

BEHAVIOURAL METHODS FOR ASSESSING ALCOHOL DEPENDENCE OF PREGNANT WOMEN

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ABSTRACT

Introduction: The problem of alcohol abuse also affects pregnant women, who often conceal the fact that they drink alcohol during pregnancy. The WHO recommends standardized screening tests for diagnosing alcohol abuse and dependence, e.g. the CAGE test, T-ACE test, and TWEAK test. These tests are an easy, non-invasive, quick way to detect pregnant women from the risk group addicted to ethyl alcohol. The aim of the study is to evaluate behavioural methods used to diagnose the alcohol problem of pregnant women, as well as to assess which of the tests (CAGE test, the T-ACE test, or the TWEAK test) is most sensitive and specific in research on the diagnosis of alcoholism among pregnant women in Poland.

Results: Based on the survey, it was found that 85% of the respondents drank alcohol before pregnancy, while 26% (39) of the respondents continued to drink alcohol during pregnancy. A positive result of the CAGE test was obtained in 56% of the 39 women who declared that they drank alcohol during pregnancy and in 13% of the respondents who concealed their drinking of alcohol during pregnancy. A positive result of the T-ACE test was obtained in 39% of subjects who admitted to drinking during pregnancy and in 11% of pregnant women who did not admit to it. A positive result of the TWEAK test in the study group was read in 33% of 106 respondents who denied drinking alcohol during pregnancy and in 74% of pregnant women who consumed alcohol.

Conclusions: The CAGE, TWEAK, and T-ACE tests differ in sensitivity, specificity, validity, PPV, and NPV; therefore, they should be used to diagnose different alcohol problems. The study of women's alcohol dependence should be based on several tests evaluating alcohol dependence. Implementation of alcohol abuse screening tests in the prenatal care of pregnant women will allow the identification of patients with alcohol problems who do not admit to drinking alcohol.

Key words: alcohol during pregnancy, TWEAK test, CAGE test, T-ACE test.

INTRODUCTION

In Poland there is no legal regulation prohibiting the consumption of alcohol by any population group, including pregnant women. However, the effects of alcohol on pregnancy, foetal development, and newborn health are well known. Alcohol is a toxic and highly addictive substance with an intoxicating effect. Among the psychoactive substances, i.e. those that directly affect brain activity, causing mood changes, disturbances in perception, consciousness and behaviour, alcohol is mentioned in the first place. Also, outside the mental and social sphere, neurobiological research has shown durable, negative, and diverse effects from alcohol on the body of the child developing in the womb. In light of these data, drinking alcohol during pregnancy should be prohibited by medical personnel and perhaps even prohibited by law [1].

In a study of 149 pregnant women, 26% of them drank alcohol during pregnancy. According to behavioural studies of the same group of pregnant women, the percentage of drinkers was higher and amounted to 33% [2]. Data from the State Agency for Solving Alcohol Problems from 2018 showed that about 30% of women drink alcohol during pregnancy [3]. These data, despite active prophylaxis conducted among pregnant women by medical staff, are not reflected in a decrease in alcohol consumption by pregnant women. The consequences of drinking alcohol for women are greater than for men. The reason for this is the globally higher amount of adipose tissue in women than in men and the lower amount of water in a woman's body. Women have greater amounts of oestrogens, which are conducive to more intensive absorption of ethyl alcohol, and metabolize it less efficiently in the stomach due to the lower content of enzymes compared to men [4]. Harmful doses of

ethyl alcohol are different for men than for women. A harmful dose for a woman is drinking more than 7.5 l of pure ethanol per year, while for a man this threshold is 10 l/year [5].

It has been shown that stopping alcohol consumption in early pregnancy can protect the child from the toxic effects of stimulants, the consequences of which are visible at every stage of the child's development, and also affect the health of already adult people. To make a reliable assessment of alcohol abuse by women during pregnancy and to be able to protect the child from its impact on development and health, a number of simple methods were developed to assess the mother's addiction to this stimulant. To diagnose the alcohol problem, the World Health Organization (WHO) has proposed standardized tests to assess alcohol dependence in adults. Among the recommended tests, the possibility of using some of them to assess the alcohol dependence of pregnant women was indicated. In clinical conditions, the CAGE test and its modified versions, intended for a group of pregnant women, are most often used [6]. These include the TWEAK test and the T-ACE test. The MAST, SAAST, and AUDIT tests are also popular in the assessment of harmful and risky drinking. In 1990, another test was developed that examines the problem of alcohol abuse among adolescents: the POSIT test. The names of the tests come from the first letters of the main problems tested in English: the CAGE test (cut down, annoyed, guilty, eye opener), TWEAK test (tolerance, worried, eye-opener, amnesia, cut down), T-ACE test (tolerance, annoyance, cut down, eye opener) [6]. Screening tests for the diagnosis of alcohol abuse have been used in research since the 1940s. Their task is to isolate people who have a problem with alcohol abuse, in order to implement earlier treatment and make the correct diagnosis, and in the case of pregnant women, to eliminate the exposure of the foetus to factors harmful to its health development and health [6].

