# Functional state of patients with parenteral nutrition in the postoperative period – nursery assessment

## Stan funkcjonalny chorych żywionych pozajelitowo w okresie okołooperacyjnym w ocenie pielęgniarskiej

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### Summary

**Introduction:** In the postoperative period, parenteral nutrition is implemented among undernourished or long-term famished people. Malnutrition is very dangerous. It leads to deterioration physical and mental state.

**Aim of the study:** Functional state assessment of patients with parenteral nutrition in the postoperative period.

**Material and methods:** The tests were carried out in the General, Gastroenterological, Colorectal, and Oncological Surgery Ward. The tested group constituted of 91 patients with parenteral nutrition. The tests were carried out using a prospective method with the usage of measurements, interview, and anthropometric tests. Assessed values were: undernourishment risk (NRS 2002 scale), development risk (Norton scale), depression and fear level (HADS scale), and functional condition of the patient according to everyday life activities (Barthel scale). Basic anthropometric measurements, such as: BMI, WHR, arm perimeter, skin fold thickness, and power of hand shake, were analysed.

**Results:** The analysis of changes in anthropometric tests between the initial and the final measurements showed significant differences for average values of arm perimeter, skin fold thickness, and BMI ($p < 0.001$). Among undernourished patients the average level of depression and fear lowered from 34.1 to 14.5, and among famished patients this difference was significantly less – from 29.8 to 15.6. These changes are significantly characteristic ($p < 0.001$). There was also a high ($p < 0.001$), positive dependence between the assessment of physical condition (Barthel scale) and bedsores occurrence risk (Norton scale).

**Conclusions:** Anthropometric test indicators (arm perimeter, skin fold thickness, and BMI) assessed after parenteral nutrition were significantly lower than the same indicators before its implementation. The depression and fear level was significantly lower after parenteral nutrition in comparison to the results obtained before its implementation. People with high BMI before treatment retained it also after the treat-

### Streszczenie

**Wstęp:** W okresie okołooperacyjnym żywienie pozajelitowe wprowadzane jest u osób niedożywionych lub też długotrwale głodzonych. Niedożywienie niesie ze sobą poważne następstwa zdrowotne, prowadzi do pogorszenia wydolności zarówno fizycznej, jak i psychicznej chorego.

**Cel pracy:** Ocena stanu funkcjonalnego chorych żywionych pozajelitowo w okresie okołooperacyjnym.

**Materiał i metody:** Badanie przeprowadzono na oddziale klinicznym chirurgii ogólnej. Grupę badaną stanowiło 91 chorych, u których wdrożono żywienie pozajelitowe. Badania przeprowadzono metodą prospektywną z wykorzystaniem technik pomiarów, wywiadu oraz badań antropometrycznych. Oceniano: ryzyko niedożywienia (skala NRS 2002), ryzyko rozwoju odleżyn (skala Norton), poziom lęku i depresji (skala HADS) oraz sprawność funkcjonalną chorego pod kątem codziennych czynności (skala Barthel). Analizowano podstawowe pomiary antropometryczne: BMI, WHR, obwodu ramienia, grubości fałdu skórnego i siły uścisku ręki.

**Wyniki:** Analiza zmian zachodzących w badaniach antropometrycznych w pomiarach początkowym i końcowym wykazała istotne różnice dla wartości średnich obwodu ramienia, grubości fałdu skórnego oraz wskaźnika masy ciała ($p < 0,001$). U osób niedożywionych poziom depresji i lęku obniżył się ze średniej 34,1 na 14,5, a w grupie osób głodzonych różnica była nieco mniejsza (z 29,8 na 15,6). Zmiany te są wysoce znamienne ($p < 0,001$). Wystąpiła też wysoka ($p < 0,001$), dodatnia zależność między oceną sprawności fizycznej chorego (Skala Barthel) a ryzykiem wystąpienia odleżyn (Skala Norton).

**Wnioski:** Wskaźniki badań antropometrycznych (obwód ramienia, grubość fałdu skórnego oraz wskaźnik masy ciała) oceniane po zakończeniu żywienia pozajelitowego są znamiennie niższe od wskaźników ocenianych przed jego rozpoczęciem. Poziom depresji i lęku uległ istotnemu obniżeniu po zakończeniu żywienia pozajelitowego w porównaniu z wynikami uzyskanymi przed jego rozpoczęciem. Osoby posiadające wysokie BMI przed

ment, and people with low BMI also retained the low level after the treatment. The lower the physical condition, the higher the bedsores occurrence risk.

