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About the Journal

The Catholic University of Croatia is proud to introduce the UniCath Journal of Biomedicine and Bioethics, a novel initiative ratified by the University Senate on January 16, 2024. Our goal is twofold: to advance the frontiers of research in the intersecting disciplines of biomedicine and bioethics and to provide an educational platform for our nascent researchers.

The UniCath Journal of Biomedicine and Bioethics will welcome a broad spectrum of contributions, including but not limited to research articles, editorials, case reports and other scholarly works. We are dedicated to upholding the highest standards of peer review and publication ethics, ensuring that every manuscript is rigorously evaluated by at least two expert reviewers in a meticulously conducted double-blind review process.

The journal is set to publish two issues per year, in both print and digital formats. Upon completion of the production process, the articles will be immediately available online in a fully citable form, complete with a Universal Digital Object Identifier (DOI), signifying our commitment to the rapid dissemination of research findings. Furthermore all the published articles will be freely accessible for viewing and downloading.

The launch of the UniCath Journal of Biomedicine and Bioethics represents a significant milestone in our pursuit of academic and research excellence. By offering a dynamic platform for the exploration and discussion of critical issues at the intersection of biomedicine and bioethics, we aim to contribute to the global academic community and inspire a culture of research and innovation within the Catholic University of Croatia.

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Polycystic Ovary Syndrome and Infertility: A Retrospective Cross-Sectional Study

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Abstract

Background: Polycystic ovary syndrome (PCOS) is the most common endocrinological and reproductive-metabolic disorder in women, characterized by chronic ovulatory dysfunction, oligomenorrhea, hyperandrogenism and infertility. Infertility, the absence of a desired pregnancy with regular, unprotected intercourse for a period of at least one year, is a major public health problem today.

Aim: The aim of this retrospectively registered study was to examine the hormonal characteristics of infertile patients diagnosed with PCOS and compare them with a control group of infertile women not diagnosed with PCOS, of comparable ages and body mass indices.

Methods: In this retrospective cross-sectional study, the subjects were thirty patients diagnosed with PCOS treated for infertility at the Department of Obstetrics and Gynecology, Sveti Duh Clinical Hospital, who were compared to a control group of women not diagnosed with PCOS but diagnosed with infertility, of comparable ages and body mass indices. The data were collected from an electronic database, and the values of the observed indicators of the patients' health status were presented in graphs and tables.

Results: The results show that there were statistically significant differences in the levels of AMH, LH, E2 and FSH. In other words, the patients with PCOS had higher AMH and LH, and lower E2 and FSH, in comparison to women not diagnosed with polycystic ovaries of the comparable age and body mass indices. TSH and prolactin levels were comparable between the two groups.

Conclusion: Our study confirmed that infertile patients diagnosed with PCOS have different serum levels of pituitary and ovarian sex hormones in comparison to the controls.

Keywords: Polycystic ovary syndrome, infertility, hormones

Introduction

Polycystic ovary syndrome (PCOS) is a common health disorder in women, characterized by chronic ovulatory dysfunction, oligomenorrhea, hyperandrogenism and infertility. Infertility could be defined as the absence of a desired pregnancy with regular, unprotected intercourse for a period of one year (1). PCOS is the most common endocrinological and reproductive-metabolic disorder in women, which can be the result of abnormal interaction among various behavioral, environmental and genetic factors (2). Recently, there has been increased interest in the field of PCOS research.

Hyperandrogenism, which refers to an elevated level of endogenous androgens, is one of the main features of PCOS that affects many patients. It is associated with the appearance of hirsutism, acne and androgenic alopecia (3). Hirsutism is excessive hairiness in women in places where hairiness is normally characteristic for men (4). After hirsutism, acne and oily skin are also found in almost 15–25% of women with PCOS (3). Acne is a chronic inflammatory skin disease that affects the seborrheic areas (face and upper body), and is characterized by the appearance of comedones, inflammatory lesions and scars (3). In addition to hirsutism and acne, androgen-dependent hair loss called androgenic alopecia also occurs but is less prevalent (5).

Polycystic ovaries are furthermore characterized by cycle disorders, mainly caused by anovulation and characterized by long cycles, amenorrhea, irregular bleeding that can be heavy or light, bleeding between periods and postcoital bleeding (6).

The National Institutes of Health define PCOS as unexplained hyperandrogenic anovulation. A medical diagnosis of PCOS can be established in the presence of the following criteria: androgen excess and infrequent ovulation with the exclusion of other disorders having similar clinical symptoms (7). According to the Rotterdam criteria, PCOS is defined if two of the following three parameters are present: 1. oligo-anovulation and/or anovulation with consequent oligo-amenorrhea or amenorrhea, 2. biochemical and/or clinical indicators of hyperandrogenism and/or hyperandrogenemia, 3. polycystic appearance of ovaries confirmed by ultrasonography, after the exclusion of related diseases (8).

The aim of this study was to inspect the hormonal characteristics of infertile women diagnosed with polycystic ovaries (PCOS) and compare them with a control group of infertile women without such a diagnosis, of comparable ages and body mass indices.

Matherials and Methods

Study design

We conducted a retrospective observational cross-sectional study.

Ethics

This study was approved by the Ethics Committee of the Sveti Duh Clinical Hospital, Zagreb, Croatia, under no. 01-03-1014/7, and has been performed in accordance with the principles of the Declaration of Helsinki.

Place and time conducted

The study was conducted at the Department of Obstetrics and Gynecology at the Sveti Duh Clinical Hospital from April to June 2022. During that period, data were collected on the patients who were treated in the Department during 2021.

Eligibility criteria

The subjects were thirty patients diagnosed with polycystic ovaries being treated for infertility at the Department of Obstetrics and Gynecology at the Sveti Duh Clinical Hospital, compared with a control group of women (N=15) not diagnosed with PCOS, of comparable ages and body mass indices (excluding ovarian insufficiency).

Data extraction

For this study, we collected data from an electronic database. We searched the medical records within the hospital medical program while coding the names so that the identities of the patients were kept confidential. We analyzed the serum levels

of follicle-stimulating hormone (FSH), luteinizing hormone (LH), estradiol (E2), anti-müllerian hormone (AMH), thyroid-stimulating hormone (TSH) and prolactin. Serum hormone levels were measured from blood samples collected in the early follicular phase, from the 2nd to the 4th day of the cycle, during the course of infertility treatment.

Data analysis

The values of the observed indicators of the patients' conditions are presented in graphs and tables.

Descriptive statistics methods, namely the arithmetic mean as the mean value and the standard deviation as an indicator of deviation from the mean value, were used.

The normality of the distribution had been previously tested using the Kolmogorov-Smirnov test, while the difference between the observed groups was tested using the t-test for independent measurements.

Analysis was performed using the statistical software STATISTICA 12.

Results

The level of FSH was statistically significantly lower in the infertile patients with polycystic ovary syndrome compared to the infertile patients in the control group not diagnosed with polycystic ovaries (t=1.66; P=0.05).

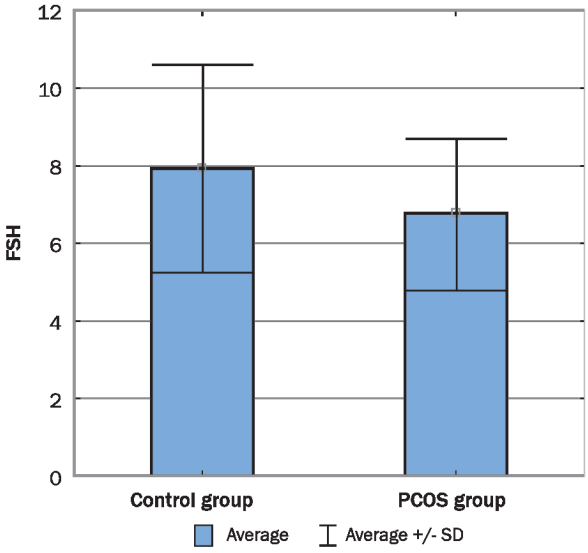

Figure 1. *Distribution of the results of the comparison of the serum FSH levels in infertile patients with and without diagnosed polycystic ovaries*

The level of LH was statistically significantly higher in the infertile patients with polycystic ovary syndrome compared to the infertile patients in the control group not diagnosed with polycystic ovaries (t=2.08; P=0.043).

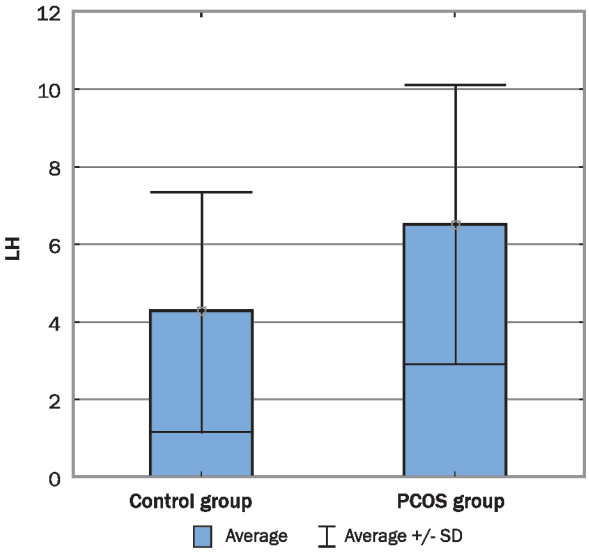

Figure 2. *Distribution of the results of the comparison of the serum LH levels in the infertile patients with and without diagnosed polycystic ovaries*

The level of E2 is statistically significantly lower in infertile patients with polycystic ovary syndrome compared to infertile patients in the control group without diagnosed polycystic ovaries (t=2.50; P=0.017).

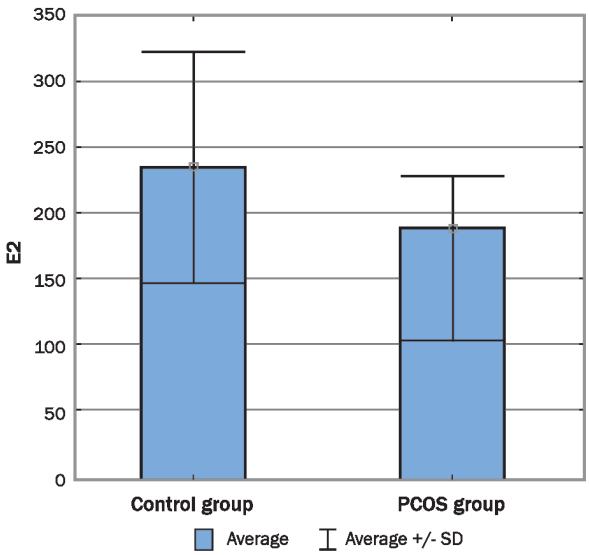

Figure 3. *Distribution of the results of the comparison of the serum E2 levels in the infertile patients with and without diagnosed polycystic ovaries*

The level of AMH is statistically significantly higher in infertile patients with polycystic ovary syndrome compared to infertile patients in the control group without diagnosed polycystic ovaries (t=4.55; P<0.001).

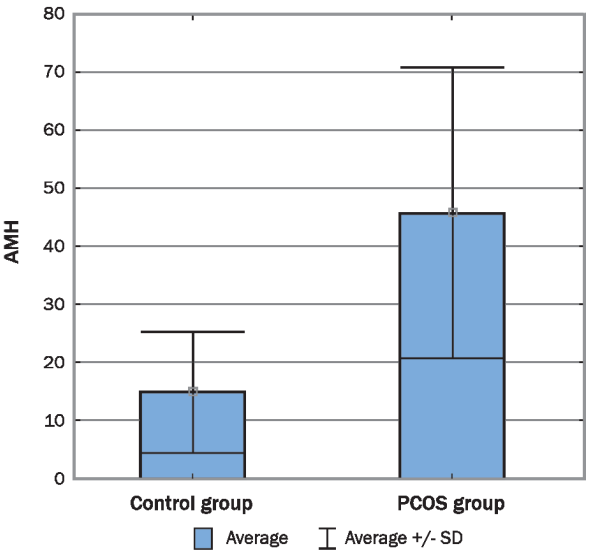

Figure 4. *Distribution of the results of the comparison of the serum AMH levels in the infertile patients with and without diagnosed polycystic ovaries*

The TSH level in the infertile patients with polycystic ovary syndrome was comparable to the control group of infertile patients without diagnosed polycystic ovaries, with no statistically significant difference (t=4.41; P=0.166).

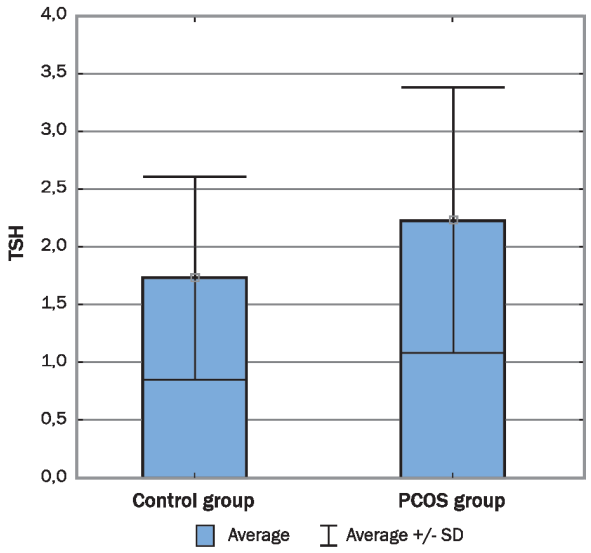

Figure 5. *Distribution of the results of the comparison of the serum TSH levels in infertile patients with and without the diagnosis of polycystic ovaries*

The level of PRL in the infertile patients with polycystic ovary syndrome was comparable to the control group of infertile patients not diagnosed with polycystic ovaries, with no statistically significant difference (t=0.49; P=0.628).

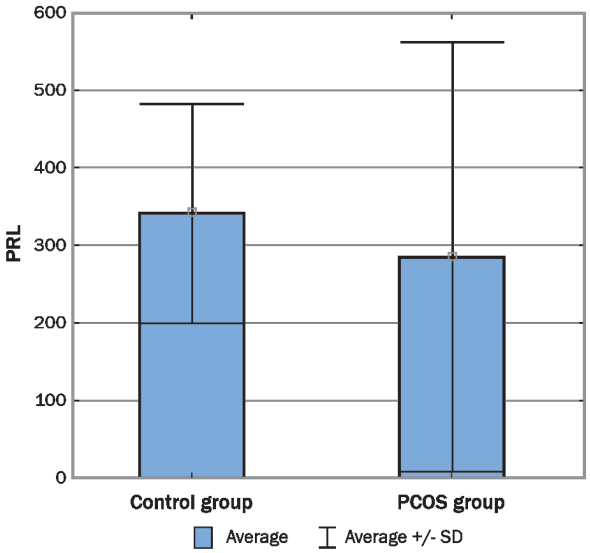

Figure 6. *Distribution of the results of the comparison of the serum PRL levels in the infertile patients with and without polycystic ovaries*

The mean duration of infertility among the patients with polycystic ovaries was not statistically significantly different from the control group (t=0.81; P=0.420).

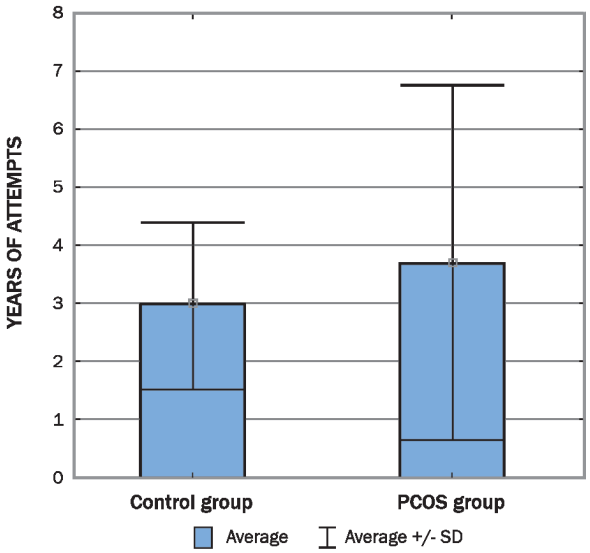

Figure 7. *Distribution of the results of the comparison of the duration of infertility in the infertile patients with and without diagnosed polycystic ovaries*

The mean age of patients with polycystic ovaries was comparable to that of the control group, with no statistically significant difference.

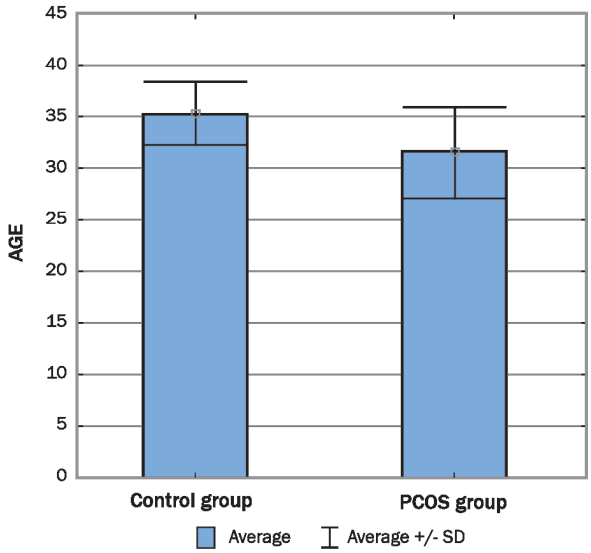

Figure 8. *Age distribution in the group of patients with PCOS, as compared to the controls*

Discussion

Polycystic ovary syndrome (PCOS) is a common endocrinopathy characterized by oligo-ovulation or anovulation, signs of androgen excess and a polycystic appearance of the ovaries on ultrasound imaging. These signs and symptoms vary widely throughout a lifetime. In patients diagnosed with PCOS, clinical signs often include menstrual cycle abnormalities, infertility, androgen excess and other endocrine dysfunctions (8). Symptoms of PCOS most often become apparent with the appearance of the first menstrual bleeding.

Infertility is defined as the inability to conceive after 1 year of regular unprotected intercourse for women under 35 years of age or after six months for women over 35. Published data in large studies claim that the chance of conception each month is 20-25% (9). When trying to conceive, the chance that a woman will become pregnant in 3 months is about 50%, the chance that she will conceive in 6 months is 75%, and during a year of trying to conceive, the chance that a woman will become pregnant is more than 85% (9, 10). However, well-publicized successes in the treatment of infertility give patients greater hope that medical intervention can help them achieve their goal.

The results showed that the FSH level was lower among the patients with polycystic ovaries compared to those in the control group (Figure 1). On the other hand, LH levels were significantly higher in the PCOS group as compared to the controls (Figure 2). This confirmed the hypothesis of differences in hormone levels between the control and PCOS groups.

The indicator and first sign of ovarian reserve is the procedure of measuring serum values of follicle-stimulating hormone (FSH) during the early follicular phase (11). As ovarian function declines, the supporting cells (granulosa cells and luteal cells) secrete less inhibin, which is responsible for inhibiting the secretion of FSH by the pituitary gland. With the loss of luteal inhibin, FSH levels rise in the early follicular phase, and a value > 10 mIU/mL indicates a significant loss of ovarian reserve, requiring more rapid evaluation and intensive treatment. In a study dealing with judgments and analyses of IVF cycles, a serum FSH value greater than 15 mIU/mL served as a predictor of a reduced pregnancy rate (11).

Malini et al. grouped subjects with PCOS into seven subcategories with regard to the pattern of LH rise in relation to FSH levels, i.e., how many times the LH level is higher than the FSH level. Sixty of the test subjects were women with normal ovulation, and the different subcategories were PCOS with the same LH and FSH levels and with variable ratios of LH and FSH levels (12).

In Saadia's investigation conducted from 2018 to 2019, LH levels were studied in 63 patients diagnosed with PCOS but with different body mass indices and these LH levels were compared in patients with low or high body mass indices (2). It was thereby confirmed that there is no significant difference between LH values in patients diagnosed with PCOS with high or low body mass indices, so it was concluded that body mass index is not correlated with LH levels (2).

Furthermore, a study conducted by Fakhoury H. et al. observed the influence of age and

body mass index on serum hormone values. The sample for the study was 62 patients with PCOS and 40 women in the control group without PCOS (13). Their conclusion also confirmed the hypothesis of this study. Serum LH values were higher in the group of patients with PCOS than in the control group of healthy women, regardless of age or body mass index (13).

