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Assessing effects of diet alteration on selected parameters of chronically mentally ill residents of a 24-hour Nursing Home. Part 3: Effects of diet modification on selected health indicators

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Summary

Aim. The aim of the research was to check whether, and to what extent, dietary changes affect the selected indicators of health, including well-being.

Material and methods. The study, lasting 3 years, included 52 chronically mentally ill people. Hand grip strength (HGS) measurements "before" and "after" feeding adjustments were performed using a SaehanTM pear dynamometer, blood pressure measurements were made using an Omron blood pressure monitor. Well-being was assessed using the UMACL *Adjective Mood Scale*. Based on the analysis of medical records, the study also included: the number of infections of the upper respiratory tract, the number of autoaggressive/aggressive behaviors and the frequency of stay of extremely offensive/agitated residents in the hospital.

Results. The dietary changes were reflected in the increased value of the hand grip strength (especially in women), lowered or normalized blood pressure to normal or recommended values, lowered tension arousal, accompanied by an increase in energetic arousal and hedonic tone (translating into improved well-being and mood), and a decrease in the number of episodes of aggression/self-aggression and associated hospitalizations.

Conclusions. The dietary changes resulted in an improvement in the tested parameters as well as in reduction in the amount of food wasted by the residents. There was also a decrease in the number of catarrh of the upper respiratory tract, which reduced the overall number and quantity of prescribed drugs.

Key words: chronically mentally ill, nutrition, health indicators

Introduction

Changing the nutrition pattern may, and should, be one of the approaches influencing the well-being of chronically ill people, including those with mental disorders, particularly that causal relationships between diet composition, the health status and well-being have already been demonstrated. Such relationships have been described both by other [e.g., 1, 2] and the present authors, the latter having published their results in *Psychiatria Polska* [3, 4]

For the patients with mental disorders, it is important that their diet be balanced, not only in its energy content and nutritive value, but also in terms of its health-promoting features which underpin the correct nourishment status, assist pharmacotherapy, and enhance the health status and mood. This part of the study was aimed at assessing effects of the accepted diet modification and nutritional supervision on selected indicators of the health status of psychiatric patients residing in a 24-h Nursing Home for the chronically mentally ill.

Material and methods

52 people participated in the research conducted over 3 years. Ultimately, the group consisted of 18 women aged 45–80 (64 ± 10.2), and 34 men aged 27–80 (59.2 ± 12.5), residents of a 24-h Nursing Home for chronic psychiatric patients, for at least 4 years. The consent to conduct the research was obtained from Regional Chambers of Physicians' Bioethical Commission in Szczecin (No. 14/KB/V/2013). Details of the study, data collection, nutrition education, diet modification and supervision were described in Part 1 of the study [3]. The limitation of the study was the size of the groups, which resulted from the current number of residents of the Nursing Home, and no possibility of creating a control group.

The Hand Grip Strength (HGS), as a non-invasive, easily measurable and repeatable [5] biomarker of health status, was measured before and after diet modification. The measurements were taken as recommended (a patient seated on a chair, with arms arranged along the torso, elbows bent at 90°, the wrist drawn between 0 and 30°, the feet flat on the floor [6]), for 6 seconds, in 3 replications, with a Saehan™ pneumatic squeeze hand dynamometer of 0–70 kg reading capacity. Classification by gender and age classes followed Schüssel et al. [7]. The value of 85% of the recommended mean grip strength for individuals of a given gender and age was adopted as a cut-off point for identifying individuals at risk of undernourishment. The same measurement pattern was followed for arterial blood pressure readings taken according to the modified Korotkow method, using an Omron arm pressure meter (values classified according to Mancia et al. [8]). Medical records pertaining to the period "before" and "after" the diet modification were analyzed in terms of the incidence of upper respiratory tract infections, self-aggressive/aggressive behaviors and the frequency of hospitalization of exceptionally aggressive patients.

The well-being was assessed, with the UMACL *Adjective Mood Rating Scale* [9], in each patient individually, on three occasions (December 2013, December 2014 and September 2015) at the same time of the day, in the same room, and even at the same place in the room. The well-being was assessed using a standardized questionnaire of the *Adjective mood rating scale* that features 29 adjectives with which the patients describe their respective mood. Three correlated bipolar mood metrics: hedonic tone (HT), tense arousal (TA), and energetic arousal (EA) constitute a trivariate model. The tense arousal can be (as cited in [10]) described as generating anxiety, the energetic arousal can be equaled with energy to act, and the hedonic tone can signify a subjective perception of pleasure-displeasure.

The data were interpreted in consultation with a professional clinical psychologist working with the mentally disturbed. The scores were totaled to obtain raw values which were subsequently converted and referred to age and gender standards, at three levels: low (1–4), average (5–6) and high (7–10). For the sake of objectivity, the raw and converted values were treated statistically.

The data, checked for normality of distribution (Shapiro-Wilk test) and homogeneity of variance (Leven's test) were log-transformed. The statistical treatment consisted of the analysis of variance (ANOVA) with repeated measures and Tukey's test (for different group sizes), at the significance levels of $p \leq 0.05$ and $p \leq 0.01$. The analyses were run using the Statistica® 12.0 software, Statsoft.

Results

When assessing effects of diet correction on nutrition of the nursing home residents, food uptake (including snacking and uneaten remains) of selected product groups was analyzed "before", a year after ("after I") and two years after ("after II") the diet correction. A statistically significant increase, frequently to the recommended levels, of consumption of vegetables, fruits, fresh cheeses and fish (Tables 1, 2) was recorded. A significant increase was observed also in the uptake of product groups consumed at too low amounts, i.e., flour and pasta, pulses and nuts, fruits and milk-based fermented beverages; on the other hand, a decrease was observed in the consumption of white wheat bread and cold meats, including a decrease to the level of recommended values, as well as hard cheeses, sugar and sweets.