**Key words:** parenteral nutrition, functional state, nursery assessment.

rozpoczęciem leczenia, zachowują wysokie BMI po jego zakończeniu, a osoby, u których BMI było niskie, po leczeniu mają nadal niskie BMI. Im mniejsza sprawność fizyczna chorych, tym większe ryzyko wystąpienia odleżyn.

**Słowa kluczowe:** stan funkcjonalny, żywienie pozajelitowe, ocena pielęgniarska.

## Introduction

Nutrition support for surgery patients became significant thanks to Studley, who in 1936 pointed out a direct connection between losing body weight and higher perioperative morbidity [1]. The implementation of parenteral nutrition significantly improved postoperative effects among highly undernourished patients [2, 3]. Parenteral nutrition before surgery is recommended among heavily undernourished patients who cannot have proper enteral nutrition. In the postoperative period, parenteral nutrition should be implemented for patients with postoperative complications that lead to digestive tract disorders, and who cannot take proper amounts of meals orally/enterally for at least seven days [4-6].

Undernourishment leads to serious health and economic aftereffects. The initial aftereffects of undernourishment are decrease of muscle and fat mass and the internal organ mass, which results in a decrease in their functionality. Nutrition state disorders lead to impairment of the immune system, which results in an increase of vulnerability to infections and may increase the healing time of postoperative wounds. Low body mass, low amounts of meals taken, and low BMI constitute factors of bedsore risk in this group of patients [7, 8]. Moreover, cognitive function disorders, including fear and depression occurrence, are highly connected with microelements, macro-elements, and protein-energetic insufficiencies [9].

Regular assessment of nutrition state enables identification of patients at risk of undernourishment or patients already undernourished. It also enables us to state the type and level of organism undernourishment and monitor the nutrition therapy [10]. The basic anthropometric tests used for identification of undernourishment connected with disease are: body mass measurement and BMI increase measurement. Interpretation of the index is shown in Table 1.

The aim of this work was the assessment of the functional state of patients with parenteral nutrition in postoperative period.

## Material and methods

The tested group consisted of 85 people hospitalised in the General, Gastroenterological, Colorectal, and Oncological Surgery Ward, with parenteral nutrition implemented. These were mainly patients surgically treated from inflammatory bowel diseases and digestive tract cancer. The average parenteral nutrition time in the perioperative period was 14 days.

The test was conducted in two patient subgroups. The first subgroup constituted patients with confirmed undernourishment, among which parenteral nutrition was implemented before surgery (G I, $n = 42$). The second group constituted famished patients who could not be nourished naturally with the usage of the digestive tract after the surgery. (G II, $n = 43$).

The tests were carried out using a prospective method with the usage of measurements, interview techniques, and anthropometric tests. For the tests, questionnaire and standardised measurement tools were used. Only once assessed was: undernourishment risk (NRS 2002 scale), bedsores development risk (Norton scale), and functional condition of the patient according to everyday life activities (Barthel scale), and then an increase measurement was taken. Anthropometric measurements were taken twice, including: body mass, abdomen and hips perimeters, arm perimeter, skin fold thickness, and hand shake power, and depression and fear level was assessed (HADS scale). Statistical analyses were made using Statistica 12.0, taking the statistical significance level as $p \leq 0.05$.

## Results

Patients famished and undernourished constituted groups in similar age. In both groups the youngest patient was 25 and the oldest 92 (group I) and 90 (group II) years old. Statistical analysis with $t$ test for independent groups revealed lack of significant difference in age in both groups ($t = 0.390$, $df = 83$, $p = 0.697$). These groups were also homogeneous in terms of variance ($F = 1.315$, $df = 83$, $p = 0.379$). There were 29% more women than men in the undernourished group. Men dominated in the famished group, but the difference

**Table 1.** BMI according to the WHO

| BMI | Classification |
|---|---|
| < 18.5 | Undernourishment |
| 18.5–24.9 | Normal |
| 25–30 | Overweight |
| > 30 | Obesity |