Our results also showed that the level of E2 in the patients diagnosed with polycystic ovaries is lower compared to patients in the control group (Figure 3). The hypothesis of differences in the level of sex hormones between infertile patients diagnosed with polycystic ovaries and those without was confirmed.

In a study carried out by Daghestani MH. et al., the authors observed metabolic profiles in obese patients with and without PCOS (14). Contrary to this study, their data describe a higher level of E2 in obese patients with PCOS with a mean value of 217, compared to obese women without a PCOS with a mean value of 143 (14). It should be noted that the studies by Daghestani MH. et al. indicated increased insulin resistance in obese women compared to women of normal weight. Taking into account that both studied groups were obese, the conclusion was suggested that PCOS does not play a role in increasing insulin resistance (14). Several studies that have noted that most PCOS patients show an abdominal form of obesity, and that increased visceral fat may be a cause or an early consequence of insulin resistance in obese PCOS patients, which support the proposed conclusion.

The results showed that the mean level of AMH was higher among patients with polycystic ovaries compared to patients in the control group (Figure 4). This confirmed the hypothesis of a different value of AMH in infertile patients with PCOS compared to infertile patients without such a diagnosis, of comparable age and body mass index. A typical polycystic ovary normally contains two to three times more preantral and antral follicles compared to a normal ovary (15). Within the granulosa cells of these developing follicles, the dimeric glycoprotein antimüllerian hormone (AMH) is produced, and serum AMH levels correlate closely with the number of antral follicles. It is convincing that AMH serum values are two to three times higher in women diagnosed with PCOS, in contrast to the control group of women without PCOS (16, 17). For this reason, some see AMH as a potentially useful diagnostic marker for PCOS (18). Documented reports referring to AMH as a marker in PCOS are still lacking and further research is required before it can be accepted as a formal, established diagnostic criterion (19).

Analyzing the literature, it should be noted that the studies cover different populations, use different sets for measuring AMH and have different cut-off values for androgen concentrations and body mass index. These and other factors, such as the small sample size and retrospective study design, probably influence the fact that AMH is not yet used as a definitive diagnostic marker of polycystic ovary syndrome. Due to the possible heterogeneity of the results and differences arising from the study population, serum AMH levels should not be used as the sole test for the diagnosis of PCOS. A cut-off value of 35 pmol/L has been proposed to differentiate women with PCOS from healthy women. A study conducted by Rudnick E. et al. showed that serum AMH values are higher in adolescents with PCOS, with an increase in antral follicles and ovarian size compared to adolescents without PCOS (20).

The results from our study showed that the level of TSH was comparable in infertile patients with polycystic ovary syndrome to that of infertile patients in the control group (Figure 5). However, there was no statistically significant difference in serum TSH levels between the observed groups.

Fatima M. et al. studied the association between subclinical hypothyroidism (SCH) and polycystic ovary syndrome to determine the correlation between SCH and PCOS together with the impact of SCH on metabolic and hormonal parameters in women with PCOS (21). The results showed a significant difference in weight, body mass index, insulin, homeostatic model assessment of insulin resistance (HOMA-IR) and TSH levels in the SCH group, compared to the control group.

An exceptional correlation was observed between serum TSH levels and hip-to-waist ratio, body weight, body mass index, insulin and judgment of insulin resistance according to the homeostatic model (HOMA-IR) in patients with PCOS (21).

Our results also showed that the level of PRL was comparable in infertile patients with polycystic ovary syndrome and infertile patients in the control group (Figure 6). However, there was no statistically significant difference in serum PRL levels between the observed groups. Davoudi Z. et al. evaluated serum prolactin levels in 330 patients with PCOS and compared clinical features and hormone levels between patients with hyperprolactinemia and normal prolactin levels (22). Prolactin values were determined to be normal if their values were equal to or less than 25 ng/ml, but if prolactin values were >25 ng/ml, then the patients were subjected to further tests to rule out macroprolactinemia (22). In the case of hyperprolactinemia, an MRI of the brain was performed in order to detect a pituitary adenoma. Furthermore, higher LH levels and LH/FSH ratios, as well as lower estradiol levels, were observed in patients with normal prolactin levels. In addition, disturbances in menstrual cycles were present in patients who had pituitary adenomas (22). Davoudi Z. et al. also found no significant differences between the examined groups with regard to age and body mass index (22).

Delcour C. et al. clarified hypothetical epidemiological links between PCOS and hyperprolactinemia through a critical and updated review of the available literature on this topic (23). They showed that the link between hyperprolactinemia and PCOS comes from old studies in which PCOS was diagnosed according to the criteria of the time and in which hyperprolactinemia was insufficiently investigated. They also provided confirmatory information about data from the literature that did not suggest the existence of hyperprolactinemia in correlation with PCOS (23).

Another study by Hayashide et al. showed that increased prolactin levels were most frequently correlated with the presence of macroprolactin in women with polycystic ovaries, indicating that prolactin evaluation is therefore necessary (24). This first step is essential in order to avoid misdiagnosis and the unnecessary prescription of pituitary MRI.

Bearing all the above in mind, it is important to stress that the patients in our study were comparable regarding all epidemiologic characteristics, such as chronological age, duration of infertility, body mass index and age (Figures 7 and 8).

The results showed different hormonal characteristics of infertile patients with established PCOS as compared to controls treated for infertility at the Department of Obstetrics and Gynecology, Sveti Duh Clinical Hospital in Zagreb.

A limitation of this study was the small sample size, considering the fact that polycystic ovary syndrome affects a relatively large number of women. The retrospective design of the study may also have influenced the results. Future work should also include data on OGTT, insulin levels and body mass index, since they all could influence the measured hormone levels and PCOS phenotype.

Conclusion

Our research confirmed that infertile patients diagnosed with PCOS have different serum levels of pituitary and ovarian sex hormones as compared to controls. This could have implications in the evaluation of the hormone levels in patients with PCOS.

Declarations

Aknowledgements

This study was part of Nada Gruja's Master of Nursing thesis, originally written and defended in the Croatian language.

Authors' contributions

NG contributed to the study design, statistical analysis, interpretation of the data and the drafting of the manuscript. ATL contributed to the study design, data analysis and manuscript review. Both authors have read and approved the final version of the manuscript.

Ethics consideration

This study was approved by the Ethics Committee of the Sveti Duh Clinical Hospital, Zagreb, Croatia, under no. 01-03-1014/7, and has been performed in accordance with the principles of the Declaration of Helsinki.

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Competing interests

The authors declare that they have no competing interests.

Data sharing statement

Data available on request from the authors.

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Self-Efficacy and Habit as the Mechanisms Underlying Physical Activity: A Cross-Sectional Study

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Abstract

Background: In a modern, predominantly sedentary society, the importance of physical activity for both physical and mental health is increasingly emphasized. Hence, it is essential to examine the factors underpinning the initiation and maintenance of regular physical activity.

Aim: The main aim of this study was to test the role of physical activity (PA) self-efficacy and PA habit in explaining the PA intensity of recreational exercisers and athletes.

Methods: We conducted an Internet-based study from July 15 to July 31, 2023, using a cross-sectional design and a non-probability (convenient) sample. Participants completed a questionnaire containing scales to assess their PA self-efficacy, PA habit and PA intensity, questions on their physical exercise and sports involvement, and questions on their sociodemographic background.

Results: The study comprised 491 participants, of whom 424 were athletes (27.4%) or individuals who regularly exercise (72.6%), (53.8% of whom were female), of an average age of 28.39 years. The results showed a direct positive contribution of PA self-efficacy to PA intensity among athletes. PA self-efficacy did not directly contribute to PA intensity in exercisers. PA self-efficacy indirectly contributed to PA intensity through enhanced PA habit, across all the observed groups.

Conclusion: The study findings demonstrated the importance of PA self-efficacy and PA habit in explaining PA intensity, with possible distinct mechanisms of contribution for athletes and regular exercisers. Specifically, the data suggest a positive impact of PA self-efficacy on PA intensity among athletes both directly and indirectly, through enhanced PA habit, while enhanced PA habit completely mediated the positive impact of PA self-efficacy on PA intensity among exercisers. This empirical evidence illustrates the necessity of providing individuals with effective skills and knowledge, which are crucial for fostering a sense of PA self-efficacy, strengthening the PA habit and, ultimately, for more effective engagement in PA.

Keywords: physical activity, recreational exercisers, athletes, self-efficacy, habit

Introduction

The empirical and theoretical significance of physical activity (PA) is not surprising given its numerous benefits on physical and mental health as well as daily functioning (1–5).

Therefore, to acquire a deeper understanding and provide efficient guidelines and practical tools, it is essential to identify the factors and processes that foster regular physical activity (PA).

One such factor might be self-efficacy, which is the individual's belief in their capacity to perform a specific task, achieve a particular goal or effectively handle various situations (6,7).

An empirically demonstrated positive correlation between PA self-efficacy and PA involvement suggests a higher probability of engaging in more strenuous PA with increased PA self-efficacy (3,8,9). Moreover, PA self-efficacy has been demonstrated to be a significant determinant in actualizing intended PA behaviors (10,11). These findings provide further insights into the theory of planned behavior, which proposes the factors that determine the intention and the ability to anticipate behavior based on an intention (12). Thus, they support the theory's assumption that perceived behavior control, a concept closely linked to self-efficacy, not only enhances intention but also operates as the mechanism through which intentions to engage in regular PA or exercise are converted into actual behavior.

Another mechanism that has been found to be correlated with PA (13–15) and potentially plays a role in translating intentions into real behaviors is the PA habit strength (10,13,16,17,18,19). It seems that habits, as processes that operate with a high degree of automaticity, responsiveness and efficiency, thus requiring less energy and effort, significantly determine more regular PA (19,20).

These empirical findings improved the theory of planned behavior by elucidating the potential processes and mechanisms contributing to the manifestation of PA. They additionally support the multi-process action control model, which posits reflective processes such as perceived self-efficacy and habit as crucial mechanisms of sustained behavioral action (21). More specifically, this model assumes that reflective processes, such as perceived capability, lead to behavior until the reflexive processes, such as habit or identity, begin to co-determine and regulate action control and, ultimately, behavior manifestation. Simply stated, when specific behaviors are repeated regularly, reflexive processes begin to influence future actions and mediate the influence of reflective processes on behavior.

Thus, to test this model's prediction and gain new insights into the relationship among PA self-efficacy, PA habit and PA intensity, this study aimed to examine the direct and indirect effects of PA self-efficacy, through PA habit strength, on PA intensity among athletes and exercisers.

Materials and method

Study design

The study employed a cross-sectional design.

Ethics

The study was conducted in compliance with the ethical guidelines outlined in the 1964 Declaration of Helsinki and subsequent amendments thereto and in accordance with the General Regulation on the Protection of Personal Data (EU) 2016/679, (GDPR) and the Law on the Implementation of the General Regulation on the Protection of Personal Data (NN 42/2018). Participants were informed about the study's objectives, characteristics, protocol and data analysis, and were informed that by proceeding with the online form, they were consenting to participate in the study. The Ethics Committee of the Catholic University of Croatia approved the study (Document Class: 602-04/23-11/029; No.: 498-15-06-23-001).

Participants

This study's target population was physically healthy adults in Croatia with various levels of PA. The study's sample was convenient

and consisted of adults who had received an invitation letter to participate in the study and who were not facing any challenges in carrying out ordinary physical tasks.

Procedure

We prepared an invitation letter that encompassed all the crucial details about the study, along with the hyperlink to the online questionnaire. We emphasized the main objective of the study, as well as its scientific and practical significance. Additionally, we noted that the study is intended for all adult individuals who do not experience any challenges in carrying out ordinary physical tasks. The invitation letter was disseminated using email, smartphone applications and social media channels. The questionnaire was created using the SurveyRock web platform. In the questionnaire's introductory section, we reiterated the study's objective and informed the participants about the confidentiality and anonymity of their data. Furthermore, we explicitly stated that the data would be evaluated strictly at the group level. We also emphasized the option to discontinue participation in the study at any time without incurring any repercussions. Upon concluding this section, we notified the participants that by proceeding (clicking the "next" button), they were consenting to participate in the study. The time needed to complete the questionnaire was up to 10 minutes. The study was conducted between July 15 and July 31, 2023.

The initial section of the questionnaire comprised scales measuring PA self-efficacy, PA habit strength and PA intensity. The questionnaire concluded with questions regarding physical exercise, sports participation and the participants' sociodemographic profiles.

Measures

Physical activity self-efficacy

We operationalized PA self-efficacy using the Self-Efficacy for Physical Activity (SEPA) scale [22,23]. The scale consists of five items that form one factor. An example of an item is "I am confident I can participate in regular physical activity when I am tired." Participants answer on a five-point scale, ranging from 1 (not at all confident) to 5 (extremely confident). The total score is obtained by summing the answers to all the items, where a higher score indicates higher PA self-efficacy.

For this study, the questionnaire was translated from English to Croatian using the double-blind translation procedure. The study also demonstrated acceptable scale reliability, with an internal consistency Cronbach alpha of 0.82.

Physical activity habit strength

We used the self-report index of habit strength (SHRI) [24] to measure habit strength for physical activity. The scale consists of ten items that form one factor. An example of an item is "Exercise is something I do frequently." The response options are on a scale ranging from 1 (I completely disagree) to 5 (I completely agree). The total score is obtained by summing the answers to all the items, where a higher score indicates higher PA habit strength. The internal consistency of the scale in this study suggested highly satisfactory reliability (Cronbach alpha = 0.96).

Physical activity intensity

To assess PA intensity, we used the *Godin-Shephard Leisure-Time Physical Activity Questionnaire* [25,26]. The participants answered the following question: "In your usual week, how many times, on average, do you perform the following forms of physical activity/physical exercise for more than 15 minutes?"

Then, three kinds of physical activity/exercise were presented and described: strenuous exercise (heart beats rapidly), moderate exercise (not exhausting) and mild/light exercise (minimal effort), with examples of activities listed, such as running, fast walking and easy walking, respectively. The participants wrote the number for each kind of exercise. A total score was formed by multiplying each score by the corresponding ponder (the score for mild exercise × 3, the score for moderate exercise × 5, and the score

for strenuous exercise × 9), with higher scores indicating more intense PA.

Physical activity levels

To report on their physical activity/sports engagement, the participants were asked to respond to the following question: *Are you engaged in any exercise or sports activity, and if so, at what level?* Choose one option, a number between 1 and 5 (1—*I am not, or I am very rarely engaged in exercise or sports activities;* 2—*I am recreationally but not so actively engaged in sports (for example, once a week, three times in two weeks, occasionally or similar);* 3—I *am recreationally actively engaged in sports (for example, a couple of times a week, 2–3 times and more);* 4—*I train for a certain sport and compete at an amateur level,* 5—*I train for a certain sport and compete at a professional level).*

To encompass physically active individuals, we removed the participants who reported being either not physically active or engaging in exercise or sports activities very rarely (participants who answered *I am not, or I am very rarely engaged in exercise or sports activities*). Therefore, three groups of participants remained: athletes, more active recreational exercisers and less active recreational exercisers.

Data analysis

To test the direct contribution of PA self-efficacy to PA intensity and the mediation role of PA habit in this relationship among athletes and more and less active exercisers, we utilized a moderation mediation with a multi-categorical moderator (Model 8) (27).

Considering the different types of involvement and distinct PA characteristics in those who exercise and compete, we used Helmert coding to differentiate between athletes and exercisers. Specifically, besides the relationship among PA self-efficacy, PA habit and PA intensity, this method's regression coefficient (bs) estimated the difference between athletes and exercisers, both less and more active (W1) and the difference between less and more active exercisers (W2) in PA habit and PA intensity.

Furthermore, the interaction effects of the estimated moderated mediation model showed the possible different relationships among PA self-efficacy, PA habit, PA self-efficacy and PA intensity among amateur athletes compared to exercisers (PA self-efficacy x W1) and between less active exercisers compared to more active exercisers (PA self-efficacy x W1). The statistical significance level was set at .05. Figure 1 depicts a hypothesized model's conceptual diagram, which illustrates PA self-efficacy's contribution to PA intensity, both directly and indirectly through PA habit and its dependence on PA levels.

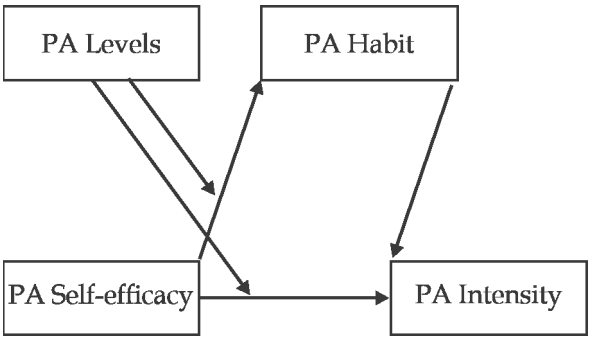

Figure 1. *Conceptual diagram of the mediation role of PA habit in relation to PA self-efficacy and PA intensity and its dependence on PA levels (as a moderator)*

Results

A total of 491 adults participated in the study. Among them, 64 reported that they are not or are very rarely engaged in exercise or sports activities. Due to the aim of this study, these participants were excluded from the analysis. Furthermore, we excluded three participants (one among the less active and two among the more active exercisers) with aberrant results on the PA intensity scale (z values of 4.92, 6.89 and 8.63). Therefore, the study sample consisted of 424 adults (53.8% females), of whom 24.3% were less active exercisers (N=103), 48.3% were more active exercisers (N=205), and 27.4 athletes (N= 17), with an average age of 28.39 (SD=9.69).

Table 1. Descriptive statistics and intercorrelations among variables

Exercisers									
	Less active		More active		Athletes				
	M (SD)	Range	M (SD)	Range	M (SD)	Range	1	2	3
PA self-efficacy (1)	13.10 (3.72)	6–24	16.77 (4.26)	5–25	19.90 (4.41)	9–25	-	0.67**	0.52**
PA habit (2)	24.30 (8.71)	10–46	37.96 (9.34)	12–50	44.26 (6.98)	12–50		-	0.55**
PA intensity (3)	33.58 (19.27)	3–105	58.48 (24.37)	6–220	81.00 (30.51)	22–185			-

**P< 0.01

The results of correlation analysis (Table 1) showed a positive relationship between PA intensity and both PA self-efficacy (r=0.52, P<0.01) and PA habit (r=0.55, P<0.01). PA self-efficacy and PA habit were also positively related (r=0.67, P<0.01).

The results of moderated mediation showed that the model accounted for 44.26% of the PA intensity, F (6, 417)=10.923, P<0.001 (Table 2).

Table 2. Moderated mediation analysis predicting physical activity intensity (Helmert coding)

					95% CI	
	b	*SE*	*t*	*p*	*LL*	*UL*
PA habit						
PA self-efficacy	1.07	0.09	11.77	<0.001	0.89	1.24
W1	-17.82	3.53	-5.05	<0.001	-24.76	-10.88
W2	-8.25	3.32	-2.48	0.014	-14.79	-1,71
W1 × PA self-efficacy	0,55	0.19	2.87	0.004	0.17	0.92
W2 × PA self-efficacy	-0.05	0.23	-0.24	0.809	-0.50	0.39
PA intensity						
PA self-efficacy	1.41	0.33	4.27	<0.001	0.76	2.06
PA habit	0.65	0.15	4.23	<0.001	0.35	0.96
W1	33.09	11.47	2.88	0.004	10.55	55.63
W2	-16.64	10.57	-1.57	0.116	-37.41	4.14
W1 × PA self-efficacy	-2.87	0.61	-4.74	<0.001	-4.06	-1.68
W2 × PA self-efficacy	0.16	0.71	0.22	0.826	-1.24	1.56

Note. W1 = athletes vs. exercisers; W2 = more vs. less active exercisers

The results revealed stronger PA habits of athletes compared to exercisers (b=-17.82, P<0.001) and stronger PA habits of more active exercisers than less active exercisers (b=-8.25, P=0.014).