Table 1. **Consumption of selected groups of products by the surveyed women from the period "before" and "after" the nutritional correction, n = 540 (for each period), $\bar{\chi} \pm SD$**

Components	"before"	"after I"	"after II"	Significance of differences
	a	b	c	
Wheat and rye bread (g)	366.3 ± 68.5	290.7 ± 38.2	261.6 ± 36.5	a – b**, a – c**, b – c**
Flour, pasta (g)	17.0 ± 0.1	21.8 ± 0.8	31.1 ± 0.8	a – b**, a – c**
Groats, rice, breakfast cereals (g)	28.2 ± 0.4	34.6 ± 4.5	36.2 ± 14.0	a – b**, a – c**

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Potatoes (g)	231.7 ± 1.8	344.0 ± 2.8	249.9 ± 71.3	a – b**, b – c**
Vegetables (g)	246.0 ± 9.2	657.3 ± 47.0	562.2 ± 47.5	a – b**, a – c**, b – c**
Pulses and nuts (g)	9.9 ± 12.8	9.9 ± 1.8	10.4 ± 1.4	a – b*, a – c**
Fruits (g)	209.6 ± 57.8	538.4 ± 78.2	493.1 ± 85.6	a – b**, a – c**
Milk-based fermented beverages (g)	59.7 ± 53.4	106.2 ± 98.2	138.7 ± 96.0	a – b**, a – c*, b – c**
Fresh cheeses (g)	22.3 ± 0.9	30.5 ± 5.3	60.9 ± 23.3	a – b**,a – c**, b – c**
Rennet cheeses (g)	18.4 ± 4.1	6.7 ± 3.0	6.8 ± 3.0	a – b**, a – c**
Meat, poultry (g)	75.9 ± 3.9	85.4 ± 15.6	74.3 ± 0.4	a – b**, b – c**
Cold meats (g)	72.7 ± 21.0	35.3 ± 16.0	47.6 ± 21.7	a – b**, a – c**, b – c**
Fish (g)	27.2 ± 7.8	26.9 ± 2.2	30.1 ± 3.3	a – c**, b – c**
Eggs (g)	15.0 ± 0.1	15.4 ± 3.2	19.2 ± 2.7	a – c**, b – c**
Animal fats (g)	3.4 ± 3.3	3.2 ± 4.3	2.8 ± 5.1	a – c**, b – c**
Vegetable fats(g)	2.3 ± 0.1	2.4 ± 0.3	2.5 ± 0.2	–
Mixed fats (g)	41.7 ± 5.0	39.4 ± 0.1	33.8 ± 3.2	a – b*, a – c**, b – c**
Sugar and sweets (g)	132.9 ± 54.6	69.4 ± 30.3	49.4 ± 34.5	a – b**, a – c**, b – c*

**, * – statistically significant difference $p \leq 0.01$, $p \leq 0.05$

Table 2. **Consumption of selected groups of products by the surveyed men from the period "before" and "after" nutrition adjustment, n = 1020 for each period, $\bar{\chi} \pm SD$**

Components	"before"	"after I"	"after II"	Significance of differences
	a	b	c	
Wheat and rye bread (g)	334.4 ± 64.3	282.4 ± 41.7	259.1 ± 36.3	a – b**, a – c**, b – c**
Flour, pasta (g)	17.0 ± 0.3	22.2 ± 2.9	31.2 ± 1.3	a – b**, a – c**
Groats, rice, breakfast cereals (g)	28.4 ± 1.4	35.9 ± 9.0	34.6 ± 8.8	a – b**, a – c**
Potatoes (g)	255.0 ± 72.2	357.8 ± 58.1	248.2 ± 54.9	a – b**, b – c**
Vegetables (g)	257.8 ± 54.9	667.2 ± 111.0	592.4 ± 114.6	a – b**, a – c**, b – c**
Pulses and nuts (g)	4.7 ± 2.0	9.1 ± 1.3	9.9 ± 1.1	a – b**, a – c**
Fruits (g)	219.4 ± 117.0	546.9 ± 153.1	485.6 ± 214.4	a – b**, a – c**, b – c*
Milk-based fermented beverages (g)	73.6 ± 80.3	73.1 ± 85.4	118.6 ± 142.0	a – c**, b – c**
Fresh cheeses (g)	22.8 ± 3.3	30.7 ± 5.1	56.7 ± 10.5	a – b**, a – c**, b – c**
Rennet cheeses (g)	16.8 ± 4.5	6.4 ± 1.8	6.3 ± 0.9	a – b**, a – c**
Meat, poultry (g)	76.5 ± 5.8	88.1 ± 22.0	78.8 ± 18.8	a – b**, b – c**
Cold meats (g)	84.0 ± 39.2	42.8 ± 39.9	48.9 ± 38.6	a – b**, a – c**, b – c*

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Fish (g)	31.9 ± 23.2	35.4 ± 43.3	40.5 ± 23.4	a – c**, b – c**
Eggs (g)	16.3 ± 6.0	17.6 ± 9.8	19.9 ± 8.5	a – c**, b – c*
Animal fats (g)	5.1 ± 8.0	3.1 ± 5.1	1.9 ± 5.1	a – c**, b – c**
Vegetable fats (g)	3.3 ± 0.7	3.3 ± 0.4	3.2 ± 0.3	–
Mixed fats (g)	40.7 ± 1.9	39.7 ± 1.7	33.5 ± 1.9	a – b**, a – c**, b – c**
Sugar and sweets (g)	142.1 ± 55.5	66.1 ± 43.9	37.1 ± 28.7	a – b**, a – c**, b – c**

**, * – statistically significant difference $p \leq 0.01$, $p \leq 0.05$

Analysis of the mean hand grip strength (HDS) (calculated for a given gender and age range) measured in the studied women "before" diet correction showed that only one of them (5.5%) had HDS within the reference values for the right hand and one (5.5%) for the left hand, and these were not the same individuals. HGS below 85% of the reference value for the right and the left hand were found in 78% and 83% of the studied women, respectively. The "after I" HGS of the right hand increased in about 80% of women, the increase in the left hand being recorded in 67%, an increase to the reference values for both the right and the left hand being observed in 16.5%; the increase was significant (Table 3). Despite the increase, HGS below 85% of the reference value was still present, in the right and the left hand, in 67% of the women.