**Table 2.** Undernourishment risk assessment in NRS 2002 scale and reason for parenteral nutrition implementation

| Reason for parenteral nutrition implementation | NRS 2002 Points | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | |
| Undernourishment (GI) | 0 | 0 | 1 | 12 | 22 | 5 | 2 | 42 |
| % | 0.0 | 0.0 | 2.4 | 28. 6 | 52.4 | 11.9 | 4.7 | 100 |
| Famishing (GII) | 7 | 8 | 7 | 15 | 5 | 1 | 0 | 43 |
| % | 16.3 | 18.6 | 16.3 | 34.9 | 11.6 | 2.3 | 0.0 | 100 |
| Total | 7 | 8 | 8 | 27 | 27 | 6 | 2 | 85 |

*V Cramer = 0.64****

**Table 3.** Differences between initial and final anthropometric indicators measurement (*N* = 85)

| Indicators | Tests beginning | | End of tests | | Differences | |
|---|---|---|---|---|---|---|
| | M | SD | M | SD | *t* (*df* = 84) | *P* |
| Arm perimeter | 24.9 | 4.3 | 24.1 | 4.3 | 7.87 | *** |
| Skin fold | 18.2 | 9.2 | 17.5 | 9.0 | 6.69 | *** |
| WHR | 0.970 | 0.107 | 0.966 | 0.107 | 1.26 | 0.209 |
| Right hand power | 9.4 | 5.6 | 9.6 | 5.7 | –1.42 | 0.159 |
| Left hand power | 9.1 | 5.4 | 9.2 | 5.7 | –0.75 | 0.454 |
| BMI | 24.3 | 5.4 | 23.6 | 5.1 | 7.34 | *** |

*** – *p* < 0.001*

**Table 4.** Differences between initial and final measurements of anthropometric indicators in undernourished and famished group of patients

| Indicators | Nutrition implementation reason | Difference significance (dependent trials) | | |
|---|---|---|---|---|
| | | *T* | *Df* | *P* |
| Arm perimeter | Undernourished | 4.62 | 41 | *** |
| | Famished | 6.73 | 42 | *** |
| Skin fold | Undernourished | 5.15 | 41 | *** |
| | Famished | 4.52 | 42 | *** |
| WHR | Undernourished | 1.53 | 41 | 0.133 |
| | Famished | 0.20 | 42 | 0.842 |
| Right hand power | Undernourished | –0.20 | 41 | 0.840 |
| | Famished | –1.67 | 42 | 0.101 |
| Left hand power | Undernourished | –1.19 | 41 | 0.238 |
| | Famished | –0.03 | 42 | 0.972 |
| BMI | Undernourished | 4.83 | 41 | *** |
| | Famished | 5.61 | 42 | *** |

was lower; there were only 12% more men than women in that group.

Comparing dependency between reason for implementation of parenteral nutrition and the result gained from the scale of undernourishment risk assessment (Table 2), it is stated that the risk of undernourishment risk in group I is significantly higher than among patients from group II. It seems to be legitimate and confirms the accuracy of the undernourishment risk assessment scale. This dependence is high in trials (V Cramer = 0.64) and significant in populations ($\chi^2$ = 34.61, *df* = 2, *p* < 0.001).

To analyse differences in initial and final anthropometric measurements the whole group was tested first. Only average values of arm perimeter, skin fold thickness, and BMI in initial and final measurement differed significantly (Table 3). In each case, these values lowered at the end of the nutrition period. For other anthropometric indicators, differences are not statistically significant.

Difference analysis between initial and final values of anthropometric indicators was repeated, but this time separately for two groups: undernourished and famished. The results are shown in Table 4. Conclusions on differ-

**Table 5.** The array of Spearman correlation coefficients

| | Norton scale result | BMI initial result | BMI end result |
|---|---|---|---|
| Barthel scale result | 0.92*** | –0.13ni | –0.10 ni |
| Norton scale result | | –0.10 ni | –0.08 ni |
| BMI initial result | | | 0.99*** |
| BMI end result | | | |

**Table 6.** Fear and depression level at the beginning and at the end of the treatment in groups with different reasons for implementation of parenteral nutrition

| Fear and depression level | | M | SD | *N* | *Z* | *P* |
|---|---|---|---|---|---|---|
| Undernourished | Beginning of the test | 34.1 | 20.2 | | | |
| | End of the test | 14.5 | 13.7 | 42 | 4.69 | < 0.001 |
| Famished | Beginning of the test | 29.8 | 18.1 | | | |
| | End of the test | 15.6 | 15.8 | 43 | 4.47 | < 0.001 |