The results also showed the significant positive contribution of PA self-efficacy to PA habit (b=1.07, P<0.001). However, the significant interaction effect (b=0.55, P<0.001) suggested a stronger correlation between PA self-efficacy and PA habit among exercisers than athletes. The correlation between PA self-efficacy and PA habit was similar for more and less active exercisers (b=-0.05, P=0.809) (Figure 2).

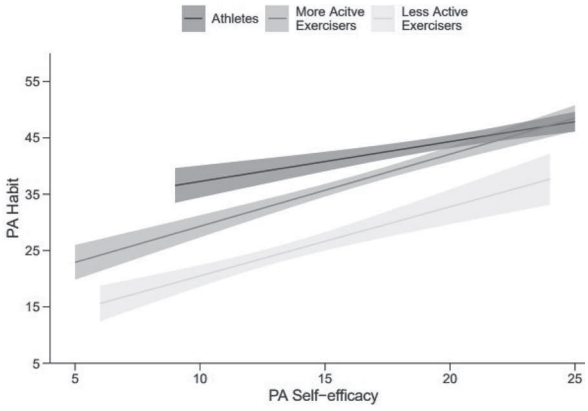

Figure 2. *The relationship among PA self-efficacy and PA habit among athletes and more and less active exercisers*

The results also revealed higher PA intensity of athletes compared to exercisers (b=33.09, P<0.001). Although the data indicated a tendency toward a higher PA intensity of more active exercisers compared to less active ones, the difference was not statistically significant (b=-16.64, P=0.116).

PA self-efficacy positively contributed to PA intensity (b=1.41, P<0.001). However, this relationship was different between athletes and exercisers (b=-.2.87, P<0.001), suggesting a stronger correlation between PA self-efficacy and PA intensity among athletes compared to exercisers. In other words, the PA self-efficacy of athletes contributed more to their PA intensity than in exercisers. The contribution of PA self-efficacy to PA intensity in less and more active exercisers was similar (b=0.16, P=0.826) (Figure 3).

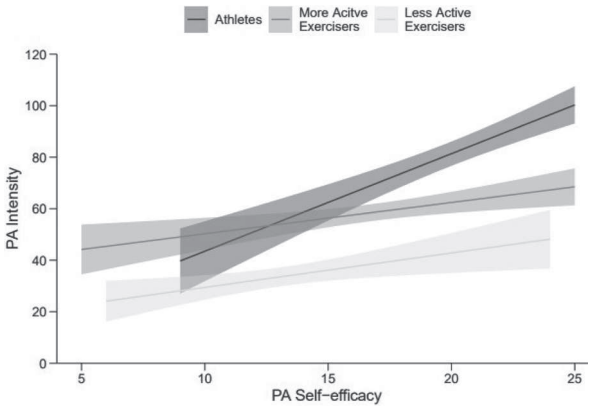

Figure 3. The relationship between PA self-efficacy and PA intensity between athletes and more and less active exercisers

Regarding the study's primary aim, the results of moderation mediation showed different contribution paths of PA self-efficacy on PA intensity through the mediation of the PA habit between athletes and exercisers. In particular, the PA self-efficacy of athletes impacted PA intensity both directly, $b_{athletes}$=3.33, [2.35–4.29], and indirectly through PA habit, $b_{athletes}$=0.46, [0.25–0.70]. In contrast, the PA self-efficacy of more active exercisers and less active exercisers impacted PA intensity only via the PA habit, $b_{more\ active\ exercisers}$=0.84, [0.46–1.25], $b_{less\ active\ exercisers}$=0.80, [0.39–1.27].

Discussion

In this study, we examined the contribution of PA self-efficacy to PA intensity and the mediating role of the PA habit in this relationship among athletes and exercisers.

We found that the contribution of PA self-efficacy to PA intensity and the mediation role of PA habit in this effect differ in athletes and exercisers. Specifically, the athletes' PA self-efficacy contributed to their PA intensity both directly and indirectly through enhanced PA habit. On the other hand, the PA self-efficacy of exercisers influenced their PA intensity only through an enhanced PA habit.

Our findings of the mediation role of PA habit in the relationship between PA self-efficacy and PA intensity support previous empirical evidence on the significance of habit in determining physical activity intensity (16,19,20). Additionally, these findings provide a deeper understanding of the underlying mechanism by which PA self-efficacy influences PA intensity.

This empirical evidence aligns with the multi-process action control model, which posits reflexive processes such as habit as the most effective means of maintaining behavior due to learned associations and less effort required, and the means by which reflective processes such as self-efficacy influence PA intensity (21).

Nevertheless, the partial mediation shown in athletes, i.e., the direct contribution of PA self-efficacy to PA intensity besides the indirect, via PA habit, provides a valuable insight into the importance of PA self-efficacy. The importance of self-efficacy is particularly pronounced among athletes, most likely due to the nature of sports. We found the strongest PA habits in athletes, and an insufficiently developed habit is surely not the factor that led to the direct effect of PA self-efficacy on PA intensity. However, sports require specific skills and expertise, which is why PA self-efficacy arguably plays a more crucial role in the training and competition process and, as a result, in PA intensity (28,29).

Furthermore, as among exercisers, our study's findings indicated the contribution of athletes' PA self-efficacy to their PA intensity, also through the PA habit, which further emphasizes the importance of this reflexive mechanism acquired via purposeful, deliberate and repetitive engagement in PA. This engagement is arguably affected by PA self-efficacy, which in turn results in the development of PA habit strength. Our study's findings support this path and align with previous empirical insights into the impact of consistent engagement in PA on forming PA habit strength, whether through structured sports training or in self-engaged recreational engagement (30). The significant role of PA self-efficacy is also conceptually supported by the self-efficacy theory (7) and the theory of planned behavior (12), which posit self-efficacy or perceived behavior control as a significant determinant of the execution of an action. However, as previously stated, our findings contribute to the current understanding of the mechanisms underlying the manifestation and regulation of action, highlighting the significant role of the PA habit in the relationship between PA self-efficacy and PA intensity.

Encompassing diverse PA-level groups, this study allowed us to gain new insights into the roles of PA self-efficacy and PA habit among populations who are differently engaged in PA. These insights benefit researchers and healthcare providers by identifying and defining the essential components for maintaining sustainable PA. They are also of particular importance in creating effective interventions for individuals seeking to establish consistent exercise routines, which will involve tools and strategies to improve individuals' beliefs in their abilities to engage in PA and other reflective processes that facilitate habit formation or a stronger connection to PA. Nevertheless, considering our study's cross-sectional design, future longitudinal studies are recommended to verify and reinforce these findings. In addition, future studies ought to encompass other potentially relevant factors that could feasibly help individuals translate their intentions into tangible PA behaviors.

Conclusion

Our study highlights the importance of PA self-efficacy and PA habit for the degree of PA intensity. The significance of PA habit is particularly evident among exercisers, as habit acts as a complete mediator in the association between PA self-efficacy and the intensity of PA. On the other hand, PA self-efficacy is essential for forming habits for both exercisers and amateurs. It also directly contributes to the PA intensity of athletes.

Therefore, this study indicates the necessity for creating and offering tools, strategies and guidance to enhance an individual's PA skills and beliefs, likely leading to a strengthened PA habit and sustainable PA.

Declarations

Acknowledgements

This study was part of Vicko Ćudina's Master of Psychology thesis, originally written and defended in the Croatian language

Authors' contributions

DG, VĆ and DD: study design; DG, VĆ and DD: data collection and analysis; DG, VĆ and DD: data interpretation; DG and VĆ: writing first draft of the manuscript; DG, VĆ and DD: revising the manuscript for critical intellectual content; DG, VĆ and DD: approval of the final version of the manuscript.

Ethics consideration

The Ethics Committee of the Catholic University of Croatia approved the study (Document number: Class: 602-04/23-11/029; No.: 498-15-06-23-001). After the participants had been given all necessary the information regarding the study and anonymity in accordance with the General Data Protection Regulation (GDPR), they gave informed consent before taking part in the study.

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Competing interests

The authors declare no conflict of interest.

Data sharing statement

The authors confirm that the data can be obtained by contacting the corresponding author.

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Ethical and Social Aspects of Ambient Assisted Living in Croatia as Perceived by the Elderly, Nurses and Engineers: A Qualitative Study

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Abstract

Background: One of the major problems affecting the Western world is the rising increase of the elderly population. Consequently, society is looking to develop care and support systems for the elderly. Technological systems are being developed that aim to improve the quality of life of older people in order to afford them independence and autonomy. One such tool is Ambient Assisted Living (AAL), which implements various technologies into the homes of the elderly, contributing to their safety. The use of such technologies may lead to various social or ethical problems.

Aim: The aim of this study was to analyze the social and ethical issues of AAL and to understand the perceptions of the stakeholders in Croatia (the elderly, nurses and engineers) in detail.

Methods: We conducted qualitative research through semi-structured interviews with 17 participants from Croatia among three categories of people who could be potential stakeholders in the AAL system: nurses, engineers and the elderly. The interviews were recorded and then transcribed. The thematic analysis method was used to analyze the data.

Results: A total of five nurses, six engineers, and six elderly individuals were interviewed. This study showed that there is a need to use AAL technology to improve the care and quality of life of the elderly. The participants were concerned about the potential of such technology to deprive the elderly of important human components of care, such as interpersonal warmth and touch, which might result in social isolation. The ethical issue of privacy breach due to constant video surveillance was a concern expressed by all the participants.

Conclusion: The greatest concerns regarding AAL found in this study were a lack of human contact, i.e., dehumanization of care, and the threat to privacy due to data collection using sensors and video surveillance.

Keywords: Ambient Assisted Living, smart homes, privacy, human contact, ethics, social isolation

Introduction

The development of medicine and medically assisted technologies undoubtedly represents a great opportunity and advantage (1), as it provides new insights into various health fields, especially with regard to aging and the applications of gerontechnology based on artificial intelligence (AI) (2). The application of technology along with a special diet—through a general healthy lifestyle and behavior—have contributed to an improvement in the quality of human life, but also to extending life expectancy significantly. This increase in longevity has consequences. The most important is an aging population, which poses a complex challenge (3), especially in the Western world. The United Nations' document *World Population Prospects 2022, Summary of Results*, projects that by 2050 one in every four persons in Europe and Northern America could be aged 65 years or over (4).

Such data imply various challenges that society must deal with effectively (5). There are economic (6), social and health repercussions: increased financial pressure on healthcare systems due to the growing number of the elderly prone to various age-related diseases, declining birth rates alongside increased mortality, creating a gap in population demographics and dynamics (3). There is also an underdeveloped care network for the elderly and a general lack of support, which is especially notable in Croatia, as well as many parts of Central and Eastern Europe. In some countries, institutional care for the elderly is still prevalent (nursing homes) (7). In the more developed countries of the Western world, care focuses on keeping the elderly in their own homes through gerontechnology, i.e., intelligent building systems (8).

In that vein, ideas and technological systems based on ambient intelligence (AmI) are being developed. Ambient Assisted Living (AAL) includes the use of ambient intelligence-based techniques, processes, and technology with the intention of enabling older people to live independently and maintain their quality life for as long as possible (9). This involves sensors, cameras and robotic systems of various types being installed in the living environment of the elderly. More specifically, the concept of *smart homes* most precisely describes the implementation of AAL in the lives of older people, i.e., in their residences (10). Due to efficient networking and connectivity, most often with smartphones, Wi-Fi network (the Internet of Things), caregivers or healthcare professionals can receive feedback through applications and software, especially in an emergency. An example of such aids are fall sensors that work by monitoring floor pressure and using this information to report on the user's condition to families or healthcare providers.

Such technologies are intended to enable the elderly to age well and with dignity in the comfort of their own homes, with a reduced dependence on others. They are used as preventive measures, as well as treatment and improvement tools to aid the well-being and health status of the elderly. The European Union has recognized the importance of developing such technologies and has listed objectives to be achieved through such programs: a) independent living in the desired environment; b) continuous health monitoring; c) avoidance of social isolation; d) improved security and privacy and e) promotion of smart systems for a better quality of life (11).

However, if we look at how technology is evolving, it is difficult to remain neutral concerning its use in this regard, that is, to adopt the view that it all depends on the way the technology is used. It is also erroneous to idealize technology as the only new form of salvation for humankind. All use of technology is an intentional activity that takes place in a specific social environment and establishes dialogue with various values and themes, domains, disciplines, environments and fields (12). Therefore, in addition to the technical specifications of AAL, it is important to observe its impact on individuals and society. The ethical issues raised according to the Royal Academy of Engineering (13) are as follows: Is social isolation the price to be paid for the autonomy provided by smart homes? How can a balance be maintained between independence and sociability (connectedness with others)? Will vulnerable

groups, such as the elderly, understand the nature of technologies in smart homes, and how can we ensure that they have given clear informed consent about their use? Who should control the data generated by systems that "supervise" people's movements and "oversee" their physical condition? Some of the social and ethical issues associated with AAL and smart homes are the threat to privacy, concerns about surveillance and control, questions of availability, the dangers of (or problems associated with) an over-reliance on technology, as well as a lack of human contact. In summary, by endeavoring to use technology to target 4P medicine (predictive, personalized, preventive and participative), there is a danger of creating the so-called 4Ds: depersonalized, discriminatory, dehumanized and disciplining (2). The results of a literature search show that no research on this topic has been conducted yet in Croatia, so for a deeper understanding of the social and ethical issues related to this topic, one should begin from the perspective of those who may be directly or indirectly involved in using AAL. To this end, our study aimed to analyze the social and ethical issues associated with AAL and achieve a detailed understanding of the perceptions of the stakeholders in Croatia (the elderly, nurses and engineers).

Materials and method

Study design

A qualitative study was conducted by means of semi-structured interviews. Different issues were devised for each category of participants.

Ethics

The study was conducted in accordance with the institutional Codes of Ethics. All methods were performed in accordance with the relevant guidelines and regulations. Written informed consent was obtained from all the study participants.

The study protocol was approved by the Ethics Committee of the Catholic University of Croatia (document number 498-03-02-06/1-21-04).

Participants and data collection

The participants were selected by snowball sampling. Seventeen interviews were conducted with 3 categories of participants: nurses (N=5), engineers (N=6) and the elderly (N=6). The first stage of the study was conducted from March to May 2021 in the Republic of Croatia and included 11 people. The second stage was conducted from January to February 2023, with an additional 6 people in the same country. The interviews lasted from 10 to 30 minutes. Some of the participants (N=9) were contacted online via the Zoom app, while others (N=8) were interviewed in person, at home or in the workplace. In this article, the participants were coded: N (nurse), OP (older person), E (engineer). The ordinal number of a participant was added to the abbreviation, for example, N1, OP2, E3. Inclusion criteria for the elderly were age (>65 years) or retirement. The nurses were required to be employed with outpatient duties (district nursing), working directly with the elderly. The engineers were from the fields of electrical engineering and information technology, and had some experience with AAL. The thematic analysis method was used to analyze the data. The obtained themes were divided into 3 categories, as presented in the results section.

Results

Thematic analysis of the results yielded three categories of themes: 1. acceptance and availability of AAL technologies, 2. loss of human contact, 3. data collection, privacy vs. safety.

1. Acceptance and availability of AAL technologies

Our study on AAL shows that nurses who made daily visits to elderly people with chronic illnesses and entered their homes expressed a level of concern regarding the physical maladaptation of apartments and the inability of the elderly to maintain their quality of life due to limited mobility. They highlighted the problem of the social isolation faced by many elderly people.

"There are a lot of practical impediments for older people. They remained in the spaces where they had lived as young people, and they hadn't thought about the fact that they would need to address those challenges" (N2).

Due to these problems, the nurses reported that their patients would benefit from using AAL technologies. The engineers, but also nurses, pointed out that introducing such technologies into the homes of the elderly would improve their quality of life but also help facilitate the work of the health professionals involved in their care.

Depending on the circumstances in which the elderly lived or the characteristics of their apartments, they were asked whether they would be interested in using a smart home system if it were offered. Some participants answered in the affirmative, recognizing the benefits that such technologies would bring to their lives, while one participant recognized the benefits of AAL technologies, responding as follows:

"Yes, I am interested. I'm very alone in the house. I would be very glad to have it [AAL]" (OP2).

One of the key problems recognized by the nurses, which concerns the challenges that AAL system users could face, is the insufficient acceptance and use of technology by their elderly patients. The technologies they use are mostly cell phones, which are not always smartphones, and televisions. The nurses' statements reveal that the elderly they encounter do not use other technologies in their apartments and are not inclined to use, or open to, technology:

"Mostly, they use cell phones, and usually their family puts it on speed dial. They are mainly connected to phones, TV and that's all" (N1).

The older people themselves considered the same issues regarding the use of some of the technologies, but they expressed disinterest more often than enthusiasm:

"I'm not exactly for modern technology; I don't even use a computer, only a cell phone. I don't use a smartphone but only a classic one because, I admit, it doesn't really interest me much. I am more practical and prefer face to face, one on one [interactions]" (OP3).

Acceptance of technology has been shown to be linked to technological literacy. Participants identified the reasons for the non-acceptance and non-use of technology as insufficient technological information as well as literacy, associated with difficulties in keeping up with technology. There was a distinctly divided view on the issue of technological literacy, on one hand believing that the elderly are not technologically literate at all (N1, 3, 4 & 6), and on the other that literacy is an individual matter, and that it is erroneous to generalize about the technological illiteracy of the elderly population as a whole (N2 & 5). Engineers, on the other hand, indicated that it is possible to offer technology to older people in an acceptable manner (E6). Therefore, ways must be found to develop technology that can be adapted to the capabilities and technological literacy of the end users, in this case, the elderly.

"I think that somehow everything needs to be adapted, [so] that there is the same critical mass of older people who can adapt to technology. Since not everyone is incompetent, those who are less able will use the smaller range of the technologies that are accessible to them" (E1). "There should be ways to make technological advances more accessible to the elderly, but again those who want them will accept them, and those who do not, will not. It's just a matter of will" (E2).

Another dimension of the social problem of AAL technologies is undoubtedly economic. The engineers addressed this point. One of the engineers emphasized cost as the primary disadvantage of AAL technology. Considering the financial status of many retired people in Central and Eastern Europe, especially in Croatia, the participants assumed that older people would neither want nor be able to spend large amounts of money for technology that they often view as a luxury:

"Very often we realize that many of them have saved money but don't want to spend it on improving their quality of life. If we were to suggest that, they would immediately respond: How much does it cost?" (E1)

With regard to the financial (in)accessibility of AAL technologies to the public, several

of the participants considered AAL systems to be extremely expensive currently but indicated it was worthwhile to invest in such technology if there is the will to do so (E5 & 6). One engineer reported that such technologies can be accessible to the general public because of the many do-it-yourself solutions:

"I think that such technologies are financially accessible to the general public. Fifteen years ago I would have said that they were not, now I would say that they are because you have a lot of smart home solutions that are based on do-it-yourself and you can do a lot of things for quite little money" (I2).

2. Loss of human contact

The use of AAL inevitably entails certain ethical issues that should not be ignored. They are perhaps more important than the prominent social issues because they concern humanity itself in its encounter with technologies, privacy management, (i.e., user data) and the future of the biomedical profession. Therefore, the first ethical challenge of AAL technologies, which was touched upon during conversations with all the participants, is the loss of human contact. Recognizing human warmth as an essential component of the nursing profession, nurses consider a lack of human contact to be detrimental, with a risk of negative consequences for the elderly. They emphasized the importance and necessity of human contact in their profession, observing that technology cannot completely replace humans, i.e., the human component in their profession, but also more generally in all human relationships.

"We need to look at technology as an auxiliary aid, but it can never replace us, and it can't replace humanity. It can't replace proximity and touch" (N3).

One nurse was more optimistic about the future of the nursing profession. According to her, these technologies will allow them to *"focus on much more important things – wound bandaging, care, hygiene, psychological help and communication with the patient. I would spend more time communicating with the patient because it means a lot more to them, and now I must do physical tasks that are strenuous and don't mean too much to them. They miss social interaction"* (N5).

The nurses' views are in accordance with the attitudes of the older people, who agreed that technology cannot replace human interaction, especially in terms of medical care. In that vein, the engineers also indicated that technology entails some consequences for human communication. Like the nurses, they reported that technology should be viewed as an aid but by no means as a substitute for real human contact and communication. All agree that regardless of the efficiency and advantages that new technology offers, it should remain an auxiliary tool and not a replacement for human interaction. *"It should by no means replace that interaction with people completely. Someone should always come to visit a person; check how they are doing. This is just support and should certainly not completely replace interaction. It should instead encourage people to meet and spend time together again, knowing that the time not spent together, thanks to technology, ensures a better quality of life"* (E3).