The analysis of HGS measured in the studied men "before" diet correction showed the reference values for the right and the left hand in as few as 24% and 12%, respectively. The HGS below 85% of the reference value for the right and the left hand were found in 65% and 79% of the men. The "after I" HGS values for the right and the left hand increased in 65% and 75% of the male patients, the increase being significant (Table 3). The HGS values lower than 85% of the reference level were still observed in 58% of men with respect to the right hand. As few as 29% of male patients showed the below-standard values in the left hand.

Table 3. **The hand grip strength values in the classification for sex and age ranges in women (n = 18) and men (n = 34), $\bar{\chi} \pm SD$**

Gender	Right hand		Significance of differences	Left hand		Significance of differences
	"before"	"after"		"before"	"after"	
Women (n = 18)	12.3 ± 3.72	15.3 ± 4.15	*	11.1 ± 3.3	14.0 ± 5.16	*
Men (n = 34)	25.6 ± 10.65	26.1 ± 8.09	-	22.0 ± 8.5	23.9 ± 6.93	*

* statistically significant difference $p \leq 0.05$

As the hand grip strength decreases significantly after the age of 40 and 50, Table 3a shows its mean value for men and women over the age of 60 and older, respectively. The obtained results showed an increase in hand grip strength in both sexes, also in these age groups.

Table 3a. **The values of the hand grip strength in the classification for sex and age ranges in women (n = 9) and men (n = 16) over 60 years of age, $\bar{\chi} \pm SD$**

Gender	Right hand		Significance of differences	Left hand		Significance of differences
	"before"	"after"		"before"	"after"	
Women (n = 9)	14.0 ± 3.42	16.6 ± 4.62	-	12.4 ± 3.43	14.3 ± 6.47	-
Men (n = 16)	24.9 ± 9.89	25.8 ± 9.81	-	21.8 ± 8.70	23.5 ± 8.03	-

A comparison of various types of upper respiratory tract infections, burdensome for the examined subjects, reported during the period of study showed their incidence to have decreased in the women from 15 cases in "before" to 7 "after I" (a 53% decrease) and to 9 "after II". The male patients showed a decrease from 16 to 14 (12.5% decrease) and 13 cases (an about 20% reduction) (Table 4).

Table 4. **The number of upper respiratory tract infections in women (n = 18) and men (n = 34), residents of the NH**

	Gender	"before"	"after I"	"after II"
Number of cases of "colds"	Women	15	7	9
	Men	16	14	13

Before the diet correction was implemented, about 20% of the female patients showed hypertension. After a year, the hypertension rate dropped to 11%. Generally, the systolic blood pressure was observed to decrease in more than 94% of women (statistically significant difference; $p \leq 0.01$), the diastolic pressure being reduced in more than 60% of the female patients (Table 5). The percentage of hypertension-affected males dropped from 9% before the diet correction to 6% thereafter. A decrease in the systolic and diastolic pressure was observed in 53% and 60% of the men, but none of those changes was significant.

Table 5. **Blood pressure values in women (n = 18) and men (n = 34), residents of NH, $\bar{\chi} \pm SD$, min–max**

Gender	Systolic pressure		Significance of differences	Diastolic pressure		Significance of differences
	"before"	"after I"		"before"	"after I"	
Women (n = 18)	130.7 ± 18.4 102–176	114.9 ± 15.4 91–149	**	81.9 ± 10.2 64–99	78.1 ± 14.8 52–109	–
Men (n = 34)	135.2 ± 18.1 110–170	127.9 ± 18.7 90–169	–	79.3 ± 7.1 65–95	77.2 ± 9.3 61–99	–

** – statistically significant difference $p \leq 0.01$

The well-being assessment based on raw scores of the Adjective Mood Rating Scale showed "positive changes" in the examined indicators (Tables 6 and 7). The hedonic tone (HT) was observed to have increased during both the second and the third measurement in 64% of the female patients. In males, the HT value relative to

the "before" assessment was observed to increase in nearly 50% ("after I") and more than 65% ("after II") of the male patients; the differences with respect to the "before" values were significant ($p \leq 0.05$).

The tense arousal (TA) was significantly reduced in both groups. In the women, the "after I" and "after II" TA reduction was observed in 50% and 79% of the patients, the difference with respect to the "before" level being significant ($p \leq 0.05$). In males, the "after I" TA, despite a higher mean, was reduced in almost 44% of the patients, and the "after II" TA was reduced in almost 60% of the men, the reduction relative to the "after I" level being significant ($p \leq 0.01$).

The effects described above were accompanied by an increase in the Energetic Arousal (EA); in both the female and male patients, the increase in "after II" values relative to the "before" ones was significant. The EA increased "after I" in 50% of the female and 60% of the male patients, the respective increases "after II" being observed in 86% and 72%.

