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Introduction

Congenital heart defects (CHDs) are structural abnormalities of the heart and blood vessels that arise during prenatal development. e symptoms of CHDs vary depending on the type and severity of the defect but commonly include cyanosis, shortness of breath, growth and developmental delays, fatigue, and heart murmurs. Additionally, some milder defects may be asymptomatic

physician-patient relationship support improvements in quality of life.

Psychological resilience may play a pivotal role in the health of CHD patients by fostering the development of sustainable health-promoting behaviours and adherence to medical recommendations. e examination of health behaviours as a mediator between psychological resilience and CVD risk could facilitate the design of supportive systems provided by interdisciplinary therapeutic teams. However, there is a lack of studies addressing the long-term e ects of interventions promoting psychological resilience and healthy behaviours in this patient group [29].

e aim of this study was to analyse health-promoting behaviours as a mediator between psychological resilience and cardiovascular risk in young adults with CHDs.

e research question posed was: Does psychological resilience in uence health behaviours and, consequently, the cardiovascular risk factors in this population?

Materials and methods

Study design and setting

e research was of a cross-sectional and observational character and constitutes a part of a larger project focused on identifying the mediation role of health-related behaviours in the relation between the health locus of control or psychological resilience and the CVD risk factors in young adults with CHDs. e research was carried out from 2016 to 2017. is study followed guidelines for STROBE (strengthening the reporting of observational studies in epidemiology).

Participants

e research was conducted in the medical institution within the Silesian Voivodeship. Initially, the total number of 235 patients with congenital heart defects were quali ed for the study. ey were hospitalized in the Department of Congenital Defects and Paediatric Cardiology of the Silesian Centre for Heart Diseases in Zabrze or under care of the cardiological out-patient hospital clinic while the research was in progress.

Assuming that only 8% of all the patients with congenital heart defects are in the care of a specialised clinic for adults with a congenital heart defect, the size of the sample was considered adequate [30].

e inclusion criteria contained: age 18–30 (regardless of gender), a diagnosed congenital heart defect, the ability to ll in the questionnaire on their own. e exclusion criteria included: lack of consent to participate in the study, age below 18 or over 30, coexistent cognitive impairment or other mental disorders which prevented the respondents from active participation in the study. Based on the exclusion criteria, 34 patients were excluded, leaving a study sample of 201 patients.

e participation in the study was voluntary and anonymous. Before the examination each patient was informed about its aim and methods as well as the possibility of withdrawal at any stage.

Data sources/measurement

e research was conducted through the analysis of medical documentation, the method of estimating and the diagnostic survey method.

The analysis of medical documentation

e analysis of medical documentation included the overview of the patients' medical records (type of congenital heart defect, time of its diagnosis and the treatment applied).

Measurement

e estimation method was based on measuring blood pressure (BP) and selected anthropometric parameters (height, body mass, waist and hips circumference). e values which indicated elevated BP included ≥ 140 mmHg for systolic pressure and ≥ 90 mmHg for diastolic pressure. Anthropometric measurement was performed with the use of standardized medical scales with the height measure. e accuracy of the measurement was accepted at the level of 0,1 kg. e waist and hips circumference was assessed with the use of a non-stretch tailor tape as recommended by the World Health Organization (WHO) [31].

e measurements above were used to evaluate general obesity and the fattening of the abdominal cavity. While estimating the weight-height ratio in the population of females aged 18–30, the following indicators were applied: the body mass index (BMI) and the waist to hip ratio (WHR). e norm of BMI amounts to 19–25 kg/m2 [31].

Questionnaires

To assess the degree of health behaviour in CHD patients, Juczyński's Health Behaviour Inventory Questionnaire (HBI) was used. It is a self-description tool which consists of 24 statements describing health behaviours in four categories: proper eating habits, prophylactic behaviours, proper health practices and attitudes. Respondents evaluate each statement on a 5-degree scale (1-almost never, 2-rarely, 3-from time to time, 4-often, 5-almost always). en the scores are summed up to calculate the overall intensity of health-related behaviours which ranges from 24 to 120 points. e higher the score, the greater the intensity of the behaviours. Moreover, it veri es the intensity in all four categories separately. e reliability of this test for the four subscales ranges from 0.6 to 0.65, for the whole 0.85 (α-Cronbach's), while the

subcategory– 3.61 ± 0.62 and the lowest with respect to eating habits– 3.14 ± 0.83. e general count of resilience amounted to 70.25 ± 14.43.

