’s posture when walking. In a comparative experiment, the correlation between variables recorded when walking in two types of shoes was identified. The first pair of shoes had heels of 7 cm while the second pair of shoes were flat sport shoes (hereinafter FS). (Fig. 1). All participants wore the same type of shoes during the experiment. At the beginning, the measuring system was calibrated using the upright standing, forward bending and backward bending of the spine, side bending and rotation in both directions as recommended by the Sonosens Monitor Analyzer manufacturer.

All participants were familiar with their results from the previous testing, which were explained to them individually. After three weeks, participants were informed about the observation results pertaining to their postures and the follow-up survey was administered among them.

The observed variables pertaining to the way HH affects posture

Results pertained to the posture in the sagittal plane and the following values were compared: median sagittal bending index (mSBI) and the sagittal bending amplitude (SBA) (Fig. 2) in all sections of the spine – lumbar (LSC), thoracic (TSC) and cervical (CSC). The values measured during walking represent percent deviations from the calibration measurements (mm). The positive deviation represents flexion and the negative one represents extension. These variables were compared for both types of shoes and subsequently statistically evaluated.



Figure 1. Walking in high-heel shoes (HH); and flat shoes (FS)

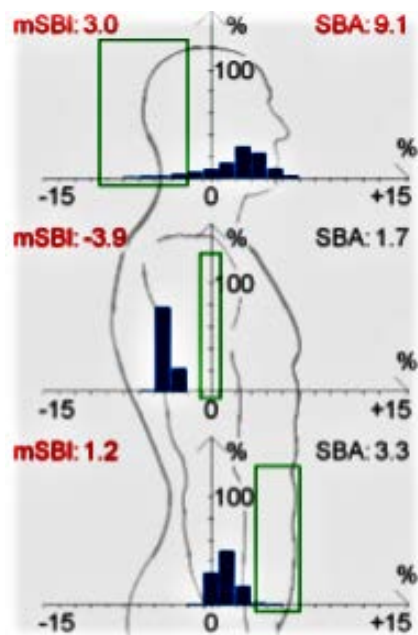


Figure 2. Bodygram in the sagittal plane during walking in HH (The values outside the field of reference – the standard is determined based on the calibration during upright posture – are provided in white)

Statistical processing

All statistical analyses were performed using Statistica 13.0 (TIBCO Software Inc., CA USA). In the case of posture, a paired *t*-test was used as the statistical processing method for the interval data between two dependent variables (i.e. paired data). It is a variant of Student's *t*-test. This test variant is used for the evaluation of experiments with an unknown mean value of the population, two sets of selective data were therefore used. In this case, each participant was measured repeatedly. The test

was performed at the significance level an alpha of 0.05, i.e. 95% probability of the phenomenon. Results are statistically significant if the t value exceeds the critical table value of 1.669 and the p value is smaller than the determined significance level of 0.05 (control value). In that case the difference between HH and FS has been confirmed using different measurements at a specific part of the spine. Using the non-parametric Chi-squared test method, the reliability of the research tool was verified by repeated testing and the correlation between the two values measured within the same sample (in questions 1 – 6) was examined. The rest result has also been verified by the Wilcoxon test. In evaluation of questions 7 – 9, the Wilcoxon test was again used to determine the statistical significance. The results were verified using Logistic regression.

RESULTS

The evaluation of total results proved statistically significant differences ($p < 0.05$) between walking in HH and FS. (Tables 1, 2). In terms of mSBI, statistically significant differences were identified in all sections of the spine at both measured walking speeds. Based on the total average of the mSBI values, it can be stated that HH affect the spine curvature in comparison to FS; HH straighten lordosis at LSC and CSC and kyphosis in TSC (Table 1). In the case of SBA, statistically significant differences were found in LSC, CSC and TSC, however, only at v_2 (Table 2).

In evaluation of questions 1 – 6 (Table 3) focused on motivation, most respondents wore HH to improve their appearance and attractiveness (Q1,2,6). Most respondents also think that women should wear HH for special occasions and social events (Q3,4). Increased height did not motivate most respondents to wear HH (Q5). Evaluation of questions 7 – 9 (Table 3) confirmed that personal participation in the research investigating the effect of HH on the posture influenced the respondent's attitude to wearing HH ($p < 0.05$).

Table 1. Differences in individual spinal sections at median index of sagittal plane (mSBI) in HH and FS.

posture*	walking speed 0.97 ms ⁻¹						walking speed 0.56 ms ⁻¹					
	HH		FS		T	p	HH		FS		T	p
	Average [%]	SD	Average [%]	SD			Average [%]	SD	Average [%]	SD		
LSC	0.550	6.962	-0.487	7.229	4.517	0.000	3.337	7.549	-0.003	6.626	4.543	0.000
TSC	-3.000	2.673	-3.403	2.586	3.947	0.000	-0.770	2.169	-2.147	2.134	3.702	0.001
CSC	-2.240	4.392	-4.120	5.019	5.182	0.000	-0.240	3.887	-3.123	3.148	8.965	0.000

*posture the sagittal plane, LSC – lumbar spine; TSC – thoracic spine, CSC – cervical spine; HH – high-heel shoes; FS – flat shoes; SD – standard deviation; T – t-test score, p – statistical significance

Table 2. Differences in the individual spinal sections at the amplitude of the movement (SBA) in the sagittal plane in HH and FS.