Table 6. **Raw results of the adjectival mood scale of women (n = 14), $\bar{\chi} \pm$ SD**

Scale	Women			Significance of differences
	"before"	"after I"	"after II"	
	a	b	c	
Hedonic Tone	27.4 ± 6.6	28.8 ± 4.5	30.6 ± 5.3	–
Tense Arousal	19.9 ± 4.8	17.9 ± 4.9	16.3 ± 4.7	a – c*
Energetic Arousal	24.2 ± 6.3	26.0 ± 2.4	29.8 ± 2.7	a – c**

**, * – statistically significant difference $p \leq 0.01$, $p \leq 0.05$

Table 7. **Raw scores of the adjectival mood scale of men (n = 32), $\bar{\chi} \pm$ SD**

Scale	Men			Significance of differences
	"before"	"after I"	"after II"	
	a	b	c	
Hedonic Tone	28.4 ± 5.9	28.4 ± 4.9	30.8 ± 4.9	a – c*, b – c*
Tense Arousal	17.7 ± 4.9	18.2 ± 3.5	15.7 ± 3.1	b – c**
Energetic Arousal	27.9 ± 5.6	28.1 ± 4.5	29.9 ± 4.9	a – c*

**, * – statistically significant difference $p \leq 0.01$, $p \leq 0.05$

To assess the patients' mood, the raw UMACL scores were converted, in accordance with standards for age and gender groups, to sten scores (Tables 8 and 9). The analysis showed the hedonic tone to have increased, both in the women and in the men, almost up to the upper limit of the moderate state (sten scores of 5–6), the increase being significant ($p \leq 0.05$) in the male patients. Eventually, the HT increase was recorded in 57% of all the examined patients. The tense arousal values decreased

in the women down to the low level (sten score of 4 on the 1–4 scale), the decrease in the males being down to the average level (sten score of 4.8 on the 5–6 scale), the differences being non-significant in both groups. A TA decrease "after I" was found in 50% of the women and 31% and of the men, the respective reductions "after II" being recorded in 57% and 50%. The two advantageous effects were accompanied, regardless of the gender, by a significant increase in the energetic arousal, finally by nearly 2 sten scores in the female and 1 sten score in the male patients, i.e., from the low to the average level. The increase "after I" was recorded in 50% of the examined women and men; the "after II" increase concerned almost 65% of the female patients and 60% of the male patients.

Table 8. **The adjective mood rating scale of the female patients (n = 14) with a reference to values in relation to the sten norms, $\bar{\chi} \pm SD$**

Scale	Women			Significance of differences
	"before"	"after I"	"after II"	
Hedonic Tone	5.0 ± 2.2	5.2 ± 1.3	5.9 ± 1.8	–
Tense Arousal	5.3 ± 1.8	4.5 ± 1.9	4.0 ± 1.8	–
Energetic Arousal	3.4 ± 2.3	3.6 ± 0.93	5.1 ± 1.1	a – c**

** statistically significant difference $p \leq 0.01$

Table 9. **The adjective mood rating scale of the male patients (n = 32) with a reference to values in relation to the sten norms, $\bar{\chi} \pm SD$**

Scale	Men			Significance of differences
	"before"	"after I"	"after II"	
Hedonic Tone	4.9 ± 2.1	4.7 ± 1.6	5.7 ± 1.7	a – c*, b – c*
Tense Arousal	5.5 ± 1.9	5.8 ± 1.5	4.8 ± 1.4	–
Energetic Arousal	4.3 ± 2.5	4.3 ± 1.8	5.2 ± 2.1	a – c*

* statistically significant difference $p \leq 0.05$

Analysis of the patients' medical records with respect to the frequency of destructive behaviors (aggression and/or self-aggression) and hospitalizations in three years (2013, 2014 and 2015) showed a distinct decrease in the incidence of such episodes (Table 10). The incidence of violent behaviors in the women changed from 5 in 2013 to 3 in 2014 and 3 in 2015; the number of episodes ending up in hospitalization decreased from 4 in 2013 to 1 in 2014 and none in 2015. The incidence of violent behaviors in the men decreased from 20 in 2013 to 16 in 2014 and 10 in 2015; the respective incidences of episodes ending up in hospital were 15, 12, and 9.

Table 10. **Number of cases of acts of aggression and/or self-aggression among NH residents (** including those resulting in a hospital stay)**

	Gender	"before"	"after I"	"after II"
Number of episodes of aggression and/or self-aggression	Women (n = 18)	5 (4)**	3 (1)**	3 (0)**
	Men (n = 34)	20 (15)**	16 (12)**	10 (9)**

Discussion

When assessing the impact of diet correction and nutritional supervision on the nutrition of the Nursing Home residents, a number of positive changes was found. The changes involved an increased uptake, frequently up to the recommended levels, of products constituting sources of vitamins, minerals, dietary fibre, and biologically active compounds as well as the recommended amounts and types of proteins, carbohydrates and lipids [3]. Such results were achieved by, *inter alia*, respecting dietary preferences of the patients; preparing their favorite but less recommended dishes (here: potato pancakes) during therapeutic activities; elimination of dishes that were not accepted (frequently for irrational reasons); and the continuous education in nutrition. The outcome was a reduction of uneaten food; the patients stopped throwing uneaten food under the table and did not show other behaviors aimed at hiding an uneaten meal. The patients' nourishment status improved, as shown by an increase in the absolute fatless body weight and body water content as well as a slight increase in the fat tissue content in undernourished/low-weight individuals, and a reduction of the fat tissue content in obese patients [4].

The Hand Grip Strength (HGS), measured in this study, is currently identified as an indispensable health status biomarker, including especially the elderly [11]. It is used to determine the functioning of the muscle-skeletal system and to assess the degree of weakness and disability. The HGS was shown to be correlated with a potential disability in the upper limbs [12] and to be useful in identification of the strength and functioning of the lower limbs [13]. A low HGS was demonstrated to be associated with an increased mortality risk in patients with cardiac and arterial dysfunction [14] and with depression [15], both conditions being diagnosed in the patients examined in this study.

Relative to the reference level, the "before" HGS average values were hardly optimistic. However, a comparison with the most recent study involving 405 individuals aged 65, with a mean HGS of 14.47 and 25.66 kg for women and men, respectively, shows the recorded values that may be regarded as "typical" of the elderly in Poland [16]. This conclusion is related to the fact that a range of values which could be regarded as age-, gender-, and BMI-appropriate for the Polish population is still a matter of debate; the relevant Polish literature concerning the elderly contains reviews only [6, 17].