Of all ve components of the resilience scale, the highest score was found in openness to new experience and sense of humour (15.31 ± 3.05), whereas the lowest score was reported in optimism and mobilization capability in di cult situations (12.97 ± 3.46) (Table 2).

Cardiovascular risk vs. the resilience assessment scale (SPP-25)

e next step of statistical analysis of the collected data included calculating Pearson's correlations - r. e analysis showed that out of all subscales of SPP-25 only perseverance and determination in action appeared to be statistically signi cant and related to the CVD risk factors scale (r = -0.17; $p < 0.05$). Greater perseverance and determination in action facilitated lower scores on the risk factors scale. However, it is worth noting that the correlation between these variables was weak. e other subscales of SPP-25 were not signi cantly determinant for the CVD risk factors scale (Table 3).

The evaluation of the relation between mental resilience (SPP-25), health-related behaviours (HBI) and the cardiovascular risk

e following model of mediations presupposed the prevalence of the relation between mental resilience in the respondents (scores on SPP-25) and the CVD risk factors scale with health-related behaviours (HBI scores) which functioned as a mediator (Fig. 1).

(β = -0.09; $p < 0.01$), tolerance to failure and perceiving life as a challenge (β = -0.09; $p < 0.01$), optimism and mobilization capability when faced with di culties (β = -0.08; $p < 0.05$) and overall mental resilience measurement (β = -0.11; $p < 0.001$), the lower the CVD risk. Additionally, some statistically signi cant direct correlations were revealed between the mediator– eating habits, and perseverance and determination (β = 0.34; $p < 0.001$), openness and sense of humour (β = 0.33; $p < 0.01$), tolerance to failure (β = 0.33; $p < 0.01$), optimism and mobilization (β = 0.21; $p < 0.05$) and overall resilience (β = 0.32; $p < 0.001$). Greater resilience correlated with better eating habits (details available in supplementary materials - Table S1). However, taking into account the model with the mediator and each of the independent variables mentioned above, it turned out that the role of perseverance and determination decreased but remained statistically vital (β = -0.07; $p < 0.005$), while the role of the other resil-

well as signi cant and positive in uence of overall resilience measurement ($\beta = 0.34$; $p < 0.001$). Greater mental resilience facilitated higher evaluation of prophylactic behaviours (details available in supplementary materials - Table S2). However, the model including each of the independent variables mentioned above and prophylactic behaviours as a mediator revealed that the role of each independent variable in estimating the risk factors scale proved to be statistically insigni cant with a statistically signi cant relation of the mediator with the dependant