For one nurse, there is the danger that technology will take over:

"The technology could in some ways make things worse because the elderly still have some physical requirements. Those who may be more mobile can go to the bank to withdraw cash and may meet a neighbor and exchange a few words. Technology could in some ways tie them even more to the house" (N4).

The practical aspects of using AAL as an aid for the elderly include various robotic devices and digital assistants to help with daily activities, but also to help perform some medical procedures that are otherwise practiced by nurses. Interestingly, nurses are not in favor of introducing robots as a substitute for medical staff. This is primarily due to the inability of robots to communicate constructively or express human warmth. Regarding the possibility of robotic care replacing a nurse or physiotherapist, the concerns of the elderly focused on

communication, human warmth and the importance of human touch, i.e., human interaction.

"I love seeing them. I love their touch. I love hearing their voices. I don't know how I would feel; I can't even imagine it. I don't know how a robot would rub my arm. This is the biggest failing (or deficiency) of technology: the lack of human contact. If a robot showed a little emotion, I would allow it to do everything" (OP2).

"I want contact with others. Such technology would not prevent me from being in touch with others" (OP5).

A similar opinion is shared by OP6, while one elderly person alluded to the spiritual dimension of contact, claiming:

"I would not accept a robot. I don't need anything without a soul. I don't see any advantage in that" (OP4).

3. Data collection, privacy vs. security

AAL uses AI and AmI. Certain user data must be collected to ensure the optimal functionality of the system for the user. Data collected by the system are mostly personal, so some of the engineers emphasized possible data misuse as an ethical issue.

"For that reason, it should be accepted as a support in your daily life but understood that in return some personal information must be collected" (E3).

Two (E2 & 5) of the engineers emphasized that they had never considered the ethical issues that might arise. However, all the engineers were of the same opinion that the use of data, even the possibility of manipulation and misuse, depends on who coordinates the system and manages the data. An interesting observation was made by one participant who underscored the importance of vetting any prospective company prior to contracting them to check for any prior data breaches or misuse of personal data. The engineers emphasized that the quantity and nature of the data collected were valuable, as they enabled the system to function more effectively. However, the nature of valuable data makes them subject to manipulation and abuse. For this reason, the importance of legal frameworks for AAL technologies was stressed. It was agreed that such issues touch upon the legal implementation of the General Data Protection Regulation (GDPR). The engineers emphasized the need for some form of contract to be signed between the user and service provider to minimize data misuse and ensure informed consent:

"In my opinion, there are already many laws, such as the GDPR laws, but also others, I believe, that regulate the modification and exchange of such data, any data, about an individual. Clearly, companies that develop such laws would be legally subject to them and any data abuse or mismanagement would be subject to criminal liability. Issues outside such regulations could be addressed with separate direct contracts, agreements between the provider and the end user. These issues would have to be agreed upon and signed" (E1).

In short, the possibility of data misuse exists.

As there is no effective and comprehensive application of AAL technologies without placing cameras in apartments to achieve increased security, elderly individuals stressed that they would feel (extremely) uneasy under video surveillance. Nevertheless, most indicated that the issue of 24-hour surveillance should be solely a matter of personal choice, but over time most people would get used to it.

"I hold that it would be positive, but I think it would take time for a person to get used to it. You would feel like someone was following you all the time. It might be discomforting at first, but I think it would eventually be okay" (OP3).

Some of the engineers agreed on this issue, considering it unacceptable to incorporate in-home video surveillance.

"I would say anything other than video is acceptable. If it's a person's location, if it's alarms, that's all fine as long as you don't have constant video footage of the person, if it's not necessary" (E2).

They cited the need for privacy in the home:

"I wouldn't want to have cameras because at least at home I would like to have some privacy" (E4).

One of the major ethical issues associated with AAL technologies directly concerns the threat to user privacy. One nurse referred to the elderly's desire for their own intimacy, privacy, ability to remain in their own home and the fact that video surveillance might endanger precisely that which they considered most important.

"I think it would help, in terms of family, to follow and supervise them, but it would deprive them of their privacy. That's exactly why they want to be in their own home. They don't go into [sheltered] accommodations; they want to live their own lives. Surveillance eliminates that" (N2).

One of the engineers also emphasized the right to privacy. However, the participant cited the threat to privacy as the price to pay for using AAL technologies. He noted that everyone needs to assess what the advantages and disadvantages are, bearing in mind the price of security.

"I believe that one of the major ethical issues is certainly encroaching on someone's privacy. Everyone has the right to keep their life within their own four walls. However, if you want to take care of someone vulnerable, certain boundaries may need to be crossed" (E3).

These attitudes of the engineers and nurses lead us to the key ethical issue: the choice between security and privacy. Considering that a primary goal of AAL is to provide security for the elderly, and to achieve this may entail a sacrifice of one's privacy, the participants were asked whether privacy or security should be prioritized for the elderly. The nurses opted for privacy, while a participant from the group of elderly people opted for safety. Three engineers responded that this should be an individual decision, depending on the pros and cons of surveillance for each individual. For the elderly, the advantage is safety:

"I hold that safety is more important. Privacy is of course important, but to an older man security means a lot" (OP3).

"A feeling of security is an advantage, and I don't see any particular downsides, maybe others would make fun of me" (OP5).

Theme	Subtheme	Quotes
Acceptance and availability of AAL technologies	Maladaptation of apartments	*"There are a lot of practical impediments for older people. They remained in the spaces where they had lived as young people, and they hadn't thought about the fact that they would need to address those challenges" (N2).*
		"Yes, I am interested. I'm very alone in the house. I would be very glad to have it [AAL]" (OP2).
	Technological illiteracy	*"Mostly, they use cell phones, and usually their family puts them on speed dial. They are mainly connected to phones, TV, and that's all" (N1).*
		"I'm not exactly for modern technology. I don't even use a computer, only a cell phone. I don't use a smartphone, only a classic one because, I admit, it doesn't really interest me much. I am more practical and prefer face to face, one on one [interactions]" (OP3).
	Economic aspects	*"Very often we realize that many of them have saved money but don't want to spend it on improving their quality of life. If we were to suggest that, they would immediately respond: How much does it cost?" (E1).*
		"I think that such technologies are financially accessible to the general public. Fifteen years ago I would have said that they were not; now I would say that they are because you have a lot of smart home solutions that are based on do-it-yourself and you can do a lot of things for quite little money" (I2).
	Adaptation for end users	*"I think that somehow everything needs to be adapted, [so] that there is the same critical mass of older people who can adapt to technology. Since not everyone is incompetent, those who are less able will use a smaller range of technologies that are accessible to them" (E1).*
		"There should be ways to bring technological advances more accessible for the elderly, but again those who want them will accept them, and those who do not, will not. It's just a matter of will" (E2)

Data collection, privacy vs. safety	Dehumanization of care	*"We need to look at technology as an auxiliary aid, but it can never replace us, and it can't replace humanity. It can't replace proximity or touch" (N3).*
		"It should by no means replace that interaction with people completely. Someone should always come to visit a person; check how they are doing. This is just support and should certainly not completely replace interaction. Instead, it should encourage people to meet and spend time together again, knowing that the time not spent together thanks to technology ensures a better quality of life" (E3).
		"The technology could in some ways make things worse because the elderly still have some physical requirements. Those who may be more mobile go to the bank to withdraw cash and may meet a neighbor and exchange a few words. Technology could tie them even more to the house in some ways" (N4).
	Robotic care	*"I love seeing them. I love their touch. I love hearing their voices. I don't know how I would feel; I can't even imagine it. I don't know how a robot would rub my arm. This is the biggest failing (or deficiency) of technology: the lack of human contact. If a robot showed a little emotion, I would allow it to do everything" (OP2).*
		"I want contact with others. Such technology would not prevent me from being in touch with others" (OP5).
		"I would not accept a robot. I don't need anything without a soul. I don't see any advantage in that" (OP4).
	Positive perceptions	*"Focus on much more important things – wound bandaging, care, hygiene, psychological help and communication with the patient. I would spend more time communicating with patients because it means a lot more to them, and now I must do physical tasks that are strenuous and don't mean too much to them. They miss social interaction" (N5).*
Data collection, privacy vs. safety	Data collection	*"For that reason, it should be accepted as a support in your daily life but understood that in return some personal information must be collected" (E3).*
		"In my opinion, there are already many laws, such as the GDPR laws, but also others, I believe, that regulate the modification and exchange of such data, any data, about an individual. Clearly, companies that develop such laws would be legally subject to them, and any data abuse or mismanagement would be subject to criminal liability. Issues outside such regulations could be addressed with separate direct contracts, agreements between the provider and the end user. These issues would have to be agreed and signed to" (E1).
	Video surveillance	*"I hold that it would be positive, but I think it would take time for a person to get used to it. You would feel like someone was following you all the time. It might be discomforting at first, but I think it would eventually be okay" (OP3).*
		"I would say anything other than video is acceptable. If it's a person's location, if it's alarms, that's all fine as long as you don't have constant video footage of the person, if that's not necessary"(E2).
		"I wouldn't want to have cameras because at least at home I would like to have some privacy" (E4).
		"I think it would help, in terms of family, to follow and supervise them, but it would deprive them of their privacy. That's exactly why they want to be in their own homes. They don't go into [sheltered] accommodations; they want to live their own lives. Surveillance eliminates that" (N2).
	Privacy vs. safety	*"I believe that one of the major ethical issues is certainly encroaching on someone's privacy. Everyone has the right to keep their life within their own four walls. However, if you want to take care of someone vulnerable, certain boundaries may need to be crossed" (E3).*
		"I hold that safety is more important. Privacy is of course important, but to an older man security means a lot" (OP3)
		"A feeling of security is an advantage, and I don't see any particular downsides, maybe others would make fun of me" (OP5).

Discussion

Our study, unique in the context of Central Eastern Europe, more precisely Croatia, reveals the participants' expectations and concerns. The importance of this research lies in the confrontational dynamic involving the key strata of those societies affected by AAL. The most prominent components concern the real need for AAL technologies, the interest of the elderly in technology, the cost-effectiveness of AAL technologies, the loss of human contact and privacy issues.

The challenge of aging and accompanying difficulties

Undoubtedly the biggest problems faced by the elderly include social isolation and loneliness, further exacerbated by a diminishing quality of life, reduced financial income, loss of independence and feelings of insignificance due to the familial obligations of their kin. A 2020 report by the National Health and Aging Study, prior to the COVID-19 outbreak, found that 24% of persons aged 65 and over in the United States (approximately 7.7 million people) were socially isolated (14). In our study, the elderly and nurses referred to social isolation during the COVID-19 pandemic when people were advised to avoid meeting the elderly for their safety, further increasing their social isolation and loneliness. In Japan, such living conditions for the elderly have led to the Kodokushi phenomenon (15), so-called "lonely" death, i.e., the undignified deaths of elderly people living in social isolation. Questions pertaining to feelings of isolation and loneliness inevitably require solutions from technology. Nakazawa and others emphasize the invaluable role that wearable devices can play in monitoring an elderly individual's health, thus enabling a timely response to any crisis.

Wearable devices and other AAL technologies can indeed contribute significantly to independence, but problems with lack of interest in technological assistance may arise. However, those surveyed generally did not exhibit an aversion to or disinterest in assistive technology, although the nurses interviewed reported disinterest shown by the patients they visit. This is understandable, given that such technology is a relatively recent development. It should be emphasized that an understanding of older people's perception of technology is crucial. Comprehensive explanations should be provided and technological literacy encouraged to help foster acceptance of technology's role in helping to create an easier and more independent life (16).

In this regard, technological literacy, i.e., the ability to understand, evaluate, use and manage technology, is crucial. Those with minimal life experience using technology have little or no technological literacy, making it difficult for them to use it later in life and posing challenges for its application in the home (17). The issue of technological literacy is clearly an individual matter. Namely, technological awareness among the elderly has been growing in tandem with advances in technology. In 2013, 18% of the elderly population (65+) in the United States used smartphones, while in 2017 that number climbed to 42% (18). Consequently, an increase in technological literacy and the use of technology among the elderly can be expected, which is certainly fertile ground for the application of AAL technologies in order to help maximize independence (19). It should be noted that there is a lack of awareness of the latest technologies that may increase independence at-home. Often marketed, sometimes at high cost, under the comfort or entertainment category, there is often public ignorance due to insufficient emphasis on the benefits of those technologies.

Another obstacle to introducing smart home technologies into the lives of older people is their cost effectiveness. Opinions are divided: namely, some respondents indicated that it was possible to find alternative do-it-yourself AAL products. Numerous studies (20–24) show otherwise. The results of a study by Pal et al. reveal cost to be the most significant predictor for refusal to use smart home technologies (20). Leaders at the national and international levels could play a more prominent role in promoting the benefits and adoption of smart homes by offering tax exemptions and other such policies to incentivize companies.

AAL trial ethics

The primary ethical concern regarding use of AAL technologies was the loss of human contact (25). Some authors (26) warn that new technologies may have a dehumanizing effect on human relationships. The elderly study participants posited similar views, i.e., that robots cannot replace the "human touch" in health care. There was a general agreement that, regardless of technology's efficiency and advantages, it should remain an aid and by no means replace humans. Human warmth, touch and supportive discourse were all considered to be important to the respondents. It is necessary to retain cautious optimism about the promises of the new technologies. They should remain aids, not substitutes, for traditional forms of human contact. AI must not exceed the fundamental values or appropriate aspects of care that only human beings can meaningfully perform. AI's task is to support, improve and create opportunities for the medical profession to provide the unique human aspect of care (27). Although technology can help reduce social isolation in the elderly, there is a real danger that avoidance of human contact risks further increasing such isolation.

Another important ethical issue raised by the participants concerns privacy. There is no doubt that the collecting and processing of enormous quantities of data by AAL systems risk compromising user privacy. This especially applies to data collected by cameras and video surveillance. We consider the threat to privacy to have a significant effect on the likelihood that the elderly will refuse to use smart homes, as previously confirmed by Koimizu et al. (28). Many other studies have also shown that privacy is one of the main concerns about technology such as AAL (29). These concerns were also raised by the nurses in our study. They believe that the privacy of the elderly is really at risk. At this vulnerable time in their lives, the elderly want to stay in their own homes precisely due to the desire to retain their independence and preserve their privacy and intimacy. Here one can speak of "aging in place," which the American Centers for Disease Control and Prevention define as "the ability to live in one's own home and community safely, independently and comfortably, regardless of age, income or ability level" (30).

One of the engineers interviewed pointed out that in developing AAL technologies, they avoided video surveillance in order to respect the individual's privacy. This was confirmed in a study by various authors (31) who interviewed engineers involved in the development of AAL technologies on the ethics of smart homes. These engineers indicated that in their current work they paid close attention to the negative consequences of the potential unauthorized exchange of information, i.e., they focused on the protection of privacy. Therefore, the "right to privacy is a key issue that should be discussed in order to conduct gerontotechnological research and practice appropriately" (32).

In addition to the aforementioned ethical issues, it is important to highlight an ethical problem related to AAL technologies that was not raised by the participants in this study but was mentioned in a paper by Koimizu and Kokado (28), who questioned engineers in Japan about AAL technologies. The engineers cited the problem of technology addiction, associated with the "disuse" syndrome that can be defined as a physical condition caused by lying in bed, immobility and/or lack of physical activity. This is related to technology addiction. Namely, technology can be an aid and a substitute for some daily activities. If technology completely replaces some of the activities required for everyday life, "prolonged overuse of such products might deprive the elderly person of the chance or motivation to use their body more fully" (28). Moreover, some older users became attached to such products and sometimes became emotionally dependent on them, especially in the case of robots that have a social dimension. Such users appeared confused and restless when separated from their AAL technologies (28). Therefore, it is necessary to find an appropriate balance between long-term benefits and the immediate need for support in caring for the elderly with the help of technology. Elderly people usually want to conserve physical energy by using technologies, which could result in "disuse"

syndrome in the long term. It is, therefore, important to determine a level of assistance that is adequate but not excessive.

The results of our investigation lead us to emphasize the importance of a holistic, multidisciplinary approach to technology, in a manner that presupposes the mandatory consideration of users and their real needs, expectations and perceptions. Precisely because of this, and in the desire to contribute to a multidisciplinary approach to technology development and observation, this study examines the perceptions of multiple categories of participants who may be potential stakeholders in such systems. Considering the challenges and issues, whether social or ethical, it is extremely important to develop guidelines for the management of AAL technologies based on (bio)ethical principles while respecting the fundamental dignity of each human being. Such guidelines have been initiated by the AAL program funded by the European Commission. Namely, in 2020, new AAL Guidelines for Ethics, Data Privacy and Security were published (33). An updated version was published in December 2022 (34). These guidelines offer a model that integrates compliance with the general law with ethical dialogue and offer suggestions on how to establish the ethical excellence of long-lasting solutions using digital technology. These guidelines not only seek to achieve the legal and ethical regulation of AAL systems but foster ethical excellence and encourage ethical dialogue involving various stakeholders, users, legislators, researchers and manufacturers (34). These General Data Protection Regulation (GDPR) guidelines highlight some AAL principles: justice, equality of access, respect for autonomy and dignity, trust, acceptance and accessibility, transparency and choice. Ethical principles, EU regulations, international standards and national guidelines that should provide guidance for ethical dialogue are also mentioned. The ethical principles to be considered are autonomy, benevolence, harmlessness and justice. The EU regulation refers to several legal regulations, such as the protection of any undertaking involving people (i.e., the Oviedo Convention) or the privacy and security of data dealt with by the GDPR (34). The guidelines also provide a few practical examples and allow room for analysis and dialogue (34).

It should be added that in addition to the above principles, it is very important to consider the personalistic principle of vulnerability because the effort to apply AAL represents the starting point and raison d'être of care for particularly vulnerable people, in this case the elderly. Accordingly, it cannot be viewed solely from a biomedical perspective (5). A holistic approach should consider ethical issues regarding the use of gerontotechnology, which includes not only problems related to the use of health technology (for example, telemedicine) but also aspects of social welfare and related issues. Moreover, it requires broader and more specific reflection on ethics, especially pertaining to in-home care.

We believe a possible weakness of this investigation is that the participants did not include lawyers or experts in the field, whose expertise could have contributed to the understanding and interpretation of the legal issues and regulations related to these technologies. Another important disadvantage was the small number of respondents per group. It should be noted that this [low] number of participants is due to the dearth of engineering experts in this field. However, with the study participants we sought to highlight views from this part of the European continent, with the hope of establishing the foundations for broader research.

Conclusion

The results of our investigation show that the key issues regarding the social and ethical aspects of AAL are a lack of human contact, insufficient interest of the elderly in technology, the cost-effectiveness and unavailability of AAL technologies, the issue of data collection and processing resulting in threats to privacy, and the necessity for introducing legislation to ensure the safe use of such technologies. Our study showed that the engineers focused less on ethical issues. The fact is that some of them had

never considered such technologies from an ethical stance, likely due to their focus on AAL from a primarily technical perspective. As for the elderly, they expressed a need for AAL technology, as well as a dose of skepticism concerning the robotization of care, and concerns about compromising (or jeopardizing) their own intimacy and privacy. This cautious attitude does not mean that they are unreceptive toward AAL, but they desire it to be in the service of humankind, rather than pose a threat. The nurses highlighted the high rates of technological illiteracy among the elderly, which is a problem due to the resultant limitations in the use of technologies in general, as well as the inability to use advanced technology appliances. They also recognize the essential and extremely significant need of the elderly for human contact and communication, which AAL technologies cannot provide. Their fundamental view is that AAL can only be acceptable if used as an auxiliary tool to provide practical assistance for other physical tasks. This would allow nurses more time to practice their profession with greater compassion. Research on this topic often fails to consider the ethical issues regarding the use of such technologies. The complete and proper development of any technology with potential ethical concerns calls for a survey of the views of its prospective users. We believe that this study will contribute to a multidisciplinary approach to the questions raised by this issue. The ethical aspects of AAL technology include the collection, processing, use and protection of personal data. There is no doubt that AAL is needed, given the continuing rise in the elderly population and the increasingly limited number available medical personnel. Therefore, it is necessary, on the one hand, to develop this technology, which is underrepresented in Central Eastern Europe. On the other hand, deliberation on the ethical aspects of AAL technologies should be undertaken in tandem with these developments. There is an associated need to create normative guidelines for the development and use of AAL technologies, based on ethical and bioethical principles, while respecting the fundamental dignity of each human being.