The aim of the study is to evaluate the behavioural methods used to diagnose the problem of alcohol abuse and dependence in pregnant women and to try to determine which of the tests (CAGE test, T-ACE test, or TWEAK test) is the most sensitive and specific in research on the diagnosis of alcoholism among pregnant women in Poland. As well as a presentation of the simplicity of the examination with the use of individual tests and a reflection on its inclusion in the routine examinations of women applying for exami-

nations monitoring the development of pregnancy in Poland.

MATERIAL AND METHODS

The study covered 149 healthy pregnant women reporting for childbirth, who underwent a physiological pregnancy with healthy fetuses in PZOZ in Starachowice from January 2019 to December 2020. The age of respondents ranged from 18 to 46 years. Each participant who gave informed and voluntary consent to participate in the study provided information about her demographic data and answers to 3 standardized, WHO-recommended tests assessing alcohol dependence, especially dedicated to pregnant respondents: the CAGE test, the T-ACE test, and the TWEAK test. Obtaining data from each test should exclude a possible error or confirm the result of addiction or abstinence of the tested person. Statistical analysis was performed in the Program version 4.1.0. R. The significance level of 0.05 was adopted in the analysis. Qualitative variables were analysed by calculating the number and percentage of occurrences of each value. Comparison of the values of qualitative variables in groups was performed using Fisher's exact test.

RESULTS

Among 149 pregnant women, most of the respondents [99 (66%)] were aged 26-35 years, and 22 (15%) were aged 18-25 years; full demographic data are presented in Table 1.

The largest group were pregnant women who gave birth again. 37% of the respondents gave birth for the second time, 20% of the respondents gave birth for the third time, 7% of the patients gave birth for the fourth time, and 5% of the respondents gave birth for the fifth time. 31% of the pregnant women went to give birth for the first time.

Based on the survey, it was found that 85% (126) of the respondents drank alcohol before pregnancy, while 26% (39) of the respondents continued to drink alcohol during pregnancy. None of the subjects started drinking during pregnancy. Women who drank while pregnant were characterized by a lower level of education ($p < 0.001$, $V = 0.34$) and were more often unmarried ($p = 0.001$, $V = 0.32$) compared to non-drinkers. The strength of the observed effects, measured by Cramer's V coefficient, was moderately large. There were no statistically significant

Table 1. Characteristics of the demographic data of the study group

Age, % (n)				Place of residence, % (n)		Education, % (n)		
18-25	26-35	36-40	> 40	Village	Town	Primary/professional	Medium	Higher
15 (22)	66 (99)	15 (21)	4 (6)	44 (65)	56 (84)	10 (15)	35 (52)	55 (82)

differences in terms of age and place of residence. Among those who drank before pregnancy, 57% gave up drinking during pregnancy, and 15% continued to drink. The results are summarized in Table 2.

The most common reason for drinking alcohol in 31% of the surveyed pregnant women was surprise due to unplanned pregnancy, 26% drank at social meetings, 13% at special events, and 8% due to family problems; other reasons were mentioned much less frequently.

The study showed the influence and duplication of parental behaviour in the family home. Among those who drank alcohol during pregnancy, as much as 90% came from families where alcohol was consumed by their parents. The fathers of the respondents drank more often (83% vs. 18%, respectively) than the mothers. A significant percentage (49%) of the siblings of pregnant women who drank alcohol also drank alcohol in their adult lives.

Assessing the knowledge of pregnant women about whether it is possible to drink alcohol during pregnancy, it was found that only women who themselves admitted to drinking during pregnancy significantly more often (test $\chi^2 [2] = 32.91, p < 0.001$) claimed that drinking is acceptable and motivated by the thought that "a little alcohol won't hurt". The strength of the recorded effect measured by Cramer's V coefficient was moderately large ($V = 0.48$). Among all respondents, 95% had knowledge that stimulants, including alcohol, have a negative impact on the health of the mother and the developing foetus.