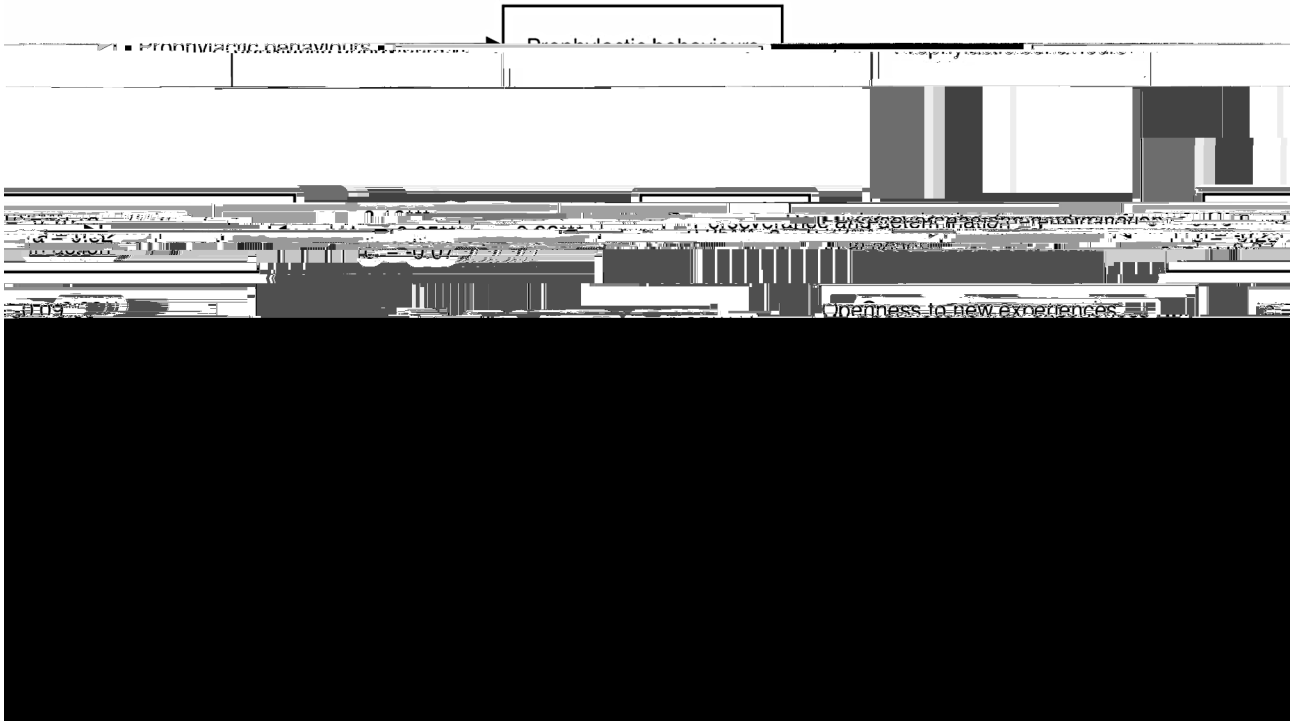

Fig. 3 The mediation model of the in□uence of the SPP-25 scale on the cardiovascular disease risk factors scale– the mediation role of prophylactic behaviours (HBI). * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