posture*	walking speed 0.97 ms ⁻¹						walking speed 0.56 ms ⁻¹					
	HH		FS		T	p	HH		FS		T	p
	Average [%]	SD	Average [%]	SD			Average [%]	SD	Average [%]	SD		
LSC	2.947	1.174	2.503	1.075	1.639	0.112	4.140	2.247	3.303	1.075	2.478	0.019
TSC	1.687	0.850	1.590	0.762	-0.501	0.620	2.520	1.285	1.733	0.727	3.208	0.003
CSC	4.720	1.841	4.850	1.994	0.521	0.606	5.853	2.391	4.627	2.064	3.432	0.002

*posture the sagittal plane, LSC – lumbar spine; TSC – thoracic spine, CSC – cervical spine; HH – high-heel shoes; FS – flat shoes; SD – standard deviation; T – t-test score, p – statistical significance

Table 3. Evaluation of input and output questionnaire. Questions 1-6 focused on participants' motivation for wearing HH and Questions 7-9 focused on the impact of the participants' personal experience within this research, and how it has influenced their new opinion and wearing of HH.

Question number	Input questions		Output questions		Chi-squared test		Wilcoxon test
	Yes	No	Yes	No	χ^2	p	
1	25	5	26	4	0.131	0.717	p=0.500 Z=0.674 T=5
2	24	6	26	4	0.480	0.488	
3	24	6	23	7	0.098	0.754	
4	21	9	20	10	0.077	0.781	
5	8	22	8	22	0	1	
6	24	6	25	5	0.111	0.739	
7	9	21	5	25	7	9	p=0.028 Z=2.201 T=0
8	18	12	17	13	8	18	
9	14	16	13	17	9	14	
Logistic regression (for 7-9): $b^* = 0.732$; $R^2 = 0.537$; $STD\ z\ b^* = 0.129$; $t(38) = 5.698$; $p = 0.000$							

DISCUSSION

The primary objective of the study was to examine how respondents' motivation for wearing HH changes under the influence of education and posture measurements. To examine the effect of the research, it was necessary to determine the motivation for wearing HH among respondents. Therefore, it was investigated as to what motivation the respondents tend to maintain or suppress. Studies show that improved attractiveness represents the main motivation for wearing HH [23,24]. The disadvantages related to wearing HH such as discomfort, worsened mobility, or health issues are compensated by improved physical attractiveness [7]. This motivation was confirmed by most respondents. The harmful behavior in contradiction to health principles is often dictated by society itself [25]. Many paradoxical examples of how culture interferes with human nature can be found. Interfering with bipedal walk and basic movement patterns belongs among them. The motivation to comply with the social conventions or standards was also confirmed by this research. It can be stated, that two main motivations are present. These are mutually interconnected and influence each other.

Increased height is another attribute that plays a role in the motivation to wear HH [23]. However, he does not state the average height of his research subjects. This kind of motivation was identified only in eight women in this research; height 1.66 ± 0.03 m, ($N = 30$). In relation to height, the height of the woman's partner can also play a role, because in heterosexual relationships, women usually do not wish to be taller than men [7].

Balls, parties, promotion ceremonies, weddings, or award-giving ceremonies represent the occasions on which women have been wearing HH for several decades. Women rarely opt not to wear HH on such occasions [26]. The reality is probably not going to change in the close future, however, after 6 months, the research subjects proved that education can change this behavior in women.

In relation to the pressure of conventions, it has been emphasized that the choice of women's shoes should be respected, and women should not be forced to wear or not wear HH against their will [7]. Either way, it is very difficult for women to confront the hidden social expectations [25,27].

The studies describing the negative impact of wearing HH on health refer most frequently to musculoskeletal issues (osteoarthritis, hallux valgus). As for the effect of HH on the spine, the widely available literature often provides chaotic, inconsistent, and unclear information [15,28]. This inconsistency of opinions on health effects of HH may contribute to downplaying the negative effects of HH. The results (presented also to the respondents) confirm that biomechanics of the spine manifests significant differences during walking in HH in comparison to FS; lumbar and cervical lordosis straightens in HH, which is consistent with the results of similar studies [17,18].

In the recent years, HH became more popular among adolescents [29]. It has been suggested that awareness should be raised regarding the health effects of HH as a part of Personal and Social

Education [30]. For example, personal participation in experiments may be educative. The era of technology provides an opportunity to raise awareness. In our experiments, participants were educated through actual experience and claimed that this experience affected their attitude towards wearing HH after the measurements were taken.

Limitations and future directions

The study aimed to interconnect psychosocial and practical biomechanics research. It is recommended to investigate the effects of HH also from the epidemiological point of view, which would provide a better insight into causality [7]. As for the caveats of the study – in the social area, the size of the sample may not be sufficient in terms of representativeness. Future research should work with a larger sample. It would also be useful to examine the motivation and attitude to wearing HH in women who wear HH to work on a daily basis. Moreover, almost all studies examined young women; wearing HH among older women should also be researched.

CONCLUSIONS

This is the first study to show experimentally that women with strong motivation to improve the aesthetics of their physical appearance may reconsider the motivation to wear HH based on personal participation in the research analysing their posture while walking in HH. In regards to good posture and spinal health, this study has raised some awareness amongst its participants, and has therefore proved to be a significant positive influence.

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