Streszczenie w języku angielskim

Malnutrition among the elderly constitutes a growing health challenge with significant clinical, social, and economic consequences. It contributes to a deterioration in quality of life, decreased immunity, increased susceptibility to chronic diseases, and higher mortality rates. According to projections by the World Health Organization (WHO), by 2050, the number of individuals over the age of 60 will exceed 2 billion, highlighting the urgent need to develop effective strategies for the early detection and prevention of malnutrition. Particular emphasis should be placed on the development of diagnostic tools that integrate both classical clinical indicators and modern biological biomarkers, which can complement conventional approaches and enhance the accuracy of identifying individuals at risk of malnutrition. This dissertation presents a review of the literature concerning the potential role of sirtuin 1 (SIRT-1) as a biomarker of malnutrition in older adults, as well as the results of two original studies: the first focused on the clinical and functional assessment of malnutrition risk in the elderly population, while the second extended the analysis to include the measurement of biochemical biomarkers related to metabolism, oxidative stress, and appetite regulation.

The literature review aimed to analyse and assess the relationship between SIRT-1 expression and malnutrition in older adults, considering its potential role as a biomarker of nutritional status. Current scientific evidence suggests that low SIRT-1 concentrations in the blood of elderly individuals are not solely a consequence of physiological ageing but may reflect a chronic inflammatory state associated with malnutrition. A deeper understanding of SIRT-1 function in this context could offer new directions for preventive and therapeutic approaches targeting geriatric malnutrition. Based on recent publications, the article proposes a pathophysiological mechanism by which malnutrition may impact SIRT-1 blood levels. Additionally, the regulatory mechanisms of SIRT-1 expression under oxidative stress and inflammatory conditions are discussed, with an emphasis on factors contributing to its downregulation. The concept of using SIRT-1 as a biomarker of nutritional status is further explored, taking into account its variable nuclear activity.

The aim of the first original study was to analyse the effectiveness of both single-parameter and multi-parameter approaches in identifying the risk of malnutrition among older adults. The study included 154 participants aged 60 to 85 years, recruited from social institutions such as the University of Healthy Senior Citizens, the Psychogeriatric University at the Medical University of Białystok, and the Senior Club operating under the Białystok

Family Academy. To assess malnutrition risk, the Mini Nutritional Assessment (MNA) scale was used. Body composition analysis and phase angle (PA) measurement were conducted using the bioelectrical impedance analysis (BIA) method. Handgrip strength was evaluated with a dynamometer, and mobility was assessed using the Timed Up-and-Go (TUG) test. Additionally, the study considered the presence of osteoporosis, sarcopenia, polypharmacy, the use of antidepressants from the selective serotonin reuptake inhibitor (SSRI) and monoamine oxidase inhibitor (MAOI) classes, as well as tobacco smoking. The risk of depression was assessed using the Geriatric Depression Scale (GDS), and appetite was evaluated using two questionnaires: the Simplified Nutritional Appetite Questionnaire (SNAQ) and the Council on Nutrition Appetite Questionnaire (CNAQ).

Statistical analysis for both original studies was conducted using R software, with the significance level set at $p < 0.05$. For continuous variables, the Wilcoxon test was used, while categorical variables were analysed using Pearson's chi-squared test or, in cases of small sample size, Fisher's exact test. The effectiveness and fit of the malnutrition risk assessment model were evaluated based on sensitivity, specificity, accuracy, area under the curve (AUC), odds ratios (OR), and Tjur's coefficient of determination. A generalized logistic regression model and cross-validation were also employed.

In the analysed sample, 36.8% of participants were classified as being at risk of malnutrition (MNA score 17–23.5). This study demonstrated that both phase angle (PA) and Geriatric Depression Scale (GDS) scores were independent predictors of malnutrition risk in older adults, supported by AUC values of 0.62 (95% CI: 0.54–0.72) for PA and 0.69 (95% CI: 0.60–0.78) for GDS. The developed multiparametric model, which included variables such as handgrip strength, muscle mass, presence of osteoporosis, depressive symptoms, mobility, appetite, and tobacco smoking, achieved a significantly higher AUC of 0.84 (95% CI: 0.77–0.91), confirming the superior diagnostic value of a comprehensive approach compared to individual indicators.

The second original study aimed to analyse and evaluate serum concentrations of sirtuin-1 (SIRT-1), melatonin, cholecystokinin-8 (CCK-8), and total antioxidant capacity (TAC) in individuals at risk of malnutrition compared to those not at risk. The study included 153 participants who met pre-defined inclusion criteria, of whom 58 were classified as being at risk of malnutrition. Concentrations of SIRT-1, melatonin, and CCK-8 were measured using the ELISA immunoenzymatic method, while TAC was assessed using the FRAP method (Ferric-Reducing Antioxidant Potential). Blood samples were collected in the fasting

state between 8:00 and 9:00 a.m. from the cubital vein into clot activator tubes, centrifuged, and the resulting serum was stored at −80°C until analysis.

The analysis revealed that among the parameters examined, CCK-8 demonstrated the highest diagnostic utility in assessing the risk of malnutrition. CCK-8 levels showed a positive correlation with muscle mass, visceral adipose tissue (VAT) content, Appendicular Skeletal Muscle Index (ASMI), fat-free mass, and energy expenditure. The AUC for CCK-8 was 0.64 in men and 0.58 in women. In contrast, although SIRT-1 is a well-documented regulator of energy metabolism and oxidative stress response, it exhibited lower diagnostic performance (AUC = 0.57). Melatonin demonstrated very low predictive value (AUC = 0.46 in women; AUC = 0.51 in men). TAC showed the lowest AUC values among the assessed parameters (AUC = 0.42–0.54), although it positively correlated with selected body composition measures.

The multiparametric model developed in this study—accounting for CCK-8 concentration, depressive symptoms, poor appetite, low ASMI, increased VAT, use of SSRI/MAOI antidepressants, and tobacco smoking—achieved an AUC of 0.84 (95% CI: 0.77–0.90). This result is consistent with the model developed in the first study, further confirming the effectiveness and diagnostic value of an integrated approach to identifying malnutrition risk in older adults.

In conclusion, although the literature suggests a potential role for SIRT-1 in metabolic processes and its association with malnutrition, the findings of this study did not demonstrate significant differences in SIRT-1 levels between groups, indicating a need for further research in this area. In contrast, cholecystokinin-8 (CCK-8) showed clear diagnostic potential as a biomarker of malnutrition risk—particularly in men—as confirmed by AUC values and correlations with body composition parameters. Melatonin and total antioxidant capacity (TAC) lacked significant predictive value; in the case of TAC, limitations in interpretation may be due to the presence of comorbidities. The use of a multiparametric approach incorporating clinical, functional, and biochemical indicators enabled a more accurate assessment of malnutrition risk compared to the analysis of individual variables. The most important predictors included phase angle, muscle mass, depressive symptoms, osteoporosis, smoking, and reduced appetite. These findings underscore the importance of comprehensive assessment in identifying individuals at risk of malnutrition and point to the need for further research—particularly into the role of CCK-8 and its potential application in clinical practice. These conclusions may serve as a basis for developing more individualized screening tools

and nutritional intervention strategies that integrate both classical clinical indicators and selected biomarkers with proven diagnostic value.