Declarations

Authors' contributions

All the authors contributed to the study design, statistical analysis, interpretation of the data and the drafting of the manuscript. All the authors have read and approved the final version of the manuscript.

Ethics consideration

This study obtained ethics approval from the Ethics Committee of the Catholic University of Croatia (document number 498-03-02-06/1-21-04). Before the interviews started, an informed consent document with information on the study was given to each participant.

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Competing interests

The authors declare that they have no conflict of interest.

Data sharing statement

Data available on request from the authors.

Code availability (software application or custom code) NA

Supplementary files

Interview guide, informed consent (available on request from the authors).

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The association between self-esteem level and quality of life in patients with diabetic foot: A cross-sectional study

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Abstract

Introduction: Diabetes is a global problem of modern times, and diabetic foot is an unpleasant complication of diabetes, which requires long-term, expensive and exhaustive treatment. Diabetes as a chronic disease can affect many aspects of an individual's quality of life, and patients suffering from diabetes are usually at risk of developing low self-esteem.

Aim: This study aimed to determine whether there is a relationship between the level of self-esteem and the estimated quality of life in patients with diabetes and diabetic foot.

Methods: This study was conducted at the Institute for Diabetes and the Diabetic Foot Clinic of the Vuk Vrhovac University Clinic, Merkur University Hospital, Zagreb, Croatia, from February 2020 to October 2021. The participants were patients who suffered from diabetes and had diabetic foot as a complication. Data were collected using the Rosenberg Self-Esteem Scale (RSE) and the World Health Organization Quality of Life Questionnaire (WHOQOL-BREF).

Results: A total of 68 participants participated in the study. The quality of life of those included in the study worsened as the degree of diabetic foot worsened, and was the worst in the physical domain ($F(2/65)=22.160$; $P<.01$). Likewise, significant positive correlations were obtained among all measures of quality of life and self-esteem. The higher the quality of life, the higher the level of self-esteem, and vice versa. The highest correlation was between the mental health domain and self-esteem ($r=0.860^{**}$).

Conclusion: This study showed that quality of life is impaired in patients with diabetic foot and worsens as the diabetic foot worsens. Furthermore, it showed that the quality of life in these patients is also related to the level of self-esteem. Therefore, it is important to take all preventive measures and include all available resources in order to prevent the development of diabetes complications.

Key words: diabetes, diabetic foot, self-esteem, quality of life

Introduction

The number of people suffering from diabetes is increasing day by day. Research shows that more than half a billion people in the world live with diabetes, that is, 10.5% of the world's adult population (1). It is estimated that the number of people suffering from diabetes will reach 643 million by 2030, and 783 million by 2045 (2).

Diabetes is associated with the development of micro- and macrovascular complications. Hyperglycemia, in addition to obesity, smoking, hypertension and dyslipidemia, increases the risk of peripheral arterial disease, coronary disease and cerebrovascular disease (3).

The majority of patients with diabetes have developed some microvascular complications (4). As many as 45% of all diabetes patients have developed diabetic nephropathy, which is also the most common cause of chronic kidney disease (5). Diabetic retinopathy is the main cause of visual impairment among the working-age population, and about a third of those with diabetes have developed retinopathy (6). Diabetes is also the most common cause of neuropathy. Neuropathy develops in 40–50% of patients, and a quarter of them feel neuropathic pain (7, 8).

Diabetic peripheral neuropathy leads to a series of impairments and functional limitations. People with diabetic peripheral neuropathy are exposed to a high risk of ulceration and tissue destruction in the foot and subsequent amputation of the lower extremities (9). Diabetic foot as a complication occurs in about 25% of patients with diabetes, and about 40% of ulcers recur within a year of healing, while about 65% of patients are at risk of recurrence within three years of healing (10–12). Furthermore, as many as 85% of the amputations in diabetes patients are the result of foot ulceration combined with infection. Also, diabetic foot prolongs hospitalization by 2.5 times (13–15).

Most chronic diseases, including diabetes, can worsen patients' overall health by limiting their ability to live well, limiting functional status, productivity, and worsening the quality of life (16). The World Health Organization defines quality of life as "an individual's perception of their life situation in the context of the culture and value system in which they live and in relation to their goals, expectations, standards and concerns. The quality of life is the feeling of overall satisfaction with life as determined by a mentally alert person whose life is being evaluated" (16). Diabetes as a chronic condition accompanied by the development of numerous severe complications affects most aspects of the quality of life. Complications can cause physical discomfort, limit mobility and reduce physical activity. Patients also have a fear of hypoglycemia and concern about the outcomes of the disease, which has a negative impact on the quality of life assessment (17). Also, in the treatment of chronic diseases, the patient's lifelong engagement and effort are crucial. Patients who are dealing with diabetes can very often experience negative emotions such as worry, fear, guilt, helplessness and hopelessness. In addition to the fact that negative moods adversely affect self-care and quality of life, elevated levels of neuroticism in individuals contribute to an increased risk of developing psychiatric diseases, and diabetics suffer from depression two to three times more often than people without diabetes (18, 19). Furthermore, due to the need for continuous patient involvement in the process of treating a chronic disease, patients often experience psychological stress, and a reduced level of self-esteem can occur (20). In addition to the above, people with diabetic foot have lower self-esteem because such lesions change the lives of these individuals. Desires and plans are usually unfulfilled, and individuals may feel rejected and live in isolation because of their smell and appearance. Therefore, it is important to examine such patients psychologically (21). This study aimed to examine whether there is a connection between the level of self-esteem and the estimated quality of life in people suffering from diabetes with diabetic foot.

Materials and methods

Study design

This was a cross-sectional study.

Ethics

The Ethics Committee of the Merkur Clinical Hospital approved the implementation of this study in patients at the Institute for Diabetes and Diabetic Foot Clinic (Order number: 03/1-832). All the study participants signed an informed consent document.

Place and time of study implementation

The study was conducted at the Vuk Vrhovac University Clinic, Merkur University Hospital, Zagreb, Croatia, the Institute for Diabetes and the Diabetic Foot Clinic. The study lasted from February 2020 to October 2021.

Participants

Patients with a complication of the underlying disease, diabetic foot, who visited the Diabetic Foot Clinic between February 2020 and October 2021, and who voluntarily agreed to participate in the study were included. Patients at high risk for diabetic foot were not invited. The assessment of the foot condition and determination of the degree of ulceration were conducted by the attending physician and nurse at the clinic. The patients were invited to participate in the study by a nurse from the Diabetic Foot Clinic, who is also a researcher in this study.

The participants were divided into three groups, depending on the stage of the development of the diabetic foot. The first group included participants who had a mild form of diabetic foot—superficial wounds that did not affect tendons and/or bone (which is the equivalent of grade I according to the Wagner classification). The second group was mixed, including participants with a more severe degree of diabetic foot—deep wounds involving tendons and/or bone, gangrene or phlegmona (which is the equivalent of grades II—V according to the Wagner classification). The third group consisted of participants who had undergone amputation of a part of an extremity as a result of diabetic foot.

Procedures

Data were collected based on structured questionnaires on paper. The questionnaires used to assess self-esteem were the Rosemberg Self Esteem (RSE) (22) and the World Health Organization Quality of Life (WHOQOL-BREF) (23). The RSE questionnaire consists of 10 statements related to self-esteem, while the WHOQOL-BREF questionnaire consists of 26 statements related to different domains of quality of life (physical health, psychological health, environment and social relations). Participants rated their agreement with the statements in both questionnaires on a 5-point Likert scale with the following possible answers: 1—not at all, 2—somewhat, 3—moderately, 4—to a significant extent and 5—to the greatest extent. In addition, the participants also answered questions related to gender, age, professional education, employment and with whom they live. In order to be able to compare the data obtained on the WHOQOL-BREF questionnaire, the results were transformed into a scale on a range of 0—100. The results of the domains and overall life satisfaction are expressed in a positive direction, with a higher score indicating a higher quality of life.

Statistical methods

Statistical data processing was performed using the Statistical Package for the Social Sciences, SPSS Inc., Chicago, IL, USA version 20 for Windows (SPSS). Descriptive statistics were used in the data processing. The Pearson's correlation coefficient was used to determine the relationship among the variables, and simple analysis of variance and Scheffe's post-hoc test were used to determine differences among the groups. Calculated p-values were considered statistically significant if $P<0.05$.

Results

A total of 68 participants took part in the study. Out of the total sample, 21 of them had superficial wounds on their feet, 23 had

deeper wounds on their feet, and 24 had had part of their lower extremities amputated as a result of diabetic foot. Also, the majority of the participants were 61–75 years of age, had a high school education (65%), pensioner status (60%) and lived in a household with their families. The participants were mostly male (68%).

In order to answer the first study problem regarding the connection between the level of self-esteem and the quality of life domain, the Pearson's correlation coefficients among these measures were calculated. Significant positive correlations were obtained among all the measures of quality of life and self-esteem. The higher the quality of life, the higher the level of self-esteem, and vice versa. The strongest correlation was between the mental health domain and self-esteem (r=0.860**). If we look at the sample as a whole, satisfaction with the environment was the highest compared to the other domains of the quality of life. On the other hand, satisfaction with physical health was the lowest compared to the other variables mentioned (Table 1).

Table 1. Contingency table of LH levels of control and PCOS groups

Domain	1	2	3	4	5	M	SD
The domain of physical health	-					50.8	16.41
The domain of mental health	.747**	-				64.6	17.98
Environment domain	.697**	.797**	-			69.8	17.37
The domain of social relations	.611**	.695**	.754**	-		67.7	17.56
Self-esteem	.749**	.860**	.831**	.795**	-	25.1	7.29

P<.01

In response to the second study problem, regarding whether participants with a more severe form of diabetic foot differ from those with a milder form in terms of quality of life and self-esteem, the results show that there was a significant difference between the foot condition groups in self-esteem (F(2/65)=27.214; P<.01). The participants with severe foot wounds and amputees did not differ in their level of self-esteem. There is a significant difference between the groups of foot conditions in the physical domain of the quality of life (F(2, 65)=22.160; P<.01). A post-hoc test determined that there was a statistically significant difference between participants with superficial foot ulcers and participants with deeper foot wounds or amputees. Participants who had deeper wounds on their feet and participants with leg amputation did not differ in their reported quality of life in the physical domain. Also, there was a significant difference between the groups of foot conditions in the psychological domain of the quality of life (F(2/65)=11.004; P<.01). A post-hoc test showed that there was a statistically significant difference between participants with superficial foot ulcers and participants with deeper foot wounds. Participants who had deeper wounds on their feet and participants with leg amputation did not differ in the reported quality of life in the psychological domain. The results further show that there was a significant difference between the foot condition groups in the environmental domain of quality of life (F(2/65)=14.230; P<.01). A post-hoc test showed that the participants with superficial foot ulcers differed significantly from the participants from the other two groups. Participants who had deeper wounds on their feet and participants with leg amputation did not differ in their reported quality of life in the environmental domain. A significant difference was also found between the groups of foot conditions in the domain of social relations (F(2/65)=8.862; P<.01). The participants with superficial foot ulcers differed significantly from the participants from the other two groups. Participants who had deeper wounds on their feet and participants with leg amputation did not differ in their reported quality of life in the domain of social relationships (Table 2).

Table 2. Domains of the quality of life and self-esteem in relation to the condition of the diabetic foot

	Superficial ulcer M (SD)	**Deep ulcer** M (SD)	**Amputated** M (SD)	**F (df)**	**Post - hoc**
Self-esteem	32 (3,29)	24 (4,56)	20 (7,41)	27.214** (2, 65)	1–2** 1–3**
Physical domain of quality of life	65.3 (13,66)	48.7 (12,10)	50.8 (12,81)	22.160** (2, 65)	1–2** 1–3**
Mental domain KŽ	77.8 (11,69)	60.6 (15,04)	56.8 (19,20)	11.004** (2, 65)	1–2** 1–3**
Environment	84.5 (9,61)	69.4 (12,8)	59.0 (19,35)	14.230** (2, 65)	1–2** 1–3**
Social relations	78.9 (11,61)	66.3 (16,34)	59.2 (18,27)	8.862** (2, 65)	1–2* 1–3**

P<.01

Discussion

In this study, the male gender predominates, just as in the study on the quality of life in patients with chronic diabetes complications conducted at the Vuk Vrhovac University Clinic, Merkur University Hospital, Zagreb, Croatia (24), whose results also show male dominance among individuals with diabetes who have developed diabetic foot as a complication (24). The dominance of the male gender is also shown in the results of studies conducted elsewhere in the world (25, 26).

According to the results obtained in this study, the quality of life among the participants worsened as the severity of diabetic foot increased, with the worst being in the physical domain. Similarly, according to a study conducted at the Vuk Vrhovac University Clinic, Merkur University Hospital, Zagreb, Croatia, the quality of life among individuals with chronic complications is lowest in the physical domain (24). Likewise, the results of a study conducted in Saudi Arabia show the significant impact of diabetic foot on the lower assessment of all aspects of the quality of life in patients, particularly in the physical domain (27). Generally, patients with chronic wounds rate their quality of life as diminished in most domains, with pain, odor, limited mobility and altered self-image being significant contributors (28). Moreover, similar studies confirm that as the condition of diabetic foot worsens, the quality of life decreases (29, 30). A painful diabetic foot or the presence of pain after amputation significantly influences a diminished quality of life (31, 32).

This study found positive and significant correlations between all measures of quality of life and self-esteem. The higher the quality of life, the higher the level of self-esteem, and vice versa. The strongest correlation was found between the domain of mental health and self-esteem. Similar results have been obtained in other studies. A study conducted in Turkey confirms the existence of a relationship between the level of self-esteem and quality of life. It also shows how amputation affects the reduction of both the physical and mental quality of life (33). A study conducted in Iran also confirms a significant correlation between the level of self-esteem and quality of life (34).

In the literature, reduced self-esteem is associated with chronic diseases, such as diabetes. Additionally, reduced self-esteem caused by the presence of illness can lead to numerous problems, such as anxiety and depression (35, 36). In amputated patients, reduced self-esteem is linked to altered body image, decreased mobility and loss of employment due to physical limitations (37). A study conducted in Indonesia regarding the correlation between self-esteem and self-care abilities in individuals with diabetes indicates a positive correlation between these variables, indicating that any increase in the level of self-esteem has a positive effect on self-care (38).

Many of the limitations of this study are largely associated with the situation of the COVID-19 pandemic. The small sample size of the participants is a consequence of the prolonged ban on hospitalizing patients in hospital wards and the repurposing of diabetes clinics into isolation units, thereby limiting the availability of participants with diabetes.

A recommendation for future study is to include a larger sample size of participants while using a specific questionnaire to assess the quality of life among individuals with diabetes.

Conclusion

The results of the study indicate that the quality of life among the participants deteriorated as the severity of diabetic foot worsened, especially in the physical domain. Additionally, positive and significant correlations were found between all measures of quality of life and self-esteem. The higher the quality of life, the higher the level of self-esteem, and vice versa. The strongest correlation was observed between the domain of mental health and self-esteem. Considering the continuous increase in the number of people affected by diabetes, the severity of complications and their adverse impact on the quality of life, greater efforts should be made to raise public awareness about diabetes, the importance of adopting a healthy lifestyle to prevent diabetes, the importance of good control and delaying the development of chronic complications in individuals with diabetes to maintain a good quality of life.

Declarations

Aknowledgements

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Authors' contributions

NH, VK, VH and MČ: study design NH, VK and VH: data collection and analysis;: NH, VK, VH and MČ data interpretation; NH and MČ: writing first draft of the manuscript; NH, VK, VH and MČ: revising the manuscript for critical intellectual content; NH, VK, VH and MČ: approval of the final version of the manuscript.

Ethics

The Ethics Committee of the Merkur Clinical Hospital approved the implementation of this study in patients at the Institute for Diabetes and Diabetic Foot Clinic (Order number: 03/1-832). All the study participants signed an informed consent document.

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Competing interests

The authors have no conflicts of interest related to this work.

Data sharing statement

The authors confirm that the data can be obtained by contacting the corresponding author.

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Anesthetic management of a child with Sturge-Weber Syndrome undergoing glaucoma surgery: A case report

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Abstract

Background: Sturge-Weber Syndrome (SWS) is a rare congenital neurocutaneous disorder characterized by leptomeningeal and facial hemangiomas, with consequent neurological and ocular manifestations. The anesthesia of these patients may be challenging and patients with SWS need careful assessment during the perioperative period.

Aim: The aim is to report on a case of successful anesthetic management for glaucoma surgery in a 3-year-old patient with Sturge-Weber Syndrome.

Methods: All the medical procedures on our patient were performed in the Sestre milosrdnice University Hospital Center. The patient first underwent anesthesia to have her eyes examined and then to have glaucoma surgery. General anesthesia was introduced during both procedures.

Results: During both procedures, inhalational anesthesia with 8 Vol% sevoflurane was performed with the intraoperative addition of fentanyl for analgesia. Induction, as well as anesthetic emergence, went smoothly, without blood pressure oscillations. Maintaining blood pressure within normal limits was important, considering the risk of hemangioma rupture. Ibuprofen and paracetamol ensured adequate postoperative analgesia and no rises in blood pressure.

Conclusion: Since clinicians rarely encounter patients with SWS, it is important for all physicians involved in the treatment of such patients to become familiar with the challenges during the perioperative period. Therefore, we should like to emphasize specific anesthetic considerations for patients with SWS.

Keywords: Sturge-Weber Syndrome, anesthesia, glaucoma surgery

Introduction

Sturge-Weber Syndrome (SWS), also known as encephalotrigeminal angiomatosis, is a rare congenital neurocutaneous disorder that affects only one in 50,000 newborns. The etiology is yet unknown, but it is known that SWS is caused by a mutation in a GNAQ gene that occurs randomly in a developing embryo (1). It can be classified as trisymptomatic, bisymptomatic or monosymptomatic, depending on whether the skin, eyes or central nervous system (CNS) is affected (2). The most common types of vascular malformations are leptomeningeal and facial angiomas (3,4). Facial angiomas are often located around the eyes, so SWS frequently includes ocular manifestations, such as glaucoma, buphthalmos, choroidal hemangioma and strabismus. Glaucoma affects about 30–70% of such patients. In about 60%, glaucoma is present at birth, while in other cases it manifests later in life. The first-line treatment for congenital and early-onset glaucoma with associated angle abnormalities is surgical intervention. A goniotomy or trabeculotomy is usually performed. For late-onset glaucoma, surgery is indicated if conventional therapy is ineffective (2).

During the perioperative period, it is mandatory to ensure adequate pre-medication, as well as smooth induction, maintenance and emergence from anesthesia to avoid an increase in blood, intraocular and intracranial pressure in order to prevent hemangioma rupture. Additionally, careful assessment of the airway is necessary due to the possible presence of angiomas in the oral cavity that can compromise the airway and cause difficulty in tracheal intubation.

Case report

We hereby report a case of a 3-year-old girl (weighing 14 kg) with SWS, who first underwent anesthesia to have her eyes examined and then, 2 weeks later, to have glaucoma surgery. All the medical procedures on our patient were performed in the Sestre milosrdnice University Hospital Center. Since our patient was a 3-year-old girl, her mother gave her informed consent for us to report on her syndrome and the anesthetic management for both procedures. The girl had the following signs of SWS: hemiatrophia of the right side of the brain with left-sided hemiparesis, symptomatic epilepsy (seizures having been experienced from birth, with the last one taking place 6 months before the introduction of the anesthesia), left-sided facial hemangioma affecting all three branches of the trigeminal nerve, myopia and congenital glaucoma of the right eye. Magnetic resonance imaging of the brain showed right-sided cerebrocortical atrophy and right-sided frontotemporoparietal calcifications. Additionally, her medical history revealed hypothyreosis. Her mother reported that the girl was allergic to amoxicillin/clavulanic acid. The girl was on the following therapy: valproic acid, clonazepam, levothyroxine, and the topical ocular drugs dorzolamide/timolol and brimonidine/tartrate. Before surgery, routine blood and urine tests and ECG findings were normal, except for elevated thyroid-stimulating hormone (TSH), so the dose of levothyroxine was increased before the introduction of the anesthesia. The mouth opening was adequate (Mallampati grade I), without any visible oropharyngeal hemangiomas. An antiepileptic drug and levothyroxine were continued until the day of surgery.