On the other hand, the increase in the "after" HGS values could be cautiously assumed as resulting, in part, from the improved nutrition regime. Results of studies on

relationships between the nourishment status and HGS are not consistent, however, Sapilak et al. [18] confirmed that older patients with BMI in the upper range of the reference showed higher grip strengths, while Norman et al. [19] reported HGS values to correlate with the nourishment status of the elderly. On the other hand, Kallman et al. [20] reported a relationship between obesity and a faster (with respect to correct body weight) reduction of muscle strength.

In the present study, a causal relationship between nutrition patterns, nourishment status and HGS is indicated by the percentage of the patients who did show a positive change, particularly in the women. They were more diligent in observing dietary recommendations and showed a change in the "after" BMI, an indicator of the nourishment status: an increase in the undernourished and a reduction in the overweight or obese, the changes proving significant [4]. Although the changes in the body composition and weight were not large enough to enter the reference range, a positive trend was evident. A similar tendency was observed in the HGS, with a mean increase by 3 and 2.9 kg for the right and the left hand, respectively, including an increase to the reference range of both hands in 16.5% of the women and the maintenance of the level of the right-left hand HGS difference (1.2 kg and 1.3 kg "before" and "after", respectively). Positive changes in the male patients were smaller, with a mean of 0.5 and 1.9 kg for the right and the left hand, respectively (a significant increase of the "after" values). When analyzing the small mean increase in the male HGS, it should be noted that, in the context of males' nutrition patterns, the magnitude of consumption of various products groups relative to the unit of body weight was in many cases lower than that in the women, particularly "after I". Nevertheless, the beneficial effect of the improved nutrition regime was seen, also in the male patients, as a reduction in the difference between the right and the left hand HGS, from 3.6 kg "before" to 2.2 kg "after."

The improvement in the patients' nourishment status, observed earlier [4], and in the HGS values was paralleled with a reduction in the incidence of the upper respiratory tract infections. The enhanced immunity must have been due to improved nutrition, involving a significant increase in the uptake of: vitamins, particularly D_3 [21], C and beta-carotene, all present in vegetables and fruits; n-3 fatty acids [22]; fermented foods (natural probiotic yoghurts, natural fermented dairy drinks, and fermented vegetables) containing specific bacterial strains, including the milk fermentation bacteria [23]; and prebiotic foods containing short-chain oligosaccharides, particularly fructooligosaccharides (groats and wheat flakes, oat flakes, onion, leeks, bananas) [24]. As already demonstrated, duodenal microorganisms communicate using the quorum sensing signaling system, a system enabling population size estimation and operation synchronization. This enables, *inter alia*, prevention of inflammations via the immune system cells [25]; maintenance of the epithelial continuity to prevent pathogens from getting outside of the intestinal lumen [26]; maintenance of an appropriate $T_{H17:}$ T lymphocyte ratio, which restricts the antibacterial immunological response [25]; the pathogen cell apoptosis is made possible this way as well [27]. The lower incidence

of colds resulted in a reduction of the so-called immediate assistance drugs, which enhanced patients' well-being.

Another positive effect observed in the patients after the diet correction was an improved arterial blood pressure, particularly in the women whose systolic pressure reduction was significant. Of the four (22%) women showing hypertension "before", the condition remained in two (11%) after the diet correction, but their blood pressure dropped from the arterial hypertension level 2 to level 1; the remaining women showed a reduction from the normal high to normal or optimum levels. On the other hand, of the three men with arterial hypertension one showed a full pressure normalization, no positive change being observed in the remaining two. However, like in the women, half of the examined men showed a reduction from the normal high to the normal level. The improved blood pressure resulted in a reduction in the medication dose (Tisercin, Conor 5, Avedol).

Dietary effects on hypertension prevention or pressure leveling have been amply described by numerous authors [28]; the reported data served as a basis for, *inter alia*, the diet correction, including: increasing the consumption of potassium (a significant increase in the consumption of potatoes, vegetables and fruit), calcium and vitamin D_3 increasing its absorption (dairy products, legumes, cabbage, fish oil), and magnesium (groats, including buckwheat, rice, legumes, flakes, including oatmeal). The blood pressure lowering effect of peptide inhibitors of the enzyme converting angiotensin I to strongly vasoconstrictor angiotensin II was also used [29], as well as peptides derived from the digestion of food proteins, the rich source of which, after adjusting the diet, were primarily milk proteins, but also wheat, corn, rice, buckwheat and beans.

However, in the case of chronically mentally ill patients, the influence of the above-mentioned mechanisms may not be so clear-cut. This is related to numerous hypertension risks they are exposed to, including visceral obesity, dyslipidemia and insulin resistance [30], as well as stimulation of some of those factors by the applied medication [31]. The illness itself may exert its own specific influence [32, 33] as can the personality type [34] and anxiety disorders, regarded as belonging to strong predictors of circulation system dysfunction, including arterial hypertension [35]. Therefore, according to the authors, the observed effects were a net result of: a change in the nutrition pattern; respondents' awareness of the possibility of influencing their nutrition (from shaping the menus to products shopped for and snacking habits); and enhanced mood, including the reduced anxiety-generating tense arousal [10].

Effects of food and eating on human well-being have been known for a long time; they can be approached by emotions and mood. The first approach has a neuroanatomical underpinning and is associated with the reward-punishment system in which positive emotions are generated by fulfilling the need to eat, including foods of favorite and self-selected composition and taste. The other is associated with a nutrition pattern and nourishment status. This study utilized both aspects of inducing well-being improvement.

