

Absence of protein-energy malnutrition in Prague homeless

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Summary

Objective: Define the prevalence of protein-energy malnutrition (PEM) in a convenient sample of Prague's homeless population.

Methods: The study was conducted in Prague over an 8 month period during 2003. Nutritional status was assessed using anthropometric measurements, biochemical and hematological indicators. Of the initial 217 subjects recruited, 201 participated actively. Thirteen percent of the participants were women. One hundred and thirty four participants were interviewed on the premises of Naděje, a Czech charitable organization; the rest were interviewed in Bulovka University Hospital.

Results: Mean BMI values were within the normal range, with only 6 (3%) of the men and 2 (7%) of the women below 18.5 kg/m². Wasted muscle mass was found in only 1 (0.6%) man. Serum protein levels were within normal limits. Lymphocytopenia was reported in 3 (2%) of the men. Results of the CAGE questionnaire gave a strong indication of alcoholism in 24 (12%) and alcoholism in 32 (16%) of the participants.

Conclusions: The data fails to demonstrate the existence of protein-energy malnutrition in Prague's homeless population.

Keywords: Homeless – Protein-energy malnutrition – Nutritional status – Food sources – Alcohol abuse.

Homeless people represent a significant minority group with many problems linked to their divergent lifestyle. Their health status is usually assumed to be worse than the health status of the general population. The prevalence of skin infections, chronic diseases, alcohol and/or drug abuse and mental disor-

ders is significantly higher in the homeless population than in the general population [1–3]. The higher incidence of health problems may have a multi-faceted etiology, including: smoking, alcohol, drugs, poor hygiene, delays in seeking medical care, extreme poverty, environmental exposure, insufficient food intake, and poor quality diets.

Socio-economic, environmental, and health factors combine to further challenge the abilities of the homeless to maintain an adequate nutritional status. Food consumed by the homeless is often considered to be inadequate in quantity and nutritional quality. Studies have reported that 20%–44% of the homeless are underweight and suffer from wasting malnutrition. The same studies go on to describe vitamin and mineral insufficiency, as indicated by low blood levels or based on intakes below the recommended daily allowances [2–12]. Only a few studies have documented the absence of undernutrition in homeless populations. Austin et al. [4] found undernutrition (defined as less than 80% of ideal body weight) in only 2% of homeless veterans. Similarly, Luder et al. [10] reported that only 6% of homeless participants in their study were underweight (defined as body mass index below 18.5 kg/m²).

In the Czech Republic, homeless people live mainly in the larger towns where they have better access to odd jobs and charitable services for homeless [13]. Prague, the capital of the Czech Republic, is its largest city. When combined with its prosperity, Prague attracts and maintains the highest concentration of homeless [14] and was, therefore, an ideal location for our study.

The purpose of this study was to determine the prevalence of protein-energy malnutrition in Prague's homeless population through assessment of anthropometric, biochemical and hematological indicators. Malnutrition, in the form of overnutrition, is not addressed in this paper.

Methods

A cross-sectional study which involved assessing the nutritional status of the Prague homeless population was conducted during 2003. The study took place over a period of 8 months. It was supported by Bulovka University Hospital and Naděje (“Hope”), a Prague charitable organization.

Subjects

Out of the original 217 participants recruited, 201 participated actively. Thirteen percent of the participants were women. One hundred and thirty four participants were recruited and interviewed at Naděje, a Czech charitable organization. An additional 67 homeless were recruited at the main railway station and transported to Bulovka University Hospital where they were interviewed and had physical examinations. The main railway station and charitable organization Naděje were chosen because they were the best places to make contact with Prague’s homeless population.

Inclusion criteria for the study were (i) homelessness (for more than one month), (ii) willingness to participate and (iii) competent to give written consent of participation in the study. Exclusion criteria were (i) regular drug abuse or (ii) acute alcohol or drug intoxication at interview time.

Homeless who visited the Naděje day center were invited to participate. Participation was completely voluntary and surveys were conducted in such a way to protect the privacy of participants. Each participant received a meal voucher, valued at 50 CZK (approx. 1.50 Euro) as a gesture of appreciation. Study data is limited to those who volunteered to participate. A signed written consent was obtained from each participant. The study was approved by the Ethical Committee of the Third Faculty of Medicine, Charles University, Prague, CZ.

Data collection

Each participant answered a brief socio-demographic questionnaire, provided venous blood samples and allowed measurement of anthropometric data. The questionnaire used in the study was a specially modified version of a questionnaire developed by the Department of Nutrition of the 3rd Faculty of Medicine. It consisted of 26 questions regarding: location of overnight stays, drug intake, food sources, weight loss, as well as the CAGE alcoholism screening test. The questionnaire was given by one of the authors (DK), who had been specifically trained for this purpose; blood samples and anthropometric measurements were collected on the same day, but only after completion of the questionnaire.