General anesthesia was introduced during both procedures. The patient was pre-medicated with 4.15 mg oral midazolam 45 min before both anesthesia inductions. Vital parameters were monitored through non-invasive blood pressure monitoring, ECG monitoring, and SpO2 and etCO2 monitoring. The induction was performed by 8 Vol%-sevoflurane inhalation via a face mask, and when the girl was sedated deeply enough, a 24 G-venous cannula was inserted and an infusion of Ringer solution was started. As an induction dose, 25 mcg of fentanyl was administered. In the case of the second anesthesia induction that preceded the glaucoma surgery, 8 mg of rocuronium was administered after fentanyl. On the occasions of both surgeries, a No. 2.5-laryngeal mask was inserted. Before the insertion of the laryngeal mask during the first anesthesia

introduction, a gentle laryngoscopy was performed to evaluate the airway patency; no oropharyngeal hemangiomas were found (Comrack-Lehane grade 1). The anesthesia was maintained with inhalational sevoflurane, oxygen and air, thereby keeping the patient hemodynamically stable. Intraoperative systolic pressure was maintained at around 90 to 95 mm of mercury, and diastolic at around 45 to 55 mm. During the second general anesthesia, fentanyl 50 mcg was re-administered intraoperatively. At the end of the second procedure, a 12.5 mg diclofenac sodium suppository was inserted to ensure initial pain relief. After both procedures, anesthesia emergence went smoothly, without any increases in blood pressure. The surgical procedure went without any complications. Further postoperative pain relief was achieved with 100 mg of ibuprofen syrup, three times per day, and a 120 mg paracetamol suppository, three times per day, as needed. With this therapy, postoperative pain was adequately relieved and no hemodynamic changes were present. The patient was discharged home on the fourth postoperative day.

Discussion

Sturge-Weber Syndrome (SWS) can affect the skin, eyes and/or CNS (2). Neurological manifestations include hemiparesis, hemianopsia, stroke-like episodes, headaches, seizures and mental retardation. Facial angiomas (port-wine stains, PWSs) often involve the eyes, mouth and different parts of the airway. Angiomatous lesions of the skin usually follow the trigeminal nerve distribution pattern (5), so SWS is also called encephalic-trigeminal angiomatosis (6). Ocular manifestations can include glaucoma, buphthalmos, choroidal hemangioma and strabismus.

When it comes to SWS patients, anesthesia may be challenging for several reasons, as discussed below.

Before introducing anesthesia, adequate pre-medication should be administered, in order to avoid increases in blood pressure and possible hemangioma ruptures. Angiomas seated in the upper respiratory tract may cause ventilation difficulties. During the insertion of an airway device, hemangioma rupture involving the airway may occur, making mask ventilation, laryngoscopy and intubation difficult, so the equipment needed for endotracheal intubation must always be ready, should an emergency arise (7). An experienced anesthetist should attempt the intubation using a well-lubricated, cuffed endotracheal tube without stylettes (5). In the case of our patient, the nature of the procedure did not require intubation, so a laryngeal mask was used. An airway examination revealed no visible hemangioma in the oral cavity, but the possibility of the presence of an angioma in the pharynx was also taken into account, so a difficult airway cart was kept ready. The authors think that a laryngeal mask represents a safer and a more suitable airway securing option, provided that the nature of the surgery allows for it and that the patient has no angiomas in the oral cavity, although, in most of the cases reported in the literature, an endotracheal tube was introduced despite the absence of angiomas in the oral cavity (5,8,9). If an airway evaluation reveals the presence of angiomas in the oral cavity, an introduction of an endotracheal tube is a better choice, indeed, since it exerts pressure on a smaller oral cavity area as compared to a laryngeal mask and, therefore, makes oral cavity-seated hemangiomas less prone to rupture.

To prevent angioma ruptures, it is necessary to achieve adequate hemodynamic stability, during both anesthesia induction and maintenance (5). Blood vessels composing hemangiomas have abnormal auto-regulation. Any increase in blood pressure is associated with an outspreading of angiomas that can cause massive bleeding due to hemangioma rupture (6).

Ocular manifestations, primarily the presence of glaucoma, demand smooth anesthesia induction without any rise in the intraocular pressure. During anesthesia, it is necessary to avoid drugs that can raise intraocular pressure, such as succinylcholine, ketamine and atropine, and events that can do the same, such as hypoxia, hypercarbia

and hypertension. Anticholinergics should be avoided in patients with narrow-angle glaucoma (8). During eye surgery, rupture of a choroid hemangioma can be witnessed, which leads to excessive bleeding (6).

SWS patients such as ours often report suffering from epilepsy, so the administration of antiepileptic drugs should be maintained until the day of surgery and continued on that day. Some antiepileptic drugs, such as the valproic acid taken by our patient, affect coagulation so an extensive coagulation workup should be completed prior to major surgery expected to cause substantial bleeding. During anesthesia, hypoxia, hypoglycemia, hypotension and hyperthermia may precipitate an epileptic state and should, therefore, be avoided. Also, ketamine and etomidate should not be used during anesthesia induction, since they may provoke seizures. Concomitant chronic use of antiepileptics can affect the metabolism of some anesthetic agents (8).

Succinylcholine is usually avoided in hemiplegic patients because of its effect on serum potassium levels (6).

Vascular changes may also affect other organs (8). Angiomatous changes have been reported in the pituitary gland, thyroid gland, thymus, lungs, spleen, testicles and lymph nodes (10). In our case, a thorough evaluation ruled out the possibility of the presence of such lesions. The major challenge we had to overcome during both procedures was the placement of the intravenous route. Although the girl was of a normal body weight for her height, her blood vessels were virtually invisible and extremely gracile, so we were left with no other option but to place a 24 G-cannula. During the first anesthesia introduction, we made several attempts to place the cannula and finally succeeded in inserting it into the left radial cutaneous vein. With the second procedure, cannula placement was equally challenging.

Postoperative care should also ensure adequate pain relief, since pain raises blood pressure and might lead to hemangioma rupture.

Conclusion

Patients with SWS need careful assessment prior to anesthesia induction. Adequate pre-medication and perioperative convulsion control are imperative. Anesthesia should be planned in a manner that allows for the avoidance of trauma to eventual hemangiomas seated in the airway. Any drug or occurrence that can raise blood, intraocular or intracranial pressure should be avoided. Throughout induction/intubation and extubation, and the entire course of surgery, hemodynamic and blood pressure stability should be maintained. Moreover, adequate pain management should be provided during the postoperative period. Although the case reports published so far have neglected to mention that intravenous route placement might pose a difficulty, this was seen with our patient.

Declarations

Authors' contributions

All the authors made substantial contributions to the conception or design of the work, were involved in drafting the work or revising it critically for important intellectual content and gave final approval of the version to be published.

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Competing interests

The authors have no conflict of interest to declare.

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Work-Related Musculoskeletal Disorders in Croatian Nurses: A Cross-Sectional Study

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Abstract

Background: Work-related musculoskeletal disorders (WRMSDs) are the most prevalent group of health disorders related to work and working conditions, affecting more than half of all European workers. Nursing has previously been identified as an occupation with a high risk of developing WRMSDs, in which occupational physical static and dynamic strains seem to play a role.

Aim: This study aimed to assess the prevalence of WRMSD-related pain and common occupational physical strains associated with nursing, as well as examine their association with various occupational factors.

Methods: A self-report-based questionnaire was constructed and self-administered by hospital nurses in Croatian hospitals/hospital centers.

Results: A total of 116 nurses participated in this study. The results indicate a very high prevalence of WRMSD-related pain as well as static and dynamic loading among hospital nursing staff. Low back (87.93%), neck (84.48%) and shoulder (81.89%) pain were the most prevalent. Statistical analysis revealed strong associations of wrist/hand pain with applying manual force while performing tasks and assuming working in awkward/forced postures of the wrist and the fingers; association of low back pain with general force, and an association of ankle/foot pain with age and years of employment.

Conclusion: Our study confirmed some of the results of previous studies, suggesting a multifactorial etiology of WRMSD-related pain in hospital nursing staff, in which individual and occupational factors seem to play a role.

Keywords: musculoskeletal disorder, pain, workplace, physical work

Introduction

Work-related musculoskeletal disorders (WRMSDs) are the most prevalent group of health disorders related to work and working conditions. Research suggests that more than 58% of all European workers suffer from discomfort and/or pain in at least one body region (1), thereby affecting their physical and mental health, as well as productivity. According to the European Risk Observatory Report for WRMSDs, in 2015 three out of every five workers in the EU reported musculoskeletal discomfort in the back, upper limbs and/or lower limbs, with complaints regarding the back and upper limbs (43% and 41%, respectively) being the most commonly reported (1). Additionally, WRMSDs are the main cause of absenteeism, accounting for almost 53% of all reported cases (1).

WRMSDs are a large and heterogeneous group of functional disorders affecting the musculoskeletal and soft tissue structures associated (caused and/or aggravated) by work and/or working conditions. They comprise well-known inflammatory and degenerative clinical entities, such as carpal tunnel syndrome, medial/ lateral epicondilitys or rotator cuff tendinopathy, as well as less clinically defined but more common painful syndromes, such as lumbago or cervicalgia (2,3). The etiology, pathophysiology and risk factors for the development and/or aggravation of WRMSDs are still not fully understood. Current research suggests a multifactorial etiology of most cases of WRMSDs, where intertwining occupational and individual factors increase susceptibility to musculoskeletal and soft tissue injury. Occupational factors shown to be associated with WRMSDs include physical (static and dynamic) (4), organizational/psychosocial (5) and environmental (6) factors. Occupational physical factors reported to be associated with WRMSDs include prolonged static (sitting, standing) (7,8) and dynamic loading (walking, bending, twisting) (9,10), repetitive movements (11), and having to apply force (handling loads, applying force with hands) (10,12) while performing tasks. Research suggests that physical strains may account for the majority of the attributable risks for the development of WRMSDs. For example, manual application of force and repetitive movements comprise 93% of the attributable risks for the occurrence of upper extremity musculoskeletal disorders, while the manual handling of loads contributes to 66% of the risk for reporting low back pain (3). Organizational and psychosocial work factors, such as a heavy workload, fast-paced work, low task variety, low work autonomy, environmental discomfort arising from occupational noise or glare, as well as individual factors such as age, sex, health status, physical fitness and lifestyle, have also been previously shown to be related to musculoskeletal pain/discomfort (13).

The intensity and type of occupational physical strains differ among occupations, primarily due to the variability of the tasks performed. The Occupational Safety and Health Administration (OSHA) has identified sectors with a high risk of WRMSDs due to occupational physical strains, one of which being healthcare (14). The prevalence of WRMSDs among healthcare workers ranges from 13% to 96%, with a higher prevalence reported among nurses and nursing aids (15). Previous research shows a general prevalence of musculoskeletal pain in nurses ranging from 70.8% to 89.0% (16,17), and is considered the most prevalent occupation-related health problem (1). The reason for the higher prevalence of WRMSDs in nurses is believed to be related to risk factors arising from the manual handling of patients (e.g., lifting, moving, repositioning), working in awkward postures, applying excessive manual force, strenuous physical working conditions and long working shifts (18) associated with patient care, as well as psychosocial/ organizational and individual factors such as age, sex and previous musculoskeletal injury (15). To examine the relationship between occupational physical strains and WRMSD-related pain in nurses, numerous studies have been conducted in different countries and different occupational settings, with no available research on Croatian nurses. To address the aforementioned, this study was conducted to examine the prevalence

of WRMSD-related pain and occupational physical strains among nurses in Croatia as well as their association with various occupational factors.

Materials and methods

Study design

This was a cross- sectional study.

Ethics

This study was not subjected to research ethics evaluation due to the use of anonymous information that had no associated identifiers and a low probability that the participants would be identified.

Participants

The participants were nurses employed at five Croatian medical institutions: Osijek University Hospital Center, Special Hospital for Children with Neurodevelopmental and Motor Disorders, Srebrnjak Children's Hospital, Children's Hospital Zagreb and Jordanovac Clinic for Lung Diseases.

Data collection and study tool

Participation in the study was voluntary and anonymous. The study was conducted from February 2014 to June 2014 using a self-report-based questionnaire. Previous research has suggested that the results obtained by self-report are in good correlation with the results obtained by more objective methods (19,20). The questionnaires were delivered to the aforementioned institutions and distributed in medical wards, along with a ballot box for the anonymous submission of filled-out questionnaires. The questionnaire was self-administered, giving the respondents the choice of opting in or out of the study. Only formally educated nurses were eligible to participate in the study. Nursing aids and assistants, as well as interns, were excluded.

The questionnaire was constructed using a standardized version of the Nordic Musculoskeletal Questionnaire (NMQ-E) (21) and the results of previous research on physical strains and WRMSDs among nurses, comprising questions regarding the following domains: individual and work-related factors (age, height, weight, education, years of employment, years in current position, working hours), musculoskeletal health (musculoskeletal complaints in the last 12 months) and physical strains (static and dynamic). Based on self-reported weight and height, the Body Mass Index (BMI) was calculated and categorized according to the World Health Organization (WHO) classification: underweight (<18.5), normal (18.5–24.9), overweight (25–29.9) and obese (30 and above). The level of professional education was classified according to the Croatian Qualifications Framework. The prevalence of musculoskeletal complaints was examined for 9 different body regions using a standardized extended version of the Nordic Musculoskeletal Questionnaire (NMQ-E) (21).

Occupational static and dynamic strains were assessed as follows. The amount of force required to perform tasks at work was examined using Likert-based scaling (very small, small, moderate, large, very large). Awkward and/or forced postures for the trunk and upper extremities were examined using time spent in a particular position (not at all, < than half of the shift, > half of the shift) as an indicator of the quantity of the physical strain: neck (flexion/extension, lateral flexion, rotation), lower back (flexion, extension, lateral flexion), shoulders (abduction/adduction, elevation) and wrist (internal/external rotation). Repetitive movements were evaluated only for the upper extremities (shoulders, elbows, wrists, fingers) using the number of repetitions per minute and the number of hours spent performing repetitive work during an 8-hour working shift.

Statistical analysis

Data were analyzed using the SPSS Statistics for Windows, version 22.0. Descriptive analysis was used for demographic variables, musculoskeletal complaints, and static and dynamic occupational loads. A correlation analysis (using the Spearman and rank-biserial correlation coefficient), performed to determine the relationship between demographic and work-related variables,

reported static and dynamic loads, as well as WRMSD-related pain. To determine whether static and dynamic strains predict musculoskeletal pain in different body sites, multiple regression analysis was performed.

Results

Demographic characteristics

In total, 116 questionnaires were submitted. All the participants were women with the demographic characteristics presented in Table 1. The average age of the participants was 40.36 (±10.737) years. More than two-thirds of the nurses who reported their weight and height for the purpose of BMI calculation were of normal weight (N=58, 53.2%) or overweight (N=31, 28.4%). In total, 3 nurses (2.8%) were classified as underweight and 17 (15.6%) as obese.

The majority of the participants (N=78, 67.2%) had earned a diploma, while 38 (32.7%) had a degree in nursing with, an average of 20 years of work experience and 9.8 working hours per day.

Musculoskeletal complaints

In total, 113 nurses (97.4%) reported having musculoskeletal pain/discomfort in at least one anatomical body site. The self-reported prevalence rates of musculoskeletal pain/discomfort for different body regions in the last 12 months are shown in Table 2. Low back pain/discomfort was the most frequently reported complaint (N=102, 87.93%), followed by neck (N=98, 84.48%) and shoulders (N=95, 81.89%). The least frequently reported sites of complaints were elbows (N=67, 57.75%), hips (N=70, 60.43%) and ankles/feet (N=74, 63.79%).

Static and dynamic occupational loads

In total, 109 (93.96%) of the nurses reported that they had to apply manual force to perform daily tasks at work. The self-reported intensity of the general and manual force required to perform such tasks is presented in Table 3.

Table 1. The demographic characteristics of the participants

Variables	Mean (±SD)	Median	Range
Age	40.36 (±10.737)	38.0	21–62
Height	165.10 (±6.92)	165.00	152–190
Weight	69.45 (±13.46)	67.50	48–127
BMI	25.07 (±4.78)	24.38	17.96–49
Years of employment	20.168 (±11.26)	19.00	1–43
Years in current position	15.11 (±10.71)	11.50	0–43
Working hours per day	9.807 (±2.43)	8.12	7–24

Table 2. Site-specific prevalence of reported WRMSD-related pain

Body region	Frequency (N)	Percentage (%)	Proportion confidence interval (95% CI)
Neck	98	84.48	0.75–0.90
Upper back	86	74.13	0.68–0.85
Lower back	102	87.93	0.80–0.94
Shoulder	95	81.89	0.70–0.87
Elbow	67	57.75	0.48–0.68
Wrist/hand	83	71.55	0.61–0.80
Hip	70	60.43	0.50–0.70
Knee	76	65.51	0.57–0.76
Ankle/foot	74	63.79	0.57–0.78

In total, 78 nurses (67.24%) reported manually lifting patients. All the nurses (N=116, 100%) reported having to assume awkward/forced postures of the back, 113 (97.41%) awkward/forced postures of the neck, while 83 nurses (71.55%) reported awkward/forced postures of the wrist/hand. Working with prolonged shoulder abduction/adduction was reported by 113 nurses (97.41%), while 89 (76.72%) reported working with elevated arms. The self-reported working time spent in each position is shown in Table 3.

In total, 61 nurses (52.5%) reported that they were required to perform repetitive movements of the shoulders, elbows and fingers, while 64 (55.2%) reported having to perform repetitive wrist/hand movements. The mean, median, and range of the repetitive movements reported are shown in Table 4.

Correlation between the reported static and dynamic strains and WRMSD-related pain

Correlations between reported pain in nine different body regions and individual and static/dynamic strains are shown in Table 5. Significant correlations with a p level of 0.01 have been shown for elbow and wrist pain with manual force; wrist pain and awkward/forced postures of the wrist; wrist pain and awkward/forced postures of the fingers;

Table 3. Prevalence of reported forceful movements and awkward/forced postures

Variables	Frequency (N)	Percentage (%)
Force		
General force needed to perform tasks		
very small	14	13.08
small	35	32.71
moderate	27	25.23
large	22	20.56
very large	9	8.41
Manual force needed to perform tasks		
very small	11	10.09
small	8	7.34
moderate	36	33.02
large	42	38.53
very large	12	11.01
Awkward/forced postures		
Back		
< ½ working hours	34	29.31
> ½ working hours	82	70.69
Neck		
< ½ working hours	29	25.66
> ½ working hours	84	74.34
Shoulder (abduction/adduction)		
< ½ working hours	40	35.4
> ½ working hours	73	64.6
Shoulder (elevation)		
< ½ working hours	71	79.77
> ½ working hours	18	20.23
Wrist		
< ½ working hours	63	75.90
> ½ working hours	20	24.10

Table 4. Characteristics of reported repetitive movements

Body region	Mean (±SD)	Median	Range
Shoulder			
Per minute	20.46 (±25.97)	10.00	1–130
Hours per day	6.39 (±4.99)	6.00	1–34
Elbow			
Per minute	21.77 (±21.18)	15.00	2–100
Hours per day	6.57 (±5.36)	6.00	1–34
Wrist			
Per minute	35.36 (±54.34)	22.50	5–340
Hours per day	6.57 (±4.35)	6.00	2–24
Fingers			
Per minute	42.62 (±70.91)	20.00	5–400
Hours per day	7.60 (±9.23)	6.00	1–66

Table 5. Correlation coefficients for the correlation calculations of individual and physical factors with site-specific pain

Variables	NE	UB	SH	EL	WR	LB	HI	KN	AN
Age	-.010	.159	.212*	.197*	.148	-.010	.092	.202*	.265**
Height	-.073	-.232*	-.108	.010	.000	-.037	.066	-.091	-.120
Weight	-.086	-.069	.112	.056	.065	-.050	.070	.046	.082
BMI	-.069	.030	.143	.063	.046	-.063	.060	.127	.140
Working years	-.010	.126	.226*	.185*	.141	-.021	.081	.195*	.259**
Working years/current	.061	.154	.235*	.156	.178	-.055	.055	.109	.225**
Working hours	.008	-.071	.019	-.114	-.192*	.016	-.188	.148	.108
Force									
General force	.130	.060	.030	.146	.207*	.249**	.116	.180	.107
Manual force			.179	.281**	.255**				
Postures									
Back		.134				-.008			
Neck	.152	.193*							
Shoulder (AA)			.051						
Shoulder (E)			.098						
Wrist					.342**				
Repetition									
Shoulder									
Per minute			.111						
Hours per day			-.088						
Elbows									
Per minute				.060					
Hours per day				-.216					
Wrist/hand									
Per minute					-.024				
Hours per day					-.431				
Fingers									
Per minute					-.094				
Hours per day					-.351				

NE – neck; UB – upper back; SH – shoulders, EL – elbows; WR – wrist/hand; LB – lower back; HI – hips; KN – knees; AN – ankle/foot; * - correlation is significant at 0.05 level; ** - correlation is significant at 0.01 level

low back pain and general force; ankle/foot pain and age, ankle/foot pain and years of employment, ankle/foot pain and years in their current position. No significant correlations of individual or occupational factors with neck pain and hip pain were demonstrated. Significant correlations with a p level of 0.05 have been shown, as follows: upper back pain and height; upper back pain and awkward/forced postures of the neck; shoulder pain and age, shoulder pain and years of employment; shoulder pain and years in their current position; elbow pain and age, elbow pain and years of employment; wrist/hand pain and working hours; wrist/hand pain and the amount of general force; wrist/hand pain and repetitive movements of the fingers; wrist/hand pain and repetitive movements of the wrists; knee pain and age; knee pain and years of employment.