The first approach involved, prior to the commencement of the study, a questionnaire aimed at determining preferences with respect to foods and dishes; this information was used in developing the diet correction and new menus. The questionnaire was filled individually with each nursing home resident, which in itself had a very positive influence on the patients, particularly those legally incapacitated. Subsequently, the results were discussed with the group to arrive at a certain compromise between preferences of women and men. Positive emotions were elicited also by: a mid-morning meal for all, not only for diabetic patients; a mid-afternoon snack; carbohydrate-rich warm suppers, with a possibility of selecting a dish (e.g., pasta with cheese, with sugar and cream or with spices and stewed onion, or without any extras). This resulted, as already mentioned, in reduction of food wastes on the one hand and in stable blood glucose concentration [3] on the other, the latter aided by the 5 meals and by an increased consumption of unprocessed and non-purified complex carbohydrates (wholemeal bread, coarse groats, brown rice, pulses); a blood glucose drop may bring about nervousness, concentration disorders as well as anxiety, excitation, and aggression.

The other approach involved developing appropriate menus and influencing the patients' shopping choices to ensure optimal consumption of components affecting human mood. Vitamin B_1, B_2, B_6, B_{12} and folic acid deficiencies have been demonstrated to be conducive to depression and to disturb biosynthesis of serotonin and dopamine, neurotransmitters of a key importance for mood enhancement [36, 37]. A similarly favorable effect is produced by dietary n-3 fatty acids, regarded as specific mood stabilizers [38] as well as by vitamin D_3 [39]. A constant increase has been seen in the number of reports on intestinal microbiota effects on the well-being and emotional status, and the possibility of developing depression [40] or developing schizophrenia and Alzheimer's disease [41]. This is related to the presence of the so-called intestine-brain axis (or brain-gut-microflora axis) encompassing neuronal, immunological and endocrine signals [42] which affect processes such as neurogenesis, neurotransmission, behavior modulation, and regulation of the hypothalamic-pituitary-adrenal axis [43], the latter also participating in emotion and mood control [44]. Therefore, when correcting the diet, a particular attention was paid to an increase in the consumption of certain types of pro – and prebiotic foods of defined origin. All the changes, along with improved nourishment status and other benefits for the functioning of subjects' bodies were reflected in their mood boost, as confirmed by advantageous changes in both raw data and sten scores.

A comparison of the raw data with the sten scores shows that the former, in a higher percentage of both women and men, illustrated a positive effect of changes in nutrition pattern on the well-being, which could have, however, been influenced also by the emotions accompanying the study. After converting the raw results into sten norms determining mood, it was found that positive changes affected a smaller percentage of the respondents and in more than half of the residents were observed only in the second year after modifying the diet. This confirms the time dependence of the nourishment status effects on mood. The effects were manifested primarily as

the significant increase in the energetic arousal, eventually by 1.7 and 0.9 sten scores in the female and male patients, respectively. This was accompanied by a drop in the tense arousal, eventually by 1.3 and 0.7 sten scores in the female and male patients, respectively. It has to be borne in mind, however, that one-third of the male patients "after I" showed an increased TA and a reduced HT. How can those differences be explained? It seems that, in the case of the women, important was, *inter alia*, an improvement in anthropometric parameters [4]. As shown by the literature review and the authors' previous studies, a diet correction resulting in improved anthropometric parameters brings about a reduction in the intensity of psychotic symptoms and in enhanced cognitive abilities [45]; improvement in the physical well-being and the quality of life has been reported in women [45]. On the other hand, the increased TA and the reduced HT after one year in some men could have been related to their initially lower acceptance of suggested changes in shopping habits and reducing hard cheese and sausage consumption in favor of dairy products. It was only in the second year after diet correction that the HT values in the men increased, the increase being significant relative to the "before" and "after I" values; the TA values were observed to decrease by 1 sten.

It seems that the intra-group differences in mood were related to the initial nourishment status, willingness to accept recommendations, type of illness, and type of the psychotic medication. However, exploration of all those relationships is beyond the scope of this study.

The improvement in mood (immediate affective experience) is illustrated by a reduction in the number of destructive behavior incidents and stays at the psychiatric hospital, particularly in the men who showed a 50% and 60% reduction in the incidence of aggression/self-aggression episodes and hospitalizations, respectively; the respective reduction rates in the women were 60% and 100%. It seems that it is appropriate to say here that it is not only "music that soothes the savage breast …"

To sum up, it can be concluded that the diet correction and supervision directly affected the studied parameters by: increasing the hand grip strength; reducing the incidence of seasonal upper respiratory tract catarrh; reducing the arterial blood pressure; and improving mood. There were also indirect effects (due to a diminished tense arousal): lowered blood pressure and reduced incidence of aggression/self-aggression episodes, including those requiring hospitalization. Important was also, particularly in the legally incapacitated patients, the perception of being able to decide on certain aspects of one's life. This is confirmed by results reported by Biernacka and Jakubowska-Winecka [46] who showed this perception to reinforce behaviors associated with caring for one's health and well-being. In the opinion of physicians, nurses, and therapists, a total effect of actions undertaken within this study considerably increased the patients' well-being, which, while maintaining basic antipsychotic treatment, contributed to a reduction in the dose/number of anxiolytics/sedatives (Lorafen, Relanium, Hydroxyzinum) and reliever medications, related to infections. The effect of a general improvement in well-being was particularly evident in the female

patients who began to pay more attention to their appearance, to change for supper, to put on high-heeled shoes, etc.

Conclusions

Analysis of the results allowed to conclude that the diet correction resulted in:

(1) reduction of the amount of food wastes, which made it possible to further improve the quality and variety of the food offered to the patients, within the allowed limits;
(2) increased hand grip strength and improved well-being and mood, reflected in reduction in the incidence of aggression/self-aggression and the associated hospitalization;
(3) improved arterial blood pressure and reduction in the incidence of upper respiratory tract infections, which – taken together – allowed to reduce the amount of applied medication.