*Z – signs test*

**Table 7.** The level of fear and depression – initial result and the reason for parenteral nutrition

| Initial measurement | Reason for parenteral nutrition | Low | Moderate | High | Total |
|---|---|---|---|---|---|
| Depression | Undernourished | 3 | 11 | 28 | 42 |
| | Famished | 5 | 16 | 22 | 43 |
| | Total | 8 | 27 | 50 | 85 |
| Fear | Undernourished | 7 | 15 | 20 | 42 |
| | Famished | 7 | 14 | 22 | 43 |
| | Total | 14 | 29 | 42 | 85 |

ences between values of anthropometric indicators at the beginning and at the end of the tests for both famished and undernourished patients is similar to the analysis of the whole trial in total. In each case only arm perimeter, skin fold thickness, and BMI significantly changed. All other indicators, if they increased in the final measurement, were too small to be stated as significant.

To calculate the dependency between the results gained in Norton and Barthel scales the Spearman correlation coefficient was used. The highest correlations were between BMI measured at the beginning and at the end of the treatment and between results in Norton and Barthel scales. In both cases the dependence was almost complete and highly statistically significant (Table 5). This means that people with high BMI at the beginning of the treatment retain it at the end, and people with low BMI at the beginning retain with it at the end of the treatment. High, positive dependence between the assessment of the physical condition of the patient (Barthel scale) and the bedsores occurrence risk (Norton scale) confirms that the lower the physical condition, the higher the risk of bedsores.

Results concerning fear and depression level at the beginning and at the end of the treatment in groups with different reasons for implementation of parenteral nutrition are shown in Table 6. Among undernourished patients the fear and depression level lowered from average 34.1 to 14.5, and among famished ones this difference was smaller (from 29.8 to 15.6). These changes are highly significant ($p < 0.001$).

Analysing the dependency of fear and depression level initial measurement on the reason for implementing parenteral nutrition (Table 7), V Cramer coefficient values indicated insignificant dependence in trials ($V_d = 0.04$, $V_L = 0.13$, accordingly). The independence test used did not confirm significant dependence in terms of depression ($\chi^2 = 2.13$, $df = 2$, $p = 0.34$) or in terms of fear ($\chi^2 = 0.12$, $df = 2$, $p = 0.94$).

To check the dependence between the reason for implementing parenteral nutrition and the depression and fear level after the treatment, the above-presented analyses were repeated in terms of the final measurement results (Table 8). In the case of final measurement analysis of depression, the dependence was weak (V Cramer = 0.13) and insignificant ($\chi^2 = 1.46$, $df = 2$, $p = 0.48$). The identical analysis result was for the final fear measurement (V Cramer = 0.13, $\chi^2 = 1.46$, $df = 2$, $p = 0.48$). Also, in this case no significant dependence towards the reason for parenteral nutrition was stated.

**Table 8.** The level of fear and depression – final result and the reason for parenteral nutrition

| Final measurement | Reason for parenteral nutrition | Low | Moderate | High | Total |
|---|---|---|---|---|---|
| Depression | Undernourished | 12 | 23 | 7 | 42 |
| | Famished | 15 | 18 | 10 | 43 |
| | Total | 27 | 41 | 17 | 85 |
| Fear | Undernourished | 17 | 19 | 6 | 42 |
| | Famished | 22 | 14 | 7 | 43 |
| | Total | 39 | 33 | 13 | 85 |

## Results

Common occurrence of undernourishment among hospitalised patients is currently being confirmed by numerous researches. These indicators are oscillating around 30–40% [11–13]. On the basis of research carried out among patients hospitalised in university hospitals in Portugal, it was stated that 45.7% of respondents suffer from nutrition disturbances. The risk of undernourishment based on the NRS 2002 scale was diagnosed among 36.0% of patients and based on anthropometric tests among 9.7% [14]. In published research the average risk of undernourishment (3–4 pts NRS 2002) occurred among 63.5% of patients with parenteral nutrition, and high undernourishment risk (≥ 5 pts NRS 2002) occurred among 9.4%. Badia-Tahull and associates state that for assessment of the state of nutrition of patients after surgery of digestive tract at the moment of initialising parenteral nutrition they used the NRS 2002 scale and gained average risk among 44.4% of patients and high risk of undernourishment among 13.3% [15]. Other researchers observed undernourishment among 58% of patients with parenteral nutrition. Moreover, they stated that among patients there is a weak correlation between the results of nutrition state assessment and anthropometric assessment values [16].