In the diagnosis of alcohol problems, the WHO recommends screening tests that are used to assess whether a patient admitted to the ward drinks alcohol and is addicted to it. Three tests were used in our own research: the CAGE, T-ACE, and TWEAK tests (Tables 3-5), recommended by the WHO for pregnant patients. The American Society of Gynecology and Obstetrics recommends the T-ACE test for pregnant women. Repeating the examination based on the assessment of the results of 3 tests several times allows more objective and real results in relation to a single assessment using just one test. Because the test questions are very similar and concern one problem, the results of all tests should be very similar or identical in the group of women who admit to drinking alcohol and in the group of women who do not admit to drinking alcohol. However, our own research has shown that these results are not always confirmed.

Test evaluation criteria

CAGE test. Each question from the CAGE test was scored for one point. If the respondent answered affirmatively to at least 2 questions and obtained a score of at least 2 points, the test result was considered

Table 2. Number of women drinking alcohol before and during pregnancy

Drinking alcohol	Before pregnancy		During pregnancy	
	<i>n</i>	%	<i>n</i>	%
Yes	126	85	39	26
No	23	15	106	71
No data	–	–	4	3

Table 3. CAGE test results

CAGE test question	Yes, % (<i>n</i>)	No, % (<i>n</i>)
Have there been times in your life when you felt the need to cut back on your drinking?	20 (30)	80 (119)
Have you ever been annoyed by people around you who made comments about your drinking?	23 (34)	77 (115)
Have you ever felt remorse or shame about your drinking?	22 (33)	78 (116)
Has it ever happened that the first thing in the morning after waking up was to drink alcohol to calm down or "put yourself back on your feet"?	11 (17)	89 (132)

Table 4. T-ACE test results

T-ACE test questions	Yes, % (<i>n</i>)	No, % (<i>n</i>)
Do you get annoyed when people criticize your drinking?	24 (37)	75 (111)
Have you ever felt like you should cut down on your drinking?	22 (32)	79 (117)
Have you ever had to drink alcohol right after waking up to calm down or to stay hangover-free?	11 (16)	89 (133)
How many drinks do you need to get drunk?	Up to 2 drinks 18 (27)	3 drinks and more 43 (64)

Table 5. Assessment of alcohol dependence according to the TWEAK questionnaire among 149 surveyed pregnant women

TWEAK test question	Less than 3, % (<i>n</i>)	Three and more, % (<i>n</i>)
How many drinks do you need to feel high?	21 (31)	39 (58)
TWEAK test question	Yes, % (<i>n</i>)	No, % (<i>n</i>)
Have close friends or relatives worried or complained about your drinking in the last year?	1 (2)	99 (147)
Do you sometimes get up for a drink in the morning when you first get up?	11 (17)	89 (132)
Has a friend or family member ever told you about things you said or did while drinking that you don't remember?	44 (66)	56 (83)
Do you sometimes feel the need to cut back on your drinking?	26 (38)	75 (111)

positive, i.e. indicating an existing alcohol problem in the given respondent. A positive result of the CAGE test was obtained in 24% of the respondents. Of the 39 women who declared in the survey that they drank alcohol during pregnancy, a positive CAGE test result was obtained in 56% of the respondents. In addition, a positive test result was obtained in 13% of the respondents who did not admit it because they concealed their drinking of alcohol during pregnancy (Table 3).

The T-ACE test consists of 4 questions – 3 closed and one open-ended. The score of the test concerns the number of positive answers. If the subject gives an affirmative answer to at least 2 closed questions, and in the 4th open question she gives the amount of 2 or more drinks, then the test result is assessed as positive. Full answers to this test were given by 99% (148) of the respondents (Table 4).

A positive test result was obtained in 19% of the respondents. An answer to the question *How many drinks do you need to get drunk?* was not provided by 15% (22) of the respondents. From the group of women who declared that they drank alcohol during pregnancy, a positive result of the T-ACE test was obtained in 39% of the respondents, and a positive test result was found in 11% of the respondents who did not admit and concealed their consumption of alcohol during pregnancy.