References

1. Adamowicz K, Mazur A, Mak M, Samochowiec J, Kucharska-Mazur J. *Metabolic syndrome and cognitive functions in schizophrenia – Implementation of dietary intervention*. Front. Psychiatry 2020; 11: 359.
2. Aucoin M, LaChance L, Clouthier SN, Cooley K. *Dietary modification in the treatment of schizophrenia spectrum disorders: A systematic review*. World J. Psychiatr. 2020; 10(8): 187–201.
3. Friedrich M, Fugiel J, Bruszkowska M. *Assessing effects of diet alteration on selected parameters of chronically mentally ill residents of a 24-hour Nursing Home. Part I: Effects of diet modification on carbohydrate-lipid metabolism*. Psychiatr. Pol. 2020; 54(5): 915–933.
4. Friedrich M, Fugiel J, Goluch Z. Dziaduch I. *Assessing effects of diet alteration on selected parameters of chronically mentally ill residents of a 24-hour Nursing Home. Part 2. Effects of nutritional changes on anthropometric parameters and composition of the body.* Psychiatr. Pol. 2022; 56(6): 1365–1380.
5. Steiber N. *Strong or weak handgrip? Normative reference values for the German population across the life course stratified by sex, age, and body height*. PLoS ONE 2016; 11(10): e0163917.
6. Zasadzka E, Strzesak D, Poterska A, Trzmiel T, Pawlaczyk M. *Siła uścisku ręki u osób po 65 roku życia*. Geriatria 2017; 11: 117–122.
7. Schlüssel MM, Anjos dos LA, Vasconcellos de MTL, Kac G. *Reference values of handgrip dynamometry of healthy adults: A population-based study*. Clin. Nutr. 2008; 27(4): 601–607.
8. Mancia G, Fagard R, Narkiewicz K, Redon J, Zanchetti A, Böhm M et al. *Wytyczne ESH/ESC dotyczące postępowania w nadciśnieniu tętniczym w 2013 roku. Grupa Robocza Europejskiego Towarzystwa Nadciśnienia Tętniczego (ESH) i Europejskiego Towarzystwa Kardiologicznego (ESC) do spraw postępowania w nadciśnieniu tętniczym*. Kardiol. Pol. 2013; 71(supl. III): 27–118.
9. Goryńska E. *Przymiotnikowa skala nastroju UMACL Geralda Matthewsa, A. Grahama Chamberlaina, Dylana M. Jonesa. Podręcznik*. Warsaw: Psychological Test Laboratory of the Polish Psychological Association; 2005.

10. Nęcka E. *Twórczość*. In: Strelau J, editor. *Psychologia. Podręcznik akademicki*, vol. 2. Gdansk: Gdansk Psychological Publishing House; 2000.
11. Bohannon RW. *Grip strength: An indispensable biomarker for older adults*. Clin. Interv. Aging 2019; 14: 1681–1691.
12. Kim MJ, Park KS, Seo A-R, Lee S-I, Ha Y-C, Yoo J-I. *Determining functional activity profiles in patients with upper extremity disorders: Is there effect modification by hand-grip strength?* Clin. Interv. Aging 2018; 13: 2351–2358.
13. Bohannon RW. *Are hand-grip and knee extension strength reflective of a common construct?* Percept. Mot. Skills 2012; 114(2): 514–518.
14. Massy-Westropp NM, Gill TK, Taylor AW, Bohannon RW, Hill CL. *Hand grip strength: Age and gender stratified normative data in a population-based study*. BMC Res. Notes 2011; 4: 127.
15. Fukumori N, Yamamoto Y, Takegami M, Yamazaki S, Onishi Y, Sekiguchi M et al. *Association between hand-grip strength and depressive symptoms: Locomotive Syndrome and Health Outcomes in Aizu Cohort Study (LOHAS)*. Age Ageing 2015; 44(4): 592–598.
16. Wiśniowska-Szurlej A, Ćwirlej-Sozańska A, Kilian J, Wołoszyn N, Sozański B, Wilmowska-Pietruszyńska A. *Reference values and factors associated with hand grip strength among older adults living in southeastern Poland*. Sci. Rep. 2021; 11: 9950.
17. Skubiszewska A, Broczek K, Olędzka G. *Ocena siły mięśniowej ręki u osób w podeszłym wieku – znaczenie badania*. Gerontol. Pol. 2018; 26: 64–71.
18. Sapilak BJ, Bujnowska-Fedak MM, Melon-Sapilak M, Baran M, Bujalska A. *Ocena stanu odżywienia i siły mięśniowej pacjentów hospitalizowanych w oddziale geriatrycznym*. Fam. Med. Primary Care Rev. 2014; 16(3): 287–290.
19. Norman K, Stobäus N, Gonzalez MC, Schulzke J-D, Pirlich M. *Hand grip strength: Outcome predictor and marker of nutritional status*. Clin. Nutr. 2011; 30(2): 135–142.
20. Kallman DA, Plato CC, Tobin JD. *The role of muscle loss in the age-related decline of grip strength: Cross-sectional and longitudinal perspective*. J. Gerontol. 1990; 45(3): 82–88.
21. Pludowski P, Holick MF, Grant WB, Konstantynowicz J, Mascarenhas MR, Hag A et al. *Vitamin D supplementation guidelines*. J. Steroid Biochem. Mol. Biol. 2018; 175: 125–135.
22. Kaur H, Agarwal S, Agarwal M, Agarwal V, Singh M. *Therapeutic and preventive role of functional food in process of neurodegeneration*. Int. J. Pharm. Sci. Res. 2020; 11(6): 2882–2891.
23. Lei W-T, Shih P-C, Liu S-J, Lin C-Y, Yeh T-L. *Effect of probiotics and prebiotics on immune response to influenza vaccination in adults: A systematic review and meta-analysis of randomized controlled trials*. Nutrients 2017; 9(11): 1175.
24. Yeh T-L, Shih P-C, Liu S-J, Lin C-H, Liu J-M, Lei W-T et al. *The influence of prebiotic or probiotic supplementation on antibody titers after influenza vaccination: A systematic review and meta-analysis of randomized controlled trials*. Drug Des. Devel. Ther. 2018; 12: 217–230.
25. Binek M. *Znaczenie jelitowych mikrobiontów w utrzymaniu ogólnej homeostazy gospodarza*. Post. Mikrobiol. 2015; 54(3): 207–216.
26. Gliński Z, Kostro K. *Mikrobiom – charakterystyka i znaczenie*. Życie Weterynaryjne 2015; 90(7): 446–450.
27. Mojka K. *Probiotyki, prebiotyki i synbiotyki – charakterystyka i funkcje*. Probl. Hig. Epidemiol. 2014; 95(3): 541–549.
28. Gibała M, Janowski GJ. *Znaczenie diety w prewencji oraz wyrównaniu nadciśnienia tętniczego*. Choroby Serca i Naczyń 2016; 13(4): 265–270.