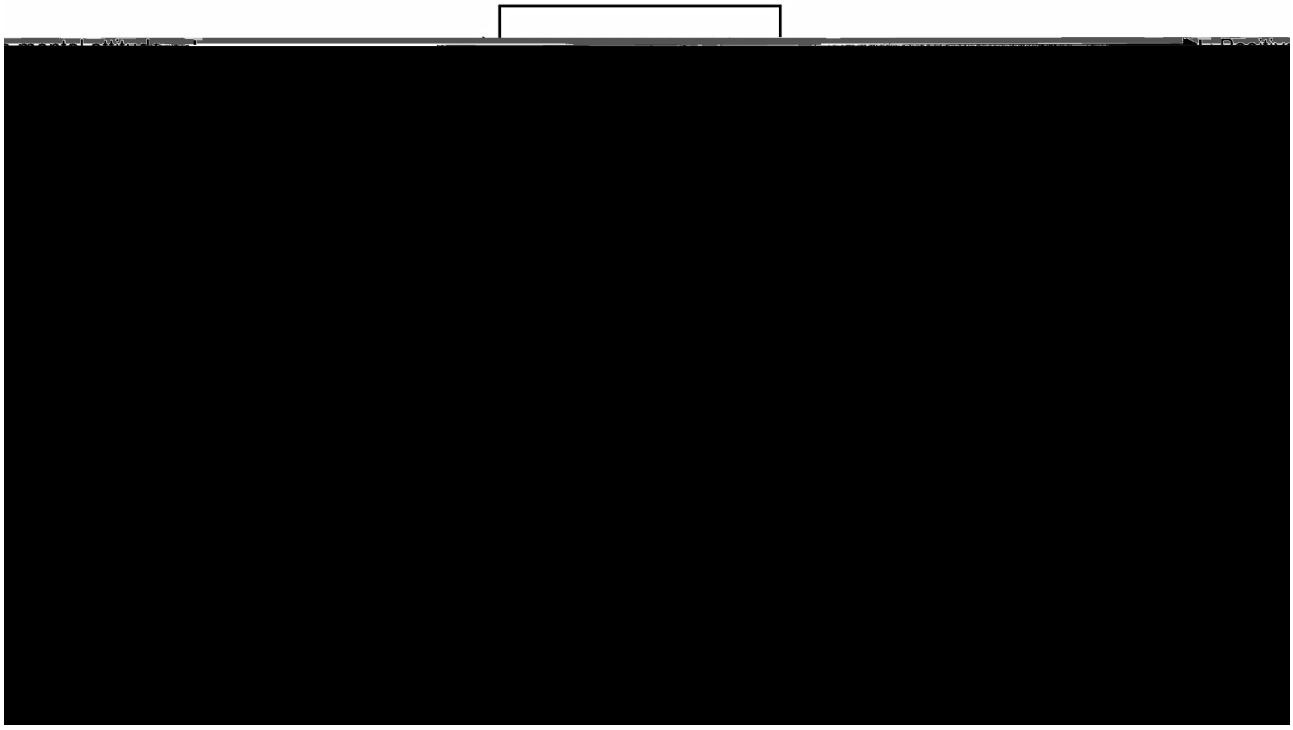

Fig. 4 The mediation model of the in□uence of the SPP-25 scale on the cardiovascular disease risk factors scale– the mediation role of positive mental attitude (HBI). * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

mentioned above, was linked to higher evaluation of their health practices (details available in supplementary materials - Table S4). After the introduction of health practices as a mediator to the relation between the SPP-25 scale scores mentioned above and the risk factors scale it turned out that the role of openness to new experience and sense of humour lost its signi cance, while the role of the other independent variables decreased but still remained statistically signi cant. e impact of health practices on the risk factors scale was statistically significant and of the same value in case of the relation with each independent variable mentioned above (and negative in each relation). In the relation between openness to new experience and sense of humour and the risk factors scale, the mediation role of health practices proved to be full, while in case of the other components– partial. e results indicating partial mediation of health practices were con rmed with the Sobel test which proved its statistical importance in terms of perseverance and determination ($Z = 2.05$; $p < 0.05$), tolerance to failure ($Z = 3.93$; $p < 0.001$), optimism ($Z = 2.53$; $p < 0.05$) as well as for overall resilience scale measurement ($Z = 3.41$; $p < 0.001$) (Fig. 5).

General indicator of the intensity of health behaviours (HBI)

e analysis of the mediation revealed that direct relationship between the general indicator of the intensity of health behaviours and individual independent variables related to mental resilience proved to be statistically signi cant and positive. Greater level of perseverance and determination in action ($\beta = 0.33$; $p < 0.001$), openness to new experience and sense of humour ($\beta = 0.37$; $p < 0.001$), tolerance to failure and perceiving life as a challenge ($\beta = 0.38$; $p < 0.001$), optimism and mobilization in difcult situations ($\beta = 0.27$; $p < 0.001$) and of overall score mental resilience ($\beta = 0.37$; $p < 0.001$) was connected with higher general indicator of the intensity of health behaviours (details available in supplementary materials - Table S5). e role of the latter as the mediator in the relation between the independent variables mentioned above and the risk factors scale was also statistically signi cant, although the impact was negative. At the same time, after the introduction of the mediator, the role of each of the independent variables diminished, however only in case of perseverance and determination in action the impact on the risk factors scale remained statistically signi cant. Hence, the mediation of the general indicator of the intensity of health behaviours in the relation between perseverance and determination in action and the risk factors scale was partial (the Sobel test proved partial mediation to be statistically vital $Z = 5.86$; $p < 0.001$), and in case of the other resilience components it was full (Fig. 6).