Table 6. Results of the TWEAK test among women admitting to drinking during pregnancy

TWEAK test result	Alcohol consumption in pregnant			P
	No (n = 106), n (%)	Yes (n = 39), n (%)	Don't remember (n = 4), n (%)	
Negative	71 (67)	10 (26)	2 (50)	< 0.001
Positive	35 (33)	29 (74)	2 (50)	

Table 7. CAGE, T-ACE, and TWEAK test results

Test	Positive in the whole study group (%)	Positive among drinkers during pregnancy (%)	Positive among non-drinkers during pregnancy (%)
CAGE	24	56	13
T-ACE	19	39	11
TWEAK	43	74	33

Table 8. Comparison of ethyl alcohol abuse tests: TWEAK, CAGE, and T-ACE tests

Test	Sensitivity (%)	Specificity (%)	Accuracy (%)	PPV (%)	NPV (%)
TWEAK	74.36	66.98	68.97	45.31	87.65
CAGE	76.92	42.45	51.72	32.97	83.33
T-ACE	38.46	89.62	75.86	57.69	79.83

PPV – positive predictive value, NPV – negative predictive value

The TWEAK test consists of 4 closed questions and one open question. The maximum test score is 7 points. The first 2 questions are scored for 0 or 2 points. If the respondent answered question 1, “that in order to feel at a high level” she needs to drink 2 or more alcoholic beverages, then she received 2 points, while if she gave an amount less than 2 alcoholic beverages or answered that she does not drink alcohol, then 0 points were obtained. A score of 2 or more indicates harmful alcohol use and requires further assessment of alcohol dependence (Table 5).

A positive result of the TWEAK test means that pregnant women drink alcohol. Such events in the study group were read in 33% of 106 respondents who denied drinking alcohol during pregnancy. In the group of pregnant women who consume alcohol, a positive TWEAK test result was recorded in 74% of the respondents (Table 6).

Among women denying drinking alcohol during pregnancy, the study using the CAGE test showed that 13% of pregnant women did not report the truth. In the assessment of the T-ACE test, the percentage of untrue responses was the lowest – 11%, and using the TWEAK test 33% drank alcohol, although they denied it in the survey.

Summing up the results of alcohol dependence tests: in the CAGE, T-ACE, and TWEAK tests, a positive result was assessed in 33% of the respondents who admitted to drinking alcohol during pregnancy and in 9% of the respondents who concealed the fact that they were drinking alcohol during this period. Full data are presented in Table 7.

The assessment of the sensitivity and specificity of the examined tests showed that the CAGE and TWEAK tests are more sensitive than the T-ACE test (Table 8). Their positive result makes it possible to select pregnant women who drink alcohol from among those surveyed. This fact means that if the study is carried out in early pregnancy, drinking women can be subjected to cognitive behavioural therapy* earlier, which can protect the child from the toxic effects of alcohol on its development.

The T-ACE test is the most specific and the CAGE test the least specific and valid. Due to the highest specificity, the T-ACE test identifies non-drinking pregnant women in the highest percentage. And the T-ACE test, due to its high predictive power (positive predictive value – PPV), is the most helpful in making decisions about monitoring women who drink.

DISCUSSION

Some pregnant women, despite their knowledge that alcohol negatively affects the development of the foetus and the health of the child, drink alcohol and hide this fact. In our own study, every fourth pregnant woman drank alcohol during this period. Most often these are women whose parents abused alcohol in their family home, mainly their fathers. In the study of Khalil *et al.*, every second pregnant woman at the beginning of the first trimester of unplanned pregnancy was under the influence of alcohol, while every fifth pregnant woman consumed alcohol occasionally throughout her pregnancy [7].

Drinking alcohol during pregnancy is embarrassing for pregnant women, which is why they hide this fact [8]. In the presented study, more than one in three respondents (33%) concealed the fact that they drank during pregnancy. The Foundation to Give Birth in a Human Way published data showing that only 1/3 of pregnant women admit to drinking alcohol [9]. Screening results based on alcohol dependence tests show that not all data obtained from pregnant women during an interview are true. Therefore, the use of alcohol dependence tests that are short, understandable, and contain only a few (4-5) questions makes women more willing to give answers, and their answers are helpful in planning preventive and educational activities. The T-ACE test, due to the highest predictive value of PPV, is the best test to determine alcohol consumption and addiction by pregnant women. Studies by Sarkar *et al.* also indicate a higher PPV predictive value of the T-ACE test [10]. The use of standardized tests approved and even recommended by the WHO on the basis of this study shows that there are problems with their unambiguous interpretation, associated with their rare use. Our study, based on the use of 3 tests, showed that there is no single dominant tool to determine a pregnant woman's addiction to alcohol. Each of these questionnaires can be helpful in analysing a different drinking problem in a group of pregnant women.