29. Iwaniak A, Mogut D, Darewicz M, Hrynkiewicz M. *Wykorzystanie biologicznie aktywnych peptydów z białek żywności w profilaktyce zespołu metabolicznego*. Zeszyty Problemowe Postępów Nauk Rolniczych 2016; 585: 75–85.
30. Casey DE, Haupt DW, Newcomer JW, Henderson DC, Sernyak MJ, Davidson M et al. *Antipsychotic-induced weight gain and metabolic abnormalities: Implications for increased mortality in patients witch schizophrenia*. J. Clin. Psychiatry 2004; 65(Suppl 7): 4–18.
31. Ryan MC, Collins P, Thakore JH. *Impaired fasting glucose tolerance in first-episode, drugnaïve patients with schizophrenia*. Am. J. Psychiatry 2003; 160(2): 284–289.
32. Milewicz A, Jędrzejuk D. *Czynniki ryzyka chorób układu krążenia u chorych na schizofrenię – rola metforminy*. Endokrynol. Otył. Zab. Przem. Mat. 2009; 5(4): 233–235.
33. Kuśmierek M, Florkowski A, Gałecki P, Talarowska M. *Współwystępowanie zaburzeń psychicznych i somatycznych u pacjentów z rozpoznaniem depresji*. Curr. Probl. Psychiatry 2011; 12(3): 285–292.
34. Szcześniak M, Furmańska J, Konieczny K, Widecka K, Rachubińska K. *imensions of neurotic personality and its selected predictors in individuals with arterial hypertension*. Psychiatr. Pol. 2019; 53(4): 901–914.
35. Pedersen SS, Känel von R, Tully PJ, Denollet J. *Psychosocial perspectives in cardiovascular disease*. Eur. J. Prev. Cardiol. 2017; 24(3 suppl): 108–115.
36. Leszczyńska T, Pisulewski PM. *Wpływ wybranych składników żywności na aktywność psychofizyczną człowieka*. Żywn. Nauka Technol. Jakość 2004; 1(38): 12–24.
37. Karakuła H, Opolska A, Kowal A, Domański M, Płotka A, Perzyński J. *Czy dieta ma wpływ na nasz nastrój? Znaczenie kwasu foliowego i homocysteiny*. Pol. Merk. Lek. 2009; 26(152): 136–141.
38. Wilczyńska A. *Kwasy tłuszczowe w leczeniu i zapobieganiu depresji*. Psychiatr. Pol. 2013; 47(4): 657–666.
39. Stefanowski B, Antosik-Wójcińska A, Święcicki Ł. *The effect of vitamin D3 deficiency on the severity of depressive symptoms. Overview of current research*. Psychiatr. Pol. 2017; 51(3): 437–454.
40. Wardziukiewicz W, Stachowska E. *Wpływ mikrobioty jelitowej i jej modyfikacji na samopoczucie pacjentów z depresją*. Postepy Hig. Med. Dosw. 2020; 74: 314–321.
41. Gulas E, Wysiadecki G, Strzelecki D, Gawlik-Kotelnicka O, Polguj M. *Can microbiology affect psychiatry? A link between gut microbiota and psychiatric disorders*. Psychiatr. Pol. 2018; 52(6): 1023–1039.
42. Karakuła-Juchnowicz H, Dzikowski M, Pelczarska A, Dzikowska I, Juchnowicz D. *The brain-gut axis dysfunctions and hypersensitivity to food antigens in the etiopathogenesis of schizophrenia*. Psychiatr. Pol. 2016; 50(4): 747–760.
43. Sherwin E, Dinan TG, Cryan JF. *Recent developments in understanding the role of the gut microbiota in brain health and disease*. Ann. N. Y. Acad. Sci. 2018; 1420(1): 5–25.
44. Vlainić JV, Šuran J, Vlainić T, Vukorep AL. *Probiotics as an adjuvant therapy in major depressive disorder*. Curr. Neuropharmacol. 2016; 14(8): 952–958.
45. Fernández-Abascal B, Suárez-Pinilla P, Cobo-Corrales C, Crespo-Facorro B, Suárez-Pinilla M. *In – and outpatient lifestyle interventions on diet and exercise and their effect on physical and psychological health: A systematic review and meta-analysis of randomised controlled trials in patients with schizophrenia spectrum disorders and first episode of psychosis*. Neurosci. Biobehav. Rev. 2021; 125: 535–568.

46. Biernacka MA, Jakubowska-Winecka A. *Health locus of control as a psychological factor in improving treatment results in adolescents with primary hypertension and diabetes*. Health Psychol. Rep. 2017; 5(1): 20–29.

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