Multivariate analysis

Multivariate analysis showed that static and dynamic strains significantly predict hand/wrist pain (F=5.272, P<0.05). The model indicates that general and manual force, as well as wrist posture, explain 14.8% of the variance in wrist/hand pain (R=0.385, R2=0.148). Multivariate analysis did not significantly predict pain in any other anatomical site.

Discussion

This study was conducted with the aim of examining the prevalence rates of WRMSD-related pain and common static and dynamic strains associated with nursing in Croatian hospital/hospital center nurses and their association with occupational factors. The Occupational Safety and Health Agency has previously classified nursing as one of the 15 occupations with a high risk of developing WRMSD due to occupational hazards (14), where lifting heavy objects, prolonged standing and working in awkward/forced postures, repetitive movements of the trunk and upper extremities, as well as forceful movements of the upper extremities (22) contribute to musculoskeletal pain. Many studies have previously examined the relationship between musculoskeletal pain/discomfort and occupational physical strains, but case differences in relation to WRMSDs and physical strains, differences in the recall period, and the predominant cross-sectional design of the studies made a comparing the given results and drawing definitive conclusions on the association of WRMSDs and occupational physical strains difficult.

In the present study, the prevalence of WRMSD-related pain and physical strains was shown to be very high. The general 12-month prevalence of musculoskeletal pain in our study was 97.4%, which is higher than previously reported. Previous research for the same recall period reported a prevalence of musculoskeletal pain ranging from 70.8% to 89.0% (16, 17). Similarly, higher prevalence rates were observed for all individual body regions as well: neck 84.48% vs 33.3%–62.7% (16, 23), upper back 74.13% vs 40.9%–45.79% (17, 24), shoulders 81.89% vs 22.0%–74.5% (5, 23), elbows 57.75% vs 5.5%–7.49% (12, 16), wrist/hand 71.55% vs 17.5%–29.7% (16, 24), low back 87.93% vs. 48.8%–72.4% (12, 5), hips 60.43% vs 8.9%–19.5% (11, 24), knees 65.51% vs 21.7%–52.1% (23, 24), ankle/foot 63.79% vs 14.9%–41.5% (16, 25), respectively. Both the high general and site-specific prevalence could indicate insufficient occupational safety measures aimed at preserving and promoting musculoskeletal health, but also a sampling bias where nurses with ongoing pain at the time of the study showed a greater inclination to participate in the study compared to those who did not experience pain. The latter may be probable, considering the self-administration of the questionnaire, which meant that not all the nurses participated in the study but only those who chose to do so (based on their will and motivation).

Low back pain is the most prevalent complaint, as consistent with previous research (18, 24, 25, 26, 27, 28). Previous research suggested that nursing tasks that require awkward/forced postures of the back while performing tasks and heavy physical exertion are the most common causes of back pain among nursing staff (29). Correlations of reported low back pain with awkward postures of the back and lifting patients in

the present study did not meet statistical significance but have significance regarding the reported general force needed to perform tasks. A positive correlation of low back pain with the general force needed to perform tasks at work suggests that heavy physical exertion may be associated with low back musculoskeletal pain and may be of concern regarding nursing tasks that require pushing and/or pulling (patients, machines etc.).

The general force needed to perform work-related tasks was also significantly correlated with the reported elbow and wrist/hand pain, without a significant correlation with lifting patients, suggesting that the aforementioned pushing and/or pulling affects the forearm and wrist as well, aligning with previous research that associates heavy physical exertion with elbow and wrist/hand pain (4). Furthermore, a strong association was found between self-reported applied manual force and wrist/hand pain, indicating that holding and gripping equipment and medical devices, as well as the fine movements and pinch gripping required in everyday nursing practice, may be considered as risk-increasing activities for wrist and/or hand pain and overuse injuries as previously reported by Thomsen et al. (29). Furthermore, an association of awkward postures of the wrist with reported wrist/hand pain was found as well, suggesting that typing, charting, preparing and administering medication as well as wound care, all common everyday nursing activities, may also pose a risk for wrist/hand pain and overuse injuries. Multivariate analysis showed that general and manual force along with awkward/forceful postures of the wrist/hand could explain 14.8% of the variance in wrist/hand pain, suggesting a multifactorial etiology of musculoskeletal pain. It should be noted that wrist/hand WRMSDs cause the longest absences from work, compared to WRMSDs in other sites (30). However, although associated with significant functional impairment in occupations such as nursing, where manual handling and fine movements are of essential importance, pain associated with wrist or hand WRMSDs rarely receives as much consideration as pain related to WRMSDs at more common sites (e.g., low back, neck and shoulder). Therefore, a comprehensive risk assessment of manual nursing tasks should be performed, with preventive measures tailored accordingly.

Our study showed that age can play a role in the onset or aggravation of musculoskeletal pain. Pain reported in several anatomical sites, shoulders, elbows, knees and ankles/feet, was shown to be associated with age, further accentuating the multifactorial etiology of musculoskeletal pain. Both younger and older ages have previously been associated with musculoskeletal pain, depending on the anatomical site (4). However, in our study, the positive correlation observed suggests that older age is a possible contributing factor to reported pain, which is consistent with previous research showing a steady increase in the general prevalence of occupation-related musculoskeletal pain with age (31). Cardoso et al. hypothesized that the positive correlations observed between musculoskeletal pain and older age may be related to natural wear of the body and merely aggravated by the working conditions and working environment (32).

A similar explanation may be given for the observed association of years of employment and reported pain in the shoulder, elbow, knee and ankle/foot. WRMSDs usually develop over a prolonged period due to continuous exposure to occupational physical strains, where the accumulation of the effects of each occupational activity performed by workers results in the wear of the affected tissues (33). In our study, the nurses had been working for an average of 20 years at the time of the survey was conducted, which is concerning when taking into account the high general and site-specific prevalence of reported musculoskeletal pain and the number of remaining years of employment until retirement. A study conducted with Indonesian fishermen showed a 1.2 times greater risk of experiencing lower back pain in workers who had performed the same work for 20 years or more (34).

Our study has several limitations. The most important drawback has shown to be using self-reporting as a means to measure static

and dynamic strains, which seem to be overestimated and overreported, especially with regard to awkward/forced postures and repetitive movements. Previous research suggested that overestimation and overreporting of occupational strains as well as musculoskeletal pain could be associated with the pain status of participants at the time of filling out the questionnaire, as well as specific knowledge and beliefs about workplace hazards and strains (35). Therefore, although self-reporting is a reliable research method when it comes to pain, future research should consider measuring occupational physical strains using more objective methods. Second, the self-administration of the questionnaire potentially selected nurses experiencing pain at the time of the filling out of the questionnaire and/or nurses who had perceived high static and dynamic strains and could be especially motivated to participate in the study, making the prevalence of reported musculoskeletal pain, as well as static and dynamic strains higher. The aforementioned may be of even greater importance considering the relatively small sample size. Overreporting of physical strains as well as a small sample size further affected statistical analysis and correlation calculations, suggesting the need for caution in the interpretation of the results. On the other hand, the design of the cross-sectional study makes it impossible to draw conclusions about the causality between physical strains and reported pain related to WRMSDs.

Conclusion

Musculoskeletal pain is a complex multifactorial condition in which individual and occupational factors seem to play a role. However, the precise association and interaction of the aforementioned factors have yet to be determined by high-quality research. Considering that chronic musculoskeletal pain can greatly affect the quality of nurses' professional and private lives, causing work restrictions, absenteeism, and presentism, as well as their increasingly frequent desire to leave the nursing profession, it is of essential importance to identify the individual and occupational factors that contribute to the development or aggravation of pain.

Declarations

Authors' contributions

All the authors have contributed equally to this work and have read and approved the final version of the manuscript.

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Competing interests

We declare no conflicts of interest.

Data sharing statement

Data available on request from the authors.

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Identity of the Nursing Profession: A Review

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Abstract

Identity, including professional identity, is a dynamic process shaped by societal engagement and contextual factors. In nursing, the historical, social, cultural and political dimensions mold professional identity, with recent advancements emphasizing autonomy and collaboration. However, there still remains a gap in our understanding of how evolving roles impact nursing professionals' identity and healthcare outcomes.

Professional socialization is crucial for nursing professionals, extending beyond technical skills to include soft skills, ethics and responsibilities. This lifelong process, influenced by education, mentorship and societal expectations, defines nursing's professional identity. Ethical standards and values are foundational, shaping interactions with patients and colleagues. Policy implementation prompts role shifts, reflecting changing healthcare needs, such as the expansion of nurse practitioner roles. Education, ethical practice and leadership are vital for shaping the future identity of nursing.

Nursing's identity evolves with education, experience, societal needs and policy changes. Nurses are increasingly engaging in leadership and advocacy, impacting patient care and policy development. The future of nursing hinges on its adaptability to healthcare challenges and societal expectations. Scholarly works on professional socialization, nursing identity, policy implementation and the future of nursing provide insights into this evolution.

Keywords: nursing, professional identity, social values

Introduction

The construction of identity is a dynamic process facilitated through societal engagement. It aids in the perception of self and subjectivity, encompassing elements of psychological understanding. Identity is typically represented within societal contexts, through which it attains its meaning. Professional and social identities are linked by various forms of knowledge acquired through continuous socialization processes. The dynamic interaction between the presentation of identity and societal interpretation endows it with significant depth and importance (1).

The nursing profession, which occupies a unique position within the spectrum of professional identities, is supported by a broad range of social science disciplines. The identity of nursing is influenced by a convergence of historical, social, cultural, political and relational dimensions. These facets, incorporating both material and symbolic elements, sculpt the professional identity within the nursing sector (1). Recent literature has increasingly emphasized the dynamic nature of the nursing identity, highlighting shifts toward more autonomous roles and the integration of advanced practice models. For instance, advancements in nursing education and a greater focus on interdisciplinary collaboration have begun to reshape nurses' professional identity, blurring traditional boundaries and fostering a more holistic approach to patient care (2,3). Moreover, the impact of global health challenges has further underscored the adaptability and resilience of nurses, spotlighting their critical role in healthcare delivery and policy advocacy (4).

Despite these advancements, there remains a notable gap in the understanding of how these evolving roles and expectations impact the core identity of nursing professionals and how this, in turn, affects healthcare outcomes. By integrating recent empirical findings with a nuanced discussion of theoretical perspectives, this study aims to provide a balanced review that situates the nursing profession's identity within the broader academic and healthcare contexts. Through this lens, we explore the implications of these identity shifts for professional practice, healthcare delivery and policy formulation, thereby contributing to a deeper understanding of nursing's key role in the ever-changing healthcare system.

Professional socialization

Professional socialization represents a crucial process in the development and adaptation of individuals within their chosen occupational spheres. This is not merely about acquiring the necessary technical knowledge and skills; it extends to assimilating the nuanced norms, values and behaviors that are integral to a specific profession. At the heart of this process lies the objective of transforming novices into adept professionals, capable of navigating and excelling in their respective fields (5).

The inception of professional socialization is typically rooted in formal education and training, laying the foundational groundwork for the practical application of job-specific skills. This phase is crucial as it sets the tone for the individual's future engagement with the professional world. However, the process of professional socialization is far from linear or confined to the initial stages of education but rather a dynamic interplay of various influences and experiences.

As individuals step into the real-world context of their professions, they embark on a continuous path of experiential learning. In the context of nursing, competence becomes an important covariate of professional socialization trajectories. As nursing professionals navigate through their experiential learning phase, their growing competence not only enhances their ability to apply theoretical knowledge in practical situations but also plays a critical role in their professional socialization, shaping their journey toward becoming fully integrated members of the nursing community (6).

Crucially, professional socialization transcends the acquisition of technical prowess. It encompasses the cultivation of essential soft skills, such as effective communication, leadership, teamwork,

problem-solving and decision-making. These skills are indispensable in navigating the complexities and interpersonal dynamics of the modern workplace (5).

Moreover, an integral component of professional socialization is the understanding and internalization of ethical standards and professional responsibilities. This aspect underscores the importance of adhering to legal frameworks, ethical codes, and prioritizing the welfare of clients, patients and service recipients.

In the rapidly evolving context of professional environments, characterized by technological advancements and changes in practices, professional socialization is identified as a continuous process of learning, adapting and evolving, ensuring that professionals remain not only competent but also relevant and effective in their respective fields.

Professional socialization represents a critical, lifelong process of acquiring and internalizing the norms, attitudes, behaviors, skills, roles and values intrinsic to a chosen profession. It commences with academic instruction at the university level and seamlessly extends into the professional work environment. The essence of this process lies in the cultivation of a professional identity, a composite that integrates into the nurse's personal and professional self-conception (7).

The concept of professional socialization transcends mere academic learning; it is an intricate interplay between early educational experiences and subsequent real-world practice. This transition, often marked by a "transitional shock" as individuals shift from a structured academic setting to the dynamic work environment, underscores the importance of effective mentorship and guidance during the formative stages of professional development.

Socialization, in its broader sense, encompasses the myriad influences exerted by society and its institutions on an individual. It is through this process that a person is groomed to assume various social roles, thereby shaping their personality and individuality. This process can be bifurcated into primary socialization, occurring within the family during childhood, and secondary socialization, taking place within educational systems, professional settings and social circles.

Professional socialization, in particular, is often conceptualized as a subconscious process wherein individuals assimilate and internalize the behavioral norms and standards of their chosen field (5,8). This process fosters a deep sense of identity and commitment to their profession. The ultimate aim of this process is the internalization of a professional identity that aligns with the ethos of the profession.

In this complex interplay of societal and organizational expectations, individuals learn to navigate and fulfill these demands to gain acceptance within their professional community. Socialization is not a passive absorption of information; rather, it is an active, dynamic process wherein individuals engage critically and self-critically, utilizing their educational experiences to forge their own beliefs, attitudes and behaviors within the framework of their professional environment.

The process of professional socialization in nursing presents a challenge for the individual, the healthcare institution and the educational institution (9). A meta-study on professional socialization and career choice considers ten studies in the regions of Canada, England, the USA, Australia, Japan and Sweden, highlighting the importance of multiple factors at the beginning of professional socialization, as well as the role of mentors, role models and peers in shaping expectations of the future profession. The meta-analysis identifies professional socialization as "redefining role expectations in transitional shock" (10), as pre-formed attitudes and expectations change under the influence of socialization. The beginning of socialization is strongly influenced by ideals and the traditional image of the nurse based on caring, compassion and care, transitioning into a more realistic and deeper understanding of the demands of the nursing profession. In every study analyzed for the review, it is acknowledged that the process of professional socialization is significantly

shaped by the influence of others, particularly by mentor nurses. Professional socialization is recognized as a crucial process in learning skills, attitudes and behaviors.

The professional identity of nursing

Nursing theories support the fact that the identity of the nursing profession is composed of activities that provide effective care, which are standardized into a unique activity distinguishing nursing from other medical professions. Therefore, care or nursing is the basic and fundamental function that justifies all activities and competencies. In practice, the provision of care goes beyond its nominal boundaries. With developments in science and technology, particularly in the field of medicine, there is an increasing emphasis on care consisting of "people caring for people" (1). In 2012, Johnson, Cowin, Wilson and Young introduced a conceptual framework for the professional identity of nursing, presenting it as a collection of measurable concepts that can be adjusted (11), highlighting the need for the development of a professional identity. The characteristics of professional identity in nursing change, depending on the time of observation and theories of the historical period, but develop over an individual's lifetime, entering into nursing education, years of study and clinical experience, and continue to develop throughout one's career. Education plays a crucial role in the acquisition of the knowledge and skills that distinguish nurses, as professional healthcare providers, from the general public. The characteristics of such an identity can change over time, while the professional identification of the nurse remains a strong force that affords her recognition in the public eye. In short, history suggests that the pursuit of professional identity imparts meaning to life and work (11). Healthcare policy influences the shaping of the identity of the professional role of the nurse. Changes in the health status of the population affect the changing role of the nurse in the community (12).

Ethical standards and values are the foundation of nursing practice. Nurses adhere to the high moral standards defined by their professional ethics, such as confidentiality, empathy, respect for patient rights and providing care without prejudice. These principles help nurses build trust with their patients and colleagues, which is crucial for their identity.

Politics and the identity of nursing

The impact of policy implementation on the professional role identity of nurses in the community remains to be determined. Nursing is a profession with its own field of work, knowledge base and practice, where the professional possesses technical competence, the ability to reflect and critically analyze, based on their knowledge, and continuously acquire scientific insights. Given that nursing is a profession within the healthcare system, it is dynamic and subject to changes in contemporary society. Furthermore, nursing, like other professions in this field, primarily operates on interpersonal relationships, usually with multiple subjects. Interpersonal relationships from the perspective of professionals and users encourage continuous analysis of practice, as there are no ready-made answers to various life situations in everyday life. The development of analytical methodology using a reflective perspective aims for thoughtful critical thinking, understanding situations while respecting roles and timing in building professional identity. Nursing care is no longer limited to the application of equipment, materials and structured knowledge but is defined by the process of relationships, interventions and subjectivity. Nursing care focused on technical professional procedures leads to the mechanization of nursing, a "machine" and impersonality in the organization (13). Longer lifespans with the presence of chronic health conditions increasingly pose complex social and economic problems that require the restructuring of nurses' roles. Community healthcare is increasingly subject to external and internal pressures for this reason (12). The restructuring of community nursing care policy is implemented in two ways: by developing the role of nurse specialists and universal general roles. The role of the specialist implies the expansion

of nurses' roles to include more clinical tasks than general practitioners. The scope of the nursing profession and practice depends on the country. Some countries allow nurse practitioners (NPs) full practice authority, while in other countries, NP practice legally requires a supervisory agreement with a physician (14). In the USA, autonomous NP practice was introduced in 1980 due to a significant shortage of doctors, especially in rural areas. The scope of the tasks, duties and responsibilities of NPs varies among the states (15–18). By 2017, twenty-two states across the USA had granted nurse practitioners full practice authority, eliminating the need for physician supervision, while thirty-eight states still required NPs to maintain a written collaborative agreement with a physician. In Canada, nurses often specialize in one of three areas: family practice, pediatrics or adult care, with recognition in both primary and acute care settings. Primary care NPs work in various environments such as homes and community health centers, focusing on health promotion, preventive care, and the diagnosis and treatment of acute or chronic illnesses. Acute care NPs, on the other hand, cater to specific patient demographics, including those in neonatal, nephrology and cardiology departments (19).

The universal role implies the development of a holistic approach to community healthcare as, for example, in Norway (20).