In our own research, the T-ACE test obtained the highest positive predictive value, which is an indicator of the need for close supervision of women with such results. The value of this test is emphasized by Burns *et al.* They point out that the T-ACE test is promising in screening for risky drinking [11].

The TWEAK test, as a test recommended by the WHO for pregnant women who drink, did not turn out to be positive among the entire group of pregnant women who declared drinking alcohol during pregnancy. The result of the TWEAK test did not confirm drinking in 26% of women who declared drinking alcohol in the survey ($p < 0.005$). Nevertheless, when examining pregnancy addiction with the TWEAK test, researchers found it to be an effective tool for assessing

harmful drinking and alcohol dependence because it was most often positive in the alcohol drinking group. 74% of them had a positive result, compared to 33% in the group of non-drinkers and 50% in the group who did not remember whether they drank [2].

Research by Bush *et al.* claims that the TWEAK test is weak for outpatient women [12].

Based on a study of 3 benchmarks for women drinking alcohol: the TWEAK, T-ACE and CEAGE tests, it cannot be unequivocally stated that only the TWEAK test, which is recommended by the WHO, is the best test in diagnosing the alcohol problem in the group of pregnant women. Reliable results require the use of at least three research tests. In research by Sarkar *et al.* setting the TWEAK test between tests was also examined, serving to assess the alcohol problem [10].

Our own studies have shown that the CAGE test and the T-ACE test also give a positive result, indicating alcohol dependence among pregnant women. According to Bush *et al.*, the TWEAK test is a weak test in the context of alcohol screening in outpatient women [12].

Positive results of the CAGE tests were obtained in 13% of the respondents (14), the T-ACE test in 11% (12) of the respondents, and the TWEAK test in 33% (35) of the patients who denied drinking alcohol during pregnancy. Based on these facts, it can be concluded that some pregnant women conceal their drinking of alcohol during pregnancy, which is why data relating to the number of women drinking during this period are still underestimated [2].

According to López *et al.*, most of the screening tests designed to assess alcohol dependence have been developed and addressed to the male population. This is another argument for creating research tools for pregnant women, who have the least dedicated diagnostic tests [13].

Drinking alcohol by a pregnant woman has certain effects on the foetus and on the child's later development. The most serious consequences for foetuses of drinking mothers is foetal alcohol syndrome (FAS), characterized by severe changes in facial features [14-16].

Foetal alcohol effect (FAE) syndrome, as a partial FAS syndrome characterized by intellectual and mental disorders, can only be diagnosed when the child reaches school age [14].

Male foetuses of mothers who abused alcohol during pregnancy have an increased risk of cryptorchidism [17]. Identification of pregnant women, even those who are not yet addicted to alcohol but drink at risk, is very important because it allows for the implementation and coverage of the patient with appropriate intervention in advance, and not just with advice. The TWEAK test and the T-ACE test include a tolerance rating as the number of alcoholic beverages women can drink to feel 'drunk'. The TWEAK test

shows more correctly diagnosed cases of pregnant women drinking alcohol than the T-ACE test, while the T-ACE test is better at identifying patients who did not drink alcohol during pregnancy and told the truth. Also, the higher sensitivity of the TWEAK test and the higher specificity of the T-ACE test, which concern risky drinking during pregnancy, were presented by Russell *et al.* [18].

The presented study, conducted on a representative group of respondents with the use of 3 tests evaluating alcohol problems, including pregnant women, showed that we lack simple diagnostic methods in this area. Although it seems that short tests do not discourage pregnant women from participating in a study determining alcohol consumption, they often want to hide this fact. But it is the medical staff who too rarely examine pregnant women with behavioural methods and have not created important tools for assessing and interpreting the risk of the drinking of alcohol by pregnant women.

CONCLUSIONS

The CAGE, TWEAK, and T-ACE tests differ in sensitivity, specificity, validity, PPV, and negative predictive value (NPV); therefore, they should be used to diagnose different alcohol problems. The study of women's alcohol dependence due to its rare use among pregnant women should be based on several tests evaluating alcohol dependence. Implementation of alcohol abuse screening tests in the prenatal care of pregnant women will allow the identification of patients with alcohol problems who do not admit to drinking alcohol, and to implement appropriate procedures against these women.

Disclosure

The authors declare no conflict of interest.

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