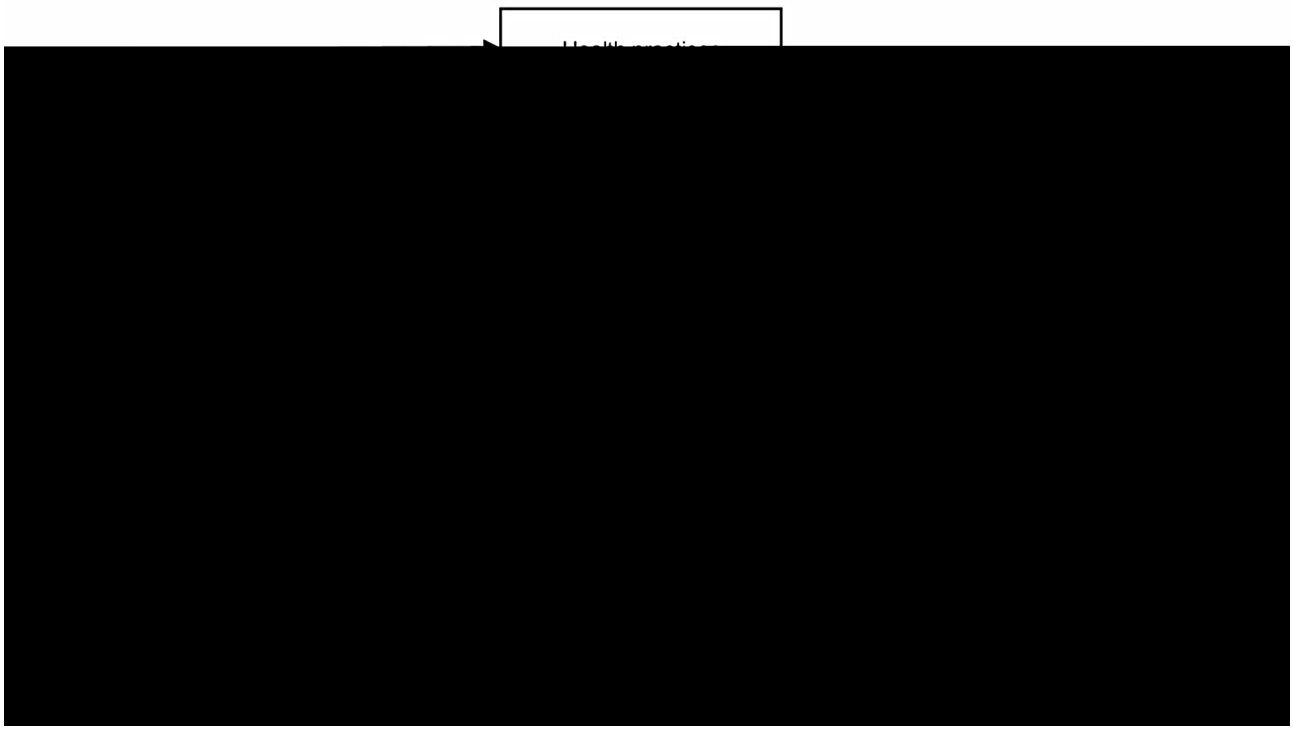

Fig. 5 The mediation model of the in uence of the SPP-25 scale on the cardiovascular disease risk factors scale– the mediation role of health practices (HBI). * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Discussion

e biopsychosocial model emphasizes the integration of biological, psychological, and social dimensions in understanding health and disease [37]. Within this framework, self-e cacy and psychological resilience are crucial psychological components that in uence individual health outcomes and the ability to cope with challenges. Patients with higher self-e cacy are more likely to adhere to treatment plans, engage in regular physical activity, and maintain dietary restrictions, which lead to improved quality of life and reduced symptoms of depression [38, 39]. Concepts of self-e cacy and resilience often interact synergistically within the biopsychosocial framework. For instance, individuals with higher self-e cacy tend to display greater resilience as they are better equipped to set realistic goals, mobilize resources, and maintain a positive attitude [40].

Main results

e research studied the correlations between mental resilience and the cardiovascular risk in patients with CHDs incorporating the role of health-promoting behaviours as a mediator. Lower risk of CVDs was associated with higher values of the overall resilience and its components such as perseverance and determination, openness and sense of humour, tolerance to failure and perceiving life as a challenge as well as optimism and mobilization capability. What is more, greater resilience determined healthier eating habits, which, in turn, decreased the risk of CVDs. Greater intensity of health behaviours and higher indices of eating habits, prophylactic behaviours and health practices fostered lower risk of CVDs.

Cardiovascular risk and its correlation with mental resilience in patients with a CHD

It is well documented that with age, individuals with CHDs are at an increased risk of developing long-term

strategies is increasingly noticed [6, 29]. e self-reported study aimed at evaluating mental resilience in patients with CHDs and the average score of the patients on the resilience scale (70.25 ± 14.43) is comparable to the values normalized for young population (below 40 years of age) which amounts to 70.24 ± 12.10, but lower than the index for the diabetics (72.75 ± 9.75) [13]. Undoubtedly, psychological resilience brings many bene ts to both mental and physical condition. Resilient individuals more rarely experience emotional disturbances such as depression or anxiety [13].

Mental resilience is closely linked to better health out

as screenings, vaccinations, and lifestyle changes. Individuals with high resilience are more e ective in managing anxiety associated with medical procedures, which enhances their engagement in preventive actions. Greater mental resilience promotes a positive perception of the

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