Framing nursing's future

Our study underscores the essential role of education and adherence to ethical standards in the development of professional identity among nurses. Beyond this foundation, we cover the expanding roles of nurses in leadership and policy advocacy, reflecting the adaptive response required by the shifting demands of the healthcare context. This expansion of roles signifies a departure from the traditional focus on caregiving, as emphasized by Virginia Henderson's influential work (21). Our findings suggest a broadening of the identity of the nursing professional to include significant elements of policy influence and leadership, indicative of a move toward an integrative healthcare model. This progression mirrors the changing needs within healthcare, corroborating recent observations by scholars on the adaptability and resilience of nursing professionals, especially evident during crises such as the COVID-19 pandemic (22). The practical applications of our findings suggest a need for nursing education programs to integrate leadership and policy advocacy training, thereby preparing nurses for expanded roles in the healthcare system. This approach does not only align with the evolution of nurses' professional identity but also addresses current healthcare challenges by empowering them to take on leadership and advocacy roles effectively.

Our study emphasizes the evolving character of the nursing identity and its significant influence on healthcare, calling for further exploration into how it is affected by education, policy shifts and complex healthcare demands. Investigating the interplay among ethical practice, specialist roles and comprehensive patient care will highlight how nursing contributes to healthcare outcomes. This paper aims not only to deepen our understanding of nursing but also to enhance healthcare systems' responsiveness to community needs, emphasizing the importance of continuous adaptation and education in the profession.

Conclusions

The evolving identity of the nursing profession is a testament to the dynamic interplay among education, experience, societal needs and healthcare policies. Extending beyond traditional boundaries, the role of nurses now encompasses a spectrum of responsibilities that include leadership, advocacy and innovation. This expansion reflects a profound shift from a mechanistic view of task execution to a more holistic approach, where nurses are not only caregivers but also key contributors to healthcare policy and patient advocacy. The diversity of nurses' roles in different countries, influenced by varying levels of education and distinct healthcare policies, underscores the importance of a balanced

professional identity. This balance is crucial in order to navigate the complexities of the healthcare environment without succumbing to role confusion or identity instability. The nurse's identity, therefore, is not a static attribute but a dynamic construct that continuously adapts to healthcare demands and societal expectations.

As the profession moves forward, it is clear that the identity of nursing will continue to evolve, shaped by the ongoing interplay of educational advancements, ethical standards and the ever-changing dynamics of patient care. Nurses, as integral members of the healthcare community, will continue to redefine their roles, embracing the challenges and opportunities that come with being at the forefront of healthcare innovation and patient advocacy. The future of nursing, rich in potential and possibilities, is poised to continue to solidify the profession's impact on healthcare at large, reinforcing the nurse's role not merely as a caregiver but as a key architect in the realm of health and wellbeing.

Declarations

Authors' contributions

All the authors have contributed equally to this work and have read and approved the final version of the manuscript.

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Competing interests

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Prevalence and Risk Factors for Postpartum Depression: A Cross-Sectional Study

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Abstract

Background: One of the most important health problems affecting the mother and child is postpartum depression (PPD). This study aimed to determine the frequency and risk factors that contribute to PPD in order to help identify those at high risk and implement preventive measures.

Methods: We conducted a cross-sectional study in Zagreb, Croatia, from November 2022 to April 2023 on a convenient sample of mothers (N=195) with children up to six months of age, using the Edinburgh Postpartum Depression Questionnaire and the Multidimensional Scale of Perceived Social Support. The data were collected during home visits by visiting nurses or meetings of the Vita breastfeeding support group.

Results: Symptoms of PPD of varying intensity were present in 43 (22.05%) of the participants. It was found that the mothers with previous mental disorders ($\chi 2=6.85$, $P=.01$) and those less satisfied with their partners' support ($\chi 2=18.93$, $P=.00$) had more depressive symptoms than those who did not have previous mental disorders and were satisfied with their partners' support. Also, it was found that mothers with depressive symptoms had a lower level of support from their significant others ($t=3.96$, $P<.01$), family ($t=3.64$, $P<.01$) and friends ($t=3.39$, $P<.01$) than mothers without such symptoms.

Conclusion: The prevalence of PPD in the sample was high, and it was shown that the following risk factors influenced its occurrence: previous mental disorders, dissatisfaction with emotional support from the partner, and a lower level of social support from significant others, family and friends. It is important to raise awareness of this problem and recognize the symptoms in time, which could facilitate the implementation of appropriate preventive measures and the provision of appropriate therapy.

Keywords: postpartum depression, risk factors, prevalence, emotional support, social support

Introduction

Postpartum depression (PPD) is a mental health condition which, according to the Diagnostic and Statistical Manual for Mental Disorders, Fifth Edition (DSM-5), is classified as a depression with onset within four weeks of postpartum (1). According to the International Classification of Disease (ICD), PPD begins by the first six weeks of the postpartum phase (2). However, many studies have shown that the onset can be after the puerperium, within the first postpartum year (3,4). Childbirth is a difficult and exhausting process since the mother goes through many physical, emotional, hormonal and psychological changes throughout pregnancy. Moreover, enormous changes occur in her social life (5).

The numerous risk factors for postpartum depression may involve a variety of biological, social, psychological and obstetrical issues, which have strong to weak associations with the development of PPD (6,7).

Depression and anxiety in pregnancy, postpartum blues, history of depression, neuroticism, excessive stress inducing life events, poor marital relations, lack of social support and low self-esteem are strongly associated with postpartum depression (8,9). In addition, low socioeconomic status, single marital status, unwanted pregnancy and obstetrical stressors are reported to have relatively weaker association with PPD (7,10). Mothers who have experienced related complications during pregnancy or childbirth, such as preterm delivery, prenatal hospitalization, emergency cesarean section, preeclampsia or decreased infant health are shown to have increased risk of developing PPD (11,12).

However, breastfeeding could be considered as a potential measure to prevent PPD (13,14). Furthermore, emotional support is one of the most important social factors during postpartum recovery, as it makes women feel loved and cared for, encouraging them to face the issues in their new role (15,16). Studies in both developed and developing countries have shown that lack of social support is an independent predictor of PPD (17,18).

PPD has many features similar to depression, which can occur at other times in women's lives with an additional history of childbirth. Symptoms include depressed mood, apathy, changes in sleep patterns, changes in appetite, feelings of worthlessness, inability to concentrate and suicidal ideation. Patients with PPD may also experience anxiety or psychotic symptoms (5). However, recent studies have shown that PPD has some specific symptoms and risk factors in comparison to major depressive disorder, and is heterogeneous with various subtypes according to the onset and severity (3).

The prevalence of PPD reported in the literature varies substantially, depending on the definition of the disorder, country, diagnostic tools and the period over which the prevalence is determined (5,19). A meta-analysis encompassing 565 studies from 80 different countries or regions has shown that the global prevalence of PPD is approximately 17.22% (20).

The consequences of PPD are negative, not only for mothers but also for the children, since it affects the child's psychological and intellectual abilities, as well as mother-child bonding (21). These negative consequences can be prevented by the early diagnosis of the mother, with timely care and management. Understanding the risk factors would also help in preventing and managing the disorder (21). Therefore, this study aimed to examine the prevalence of PPD in a sample of mothers with children up to six months of age in the area of Novi Zagreb, and to determine the risk factors (how the child is fed, lack of emotional support from the partner, previous mental disorders of the mother and the maturity of the child) associated with PPD. Moreover, we also examined the differences in social support between mothers with and without symptoms of PPD.

Methods

Study design

This was a cross-sectional study.

Ethics

The study was conducted in accordance with the institutional Code of Ethics. All the methods were performed in accordance with the relevant guidelines and regulations. Written informed consent was obtained from all the study participants. The study protocol was approved by the Ethics Committee of the Zagreb-Centar Health Center (Document number: UR 251-510-03-20-22-02.)

Participants

A convenient sample of mothers with children up to six months of age who used the home care service (visiting nurses) or attended breastfeeding support groups were included in this study. Participation was completely anonymous and voluntary.

Data collection and study tool

Data were collected by visiting nurses or during meetings of the Vita breastfeeding support group. The participants filled out a questionnaire after reading the study information and signing a written informed consent. The questionnaire was filled out in paper form.

The first part of the questionnaire consisted of six questions related to the participants' general sociodemographic data (child's age, mother's age, educational level; and work, economic and marital status).

The second part of the questionnaire was designed specifically for the needs of this study to determine the risk factors present in the development of PPD, consisting of nine questions (the number of spontaneous abortions, the course of the current pregnancy, the method of delivery, assessment of the maturity of the newborn, direct and early skin-to-skin contact, how the child is fed, previous mental disorders and the emotional support of the partner).

The third part of the questionnaire consisted of the Edinburgh Postpartum Depression Scale (EPDS), which is a widely used 10-item self-report questionnaire that measures depressive symptoms in postpartum women, including the severity of various depressive symptoms over the past week on a scale from 0 to 3, with a maximum score of 30 and a cutoff score of 13. The Croatian translation of the EPDS proved to be valid for the triage of postpartum depression and is recommended for clinical and healthcare purposes (22). The Cronbach alpha in our study was .89.

The final part of the questionnaire consisted of the Multidimensional Scale from Perceived Social Support (MSPSS) (23), with of 12 statements that measure the perceived social support from family, friends and other persons. Each source of social support is assigned 4 items. On a scale from 1 (completely disagree) to 7 (completely agree), participants should mark their degree of agreement with each statement. The total score for each of the 3 dimensions is calculated as the average of the estimates of the items that compose it. The theoretical range of the scores is from 1 to 7, with a higher score indicating a higher degree of support. The Cronbach alpha in our study was .91 for the subscales of support from family and other persons, and .93 for the subscale of support from friends.

Statistical analysis

The data were analyzed using descriptive statistics, including frequencies, percentages, means and standard deviations. The Chi-square and t-test were used to assess the significance among the variables. The value $P<0.05$ was used as the level of significance.

IBM SPSS Statistics Version 26 (Armonk, IBM, New York, USA) was used for statistical analysis.

Results

The participants' sociodemographic data are presented in Table 1. The study included 195 mothers, ranging from 21 to 40 years of age. The largest percentage of the mothers (35.9%) were between 31 and 35 years of age. The children's average age was 12.17 weeks old (SD=8.57). Most of the participants were married (75.9%), held a bachelor's or master's degree (71.3%), were employed (90.8%) and perceived their socioeconomic status as average (56.9%).

Table 2 shows that most of the mothers (85.1%) experienced an orderly course of pregnancy, and in 87.7% delivery was on time. The largest percentage of the participants (72.3%) had a vaginal birth, and after giving birth, most of the mothers had direct (74.4%) and early skin-to-skin contact with their babies (82.5%). The majority of the participants had no prior history of mental illness (92.8%). Moreover, the results indicate that 74.4% of the mothers were completely satisfied with the emotional support provided by their partners. The largest number of participants (60.5%) were breastfeeding their children exclusively on demand. Combining breastfeeding with expressed mother's milk or infant formula was practiced by 22.6% of the mothers, while 16.9% exclusively fed their children infant formula.

The Edinburgh Postnatal Depression Scale (EPDS)

Most of the participants, 152 (77.9%) had fewer than a total of 13 points on the EPDS, while the remaining 43 (22.05%) had 13 or more points, indicating the presence of symptoms of depression.

According to the results of the Chi-square tests presented in Table 3, there were no statistically significant differences ($p > .05$) between the mothers exhibiting symptoms of depression and those without such symptoms in regard to how the child is fed and the child's maturity. However, the Chi-square test is statistically significant ($p < .05$) for the variables of the partners' emotional support and previous mental disorders, which means that the participants who had

Table 1. The participants' sociodemographic data

Child's age (in weeks)	**M=12.1 (SD=8.57) N (%)**
Mother's age (in years)	
<21	0 (0.0)
21–25	16 (8.2)
26–30	66 (34)
31–35	70 (35.9)
36–40	37 (19.0)
>40	6 (3.1)
Marital status	
Married	148 (75.9)
Cohabitation	47 (24.1)
Educational level	
Elementary school	1 (0.5)
High school	55 (28.2)
Bachelor's or master's degree	139 (71.3)
Perceived socioeconomic status	
Below average	1 (0.5)
Average	111 (56.9)
Above average	83 (42.6)
Working status	
Full time employment	177 (90.8)
Part-time employment	0 (0.0)
Independent activity	2 (1.0)
Student	2 (1.0)
Unemployed	14 (7.2)

more PPD symptoms were less satisfied with their partners' emotional support and had experienced more previous mental disorders.

The Multidimensional Scale of Perceived Social Support (MSPSS)

On average, the mothers had a high level of social support. Those with symptoms of PPD had a lower level of support from significant others, family and friends than mothers without such symptoms (Table 4).

Table 2. Data on the mothers and newborns

	N (%)
Number of spontaneous abortions	
No miscarriages	154 (79.0)
One	33 (16.9)
Two	8 (4.1)
The course of pregnancy	
Orderly	166 (85.1)
With complications	29 (14.9)
Manner of delivery	
Vaginal delivery	141 (72.3)
Instrumental vaginal	3 (1.5)
Planned C-section	23 (11.8)
Emergency C-section	28 (14.4)
Assessment of maturity	
Premature birth	12 (6.2)
Born at term	171 (87.7)
Born postterm	12 (6.1)
Direct skin-to-skin contact	
Yes	145 (74.4)
No	50 (25.6)
Early skin-to-skin contact	
Yes	161 (82.5)
No	34 (17.5)
How the child is fed	
Breastfeeding on demand	118 (60.5)
Combined feeding	44 (22.6)
Dairy preparations	33 (16.9)
Previous mental disorders	
No	181 (92.8)
Depression	8 (4.1)
Other mental disorders	6 (3.1)
Emotional support from partner	
Entirely satisfied	145 (74.4)
Partially satisfied	46 (23.6)
Dissatisfied	4 (2.0)

Table 3. Results of the χ2 test of the frequency of risk factors for the development of depression between mothers with and without depressive symptoms

	Symptoms of depression N	No symptoms of depression N	χ2 (p)
How the child is fed			
breastfeeding on demand	20	98	4.75 (.09)
combined feeding	14	30	
dairy preparations	9	24	
Emotional support from partner			
entirely satisfied	21	124	18.93 (.00)
partially satisfied	20	26	
dissatisfied	2	2	
Previously experienced mental disorders			
no	36	145	6.85 (.01)
yes	7	7	
Maturity of newborn			
born prematurely	3	9	.14 (.93)
born at term	37	134	
born postterm	3	9	
The course of pregnancy			
orderly	35	131	.136 (.712)
with complications	8	22	
Manner of giving birth			
vaginal delivery and instrumental vaginal	35	109	2.828 (.243)
planned C-section	4	25	
emergency C-section	4	19	

Table 4. Differences in the level of support from significant others, family and friends between mothers with and without depressive symptoms

	Symptoms of depression	N	M	SD	df	t
1. Support from significant others	YES NO	43 152	5.90 6.61	1.09 0.71	193	3.96**
2. Family support	YES NO	43 152	5.32 6.21	1.48 1.07	193	3.64**
3. Support from friends	YES NO	43 152	5.12 6.04	1.67 1.10	193	3.39**

Discussion

PPD symptoms of varying intensity were present in 22.05% of the mothers. A previous study conducted in Croatia had recruited 272 women and used the diagnostic criteria according to the DSM-IV-TR. Out of the 272 recruited women, 12 (4.4%) experienced a minor depressive episode and 10 (3.7%) had a major depressive episode with postpartum onset, with an overall prevalence for both minor and major depressive episodes of 8.1% (24). A previous review of the literature had observed inconsistent PPD prevalence, with 1.9% to 82.1% in developed countries and 5.2% to 74% in developing countries (17).

A systematic review by Hahn-Holbrook and colleagues also showed a significant heterogeneity among nations (25). However, the global prevalence of PPD was found to be approximately 17.22% in the largest meta-analysis of PPD to-date (20). The findings of the same meta-analysis revealed that the prevalence of PPD was closely linked to the level of country development and national or regional income. Therefore, the prevalence of PPD in our sample was higher than previously reported, although this could be due to the small sample size, inclusion of a convenient sample of mothers and the research tools employed, which may have affected the final results. Another reason could be that knowing the aim of the study, some of the participants may have been inclined to report particular symptoms.

In our sample, almost 90% of the women had no complications during pregnancy, almost 80% had vaginal delivery and their children were born at term. Mental and physical problems during pregnancy or delivery, postpartum problems with the infant, breastfeeding cessation and negative life events during the previous 12 months were associated with postpartum depression in a study conducted in Finland (26). A study in Croatia, which analyzed prolonged labor (>or=12 h), very painful birth, complications and illnesses of the mother during and after delivery as a consequence of birth, preterm birth (before week 36) and/or illness of the child (as a consequence of delivery or congenital) showed that peripartal complications are significantly connected with PPD (27). In our sample, there was no statistical difference between mothers with and without depressive symptoms, with regard to the course of pregnancy and delivery.

Our findings indicate that the participants had more symptoms of PPD if they had experienced previous mental disorders, similar to the results of other researchers (28–31). Various studies emphasize the association between a mother's previous mental disorders and PPD (28,29). Furthermore, a study conducted in two regions of the Czech Republic (Brno and Znojmo) concluded that a personal and family history of depression is significantly connected with PPD (30). Moreover, the results of a systematic review and meta-analysis showed a moderate certainty of evidence for an almost 2-fold higher risk of developing postpartum depression among mothers with a family history of any psychiatric disorder compared to those without such a family history (31).

Our research also shows that mothers with a history mental disorders and those who are less satisfied with their partners' support have more depressive symptoms than mothers without such a history who are more satisfied with their partners' support. Furthermore, mothers with depressive symptoms report a lower level of support from significant others, family and friends than mothers without depressive symptoms. This is in a line with known findings, since the literature shows that poor relationships with spouses or family members and lack of social support are associated with a higher likelihood of women experiencing PPD symptoms (15,32,33). According to the measure of perceived social support, in this study the levels of support from significant others, family and partners are high. However, mothers with depressive symptoms were found to have lower levels of support from significant others, family and friends than mothers without depressive symptoms.

The results of this study suggest that the frequency of PPD is not impacted by how the baby is fed. In contrast, Gaffney et al. (34) found that mothers with depressive symptoms were at greater risk for both low breastfeeding intensity and adding cereal to infant formula at two months of age than those without PPD (34). Moreover, a study by Dennis and McQueen found that all the mothers with PPD were significantly more likely to discontinue breastfeeding at 4 and/or 8 weeks, dissatisfied with their infant feeding method, experience significant breastfeeding problems and report lower levels of breastfeeding self-efficacy (35).

There are several limitations in this study. Our research sample was recruited from a limited community in a single section of the

city of Zagreb. Although this study examined a variety of sociodemographic, maternal and newborn data, employing a questionnaire on social support and depressive symptoms, previous research has shown that biological factors such as oxytocin levels, personality traits, peer support and educational level are also correlated with maternal PPD. Additional personal, sociodemographic and biological factors could be examined in future studies. Moreover, future studies should have a longitudinal or prospective design and assess the symptoms peripartum and at the first week, six months and one year following delivery, in order to obtain insight into PPD.

Conclusion

The results of our study indicate that 22.05% of the mothers of infants up to 6 months had symptoms of PPD. Mothers who exclusively fed infant formula to their children or gave birth prematurely did not differ in the frequency of PPD symptoms from mothers who exclusively breastfed on demand or gave birth at term. On the other hand, mothers who lacked emotional support from their partners, significant others, family and friends, and had previously experienced mental disorders had more PPD symptoms.

Proper access to maternal mental healthcare could be improved by raising awareness of the features, symptoms and risk factors that lead to postpartum depression. Knowing the risk factors could help in identifying the risk groups and providing appropriate preventive measures and treatment to women suffering from PPD.

Declarations

Aknowledgements

This study was part of Karmen Sovulj's Master of Nursing thesis, originally written and defended in the Croatian language.

Authors' contributions

All the authors have contributed equally to this work and have read and approved the final version of the manuscript.

Ethics

The study protocol was approved by the Ethics Committee of the Zagreb-Centar Health Center (Document number: UR 251-510-03-20-22-02.)

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Competing interests

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Data sharing statement

The authors confirm that the data can be obtained by contacting the corresponding author.

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