The most commonly used parameter of assessing nutrition state is BMI, due to its simplicity. According to Szczygieł, undernourishment and complication risk due to trauma or surgery occurs when the BMI lowers to 19 kg/m$^2$ [17]. Despite the fact that there is proof indicating the correlation between undernourishment and low BMI [18, 19], not all research indicates this dependency. In research conducted by Tojek *et al*. among surgery patients, such correlation was not stated [20].

Among strongly undernourished patients suffering from Cohn's disease, who had parenteral nutrition significantly increased BMI (from 13.9 ± 0.6 to 15.3 ± 0.7, $p$ = 0.02), in comparison to patients without parenteral nutrition (from 14.1 ± 0.7 to 14.5 ± 0.5, $p$ = 0.81). Researchers concluded that perioperative parenteral nutrition increases humoral immunity, reverses undernourishment, and helps in rehabilitation of patients with Crohn's disease [21].

In our own research the significant parameters of assessing nutrition state were anthropometric test results, such as: skin fold thickness, arm perimeter, WHR, and BMI. Analysing both undernourished and famished people, it was observed that average arm perimeter, skin fold thickness, and BMI in initial and final measurements differed significantly. These values in each case lowered significantly at the end of the nutrition period. Lopes *et al.* also pointed out significant decrease of body mas, BMI, skin fold thickness, and arm perimeter in measurements before and after surgery among patients suffering from colorectal cancer [22]. Significant decrease of BMI (from 25.3 at the beginning to 23.6 on leaving the hospital) and 1.6-times increase of undernourishment, despite parenteral nutrition (28.3% to 45.0%), was observed for a tested population of patients with cancer after stem cell transplantation [23].

When interpreting results of anthropometric measurements, especially skin fold measurement and WHR indicator, we have to watch out for obese people and those with chronic diseases. Their oedemas, ascites, or higher amount of adipose tissue may falsify the results [24].

The Norton scale was used to assess the risk of bedsores. This scale assesses five indicators connected with the mobility of the patient and constrictor activity [25, 26]. Analysis of our own results showed a strict dependence between limited physical activity (Barthel scale) and risk of bedsores. Patient health state and nutrition state were also significant. Numerous research projects show that among patients whose BMI is 18.5 kg/m$^2$ and lower, the bedsores risk is higher [27].

Depression and fear are psychological factors, forming the patient's reaction on cancer diagnosis, chronic disease exacerbation, difficult and treatment, surgical trauma or need for parenteral nutrition. These factors may have a negative influence on the quality of life [28, 29]. Numerous publications point out a correlation between intensification of mental disturbances and patient's state. Spedding, in his research, showed that insufficiencies of some macro and microelements and D vitamin may lead to mental disturbances, especially depression [30]. Rao *et al.* proved a strict connection with depression have for omega-3 fatty acids, B vitamin, and magnesium insufficiencies [31]. In our own

research, at the moment of implementing parenteral nutrition high levels of fear and depression concerned both undernourished and famished patients. At the end of nutrition therapy fear and depression levels were significantly lowered in both groups. This has been confirmed in the available literature on this topic, especially in relation to chronic disease. Osmańska *et al*. found significantly higher levels of fear and depression among patients with testicular cancer [32]. Bączyk *et al*. [33], in the case of patients with cancer, observed a tendency for so-called "emotional awareness". According to Joseph *et al.* a high percentage of depression is characteristic for patients with type 2 diabetes [34]. Meder [35] and Guthrie [36] observed an increase in depression and fear levels during the course of disease among patients with inflammatory bowel diseases. The dependency between functional state and the increase of emotional states such as fear and depression indicates the need to involve psychologists and psychiatrists into the treatment process. According to Janke *et al*. [37], psychiatrists should normally work with patients, because leaving them on their own with their disease does not give satisfactory therapeutic results. For the whole therapeutic process, cooperation of medical personnel with the patient's family and support groups seems to be significant [38]. Stępień points out the need for mastering the psycho-social care skills of medical Staff, mainly in the field of communication, treating the patient as a subject, and emotional support [39].

## Conclusions

Anthropometric test indicators (arm perimeter, skin fold thickness, and BMI) assessed after parenteral nutrition were significantly lower that before its implementation. Fear and depression levels lowered significantly after parenteral nutrition in comparison to the results obtained before its implementation. People with high BMI before treatment retained it after treatment, and those in whom BMI was low retained a low level after the treatment. The lower the physical condition, the higher the risk of occurrence of bedsores.

*Authors declare no conflict of interest.*

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