Biochemistry

Fasting venous blood samples, drawn from the cubital vein, were used to determine albumin, transferrin, prealbumin, γ -glutamyl transferase (GGT) and blood cell values. Participant blood samples were taken in the morning, after interviews but before a free breakfast, to ensure a fasting condition. To help guarantee compliance, participants were clearly instructed to come give their blood sample before eating breakfast. These instructions were printed in leaflets and orally communicated to participants by the charity personnel.

Albumin, because of its long half-life, was used as a measure of long-term starvation. Decreased albumin levels can indicate ongoing catabolism. The synthesis of transferrin and prealbumin is also reduced during undernutrition. Prealbumin, because of its short half-life, is sensitive to changes in protein-energy intake and closely reflects dietary intake rather than overall nutritional status. Energy restriction and fasting are reflected by subnormal values within one week. Plasma protein levels, as nutritional markers, were evaluated according to Spierkerman [15]; criteria are given in Table 3.

Anthropometry

Anthropometric variables included height, weight, four skinfold measurements (subscapular, triceps, biceps, and supraspinal), waist and arm circumference. The participants were weighed in light clothing and without shoes on an electronic platform scale; weights were to the nearest 0.5 kg. Weights were then adjusted for clothing. Height was recorded to the nearest 0.5 cm. Height and weight values were used to determine body mass index (BMI) [kg/m^2]. Interpretations of BMIs were based on The World Health Organization [16].

We used the triceps skinfold (TSF) as a simple measure of subcutaneous fat stores, using values from NHANES I, II [17]; while the sum of the four skinfold measurements was used to calculate the percentage of body fat, using the method described by Durnin [18]. Skinfolds were measured to the nearest millimeter using a Harpenden caliper.

Undernutrition can cause muscle wasting and a decrease in muscle circumference. Mid-arm circumference (MAC) was measured midway between the tip of the acromion and olecranon process on the right arm while the arm was in a relaxed position at the side. Measurements were taken to the nearest 0.5 cm, using a plastic measuring tape. Mid-arm muscle circumference (MAMC), considered an index of muscle mass, was calculated and evaluated according to Jelliffe¹⁹ from MAC and TSF. The following equation was used to calculate MAMC: $\text{MAMC} = \text{MAC} [\text{cm}] - (0.314 \times \text{TSF} [\text{mm}])$. All measurements were taken by trained health personnel from Naděje (height, weight) and one of the authors (PD, other measurements).

Alcoholism

The CAGE questionnaire was used to screen the participants for alcohol abuse problems. The CAGE test is a simple, sensitive, and specific screening test for alcohol abuse [20]. Two positive answers (out of four) represent a strong indication of alcoholism, while three or four positive answers suggest alcoholism.

Statistical analysis

Data were processed using the SPSS (Statistical Package for the Social Sciences) Windows edition, version 12 and Epi Info, version 3.3. All group data are presented as the mean \pm standard deviation (SD). Frequencies are given as n (%).

Results

Background characteristics of the homeless participants are described in Table 1. The mean age for the men was 42 ± 11 years (age range 19–70) and 40 ± 9 years (age range 23–55) for the women. Most of the participants were between 25 and 54 years old. The mean duration of homelessness was 2 years and ranged from 1 month to 20 years. Long-term homelessness (>5 years) was seen in 22 (13%) of the men and 3 (12%) of the women. More than three fourths of the men (135; 78%) had completed secondary school compared to only 9 (33%) of the women. The majority of participants (183; 91%) were Czech nationals.

Laboratory assessment

Mean values of serum protein levels were within normal limits (Tab. 2). Only 2 (7%) of the women showed low levels of pre-

albumin. Seven (4%) men had low levels of blood proteins: 4 (2.3%) had serum levels of albumin <33 g/l, 3 (1.8%) had transferrin levels <1.6 g/l, and 7 (4%) had prealbumin levels <0.16 g/l. Only 3 (2%) of the men and 2 (7%) of the women had GMT levels that were out of the normal range. Twenty seven men (16%) had triglycerides >1.7 mmol/l. Twenty four (14%) men and 6 (22%) women had high mean corpuscular erythrocyte volumes (MCV >97 fl). White blood cells were increased above $10 \times 10^3/\mu\text{l}$ in 38 (22%) men and 4 (15%) women. Lymphocytopenia (< $900 \times 10^3/\mu\text{l}$) was not seen in the women and in only 3 (2%) men.

Ninety-nine (57%) men and fifteen (56%) women showed one or more of the following abnormalities in red cell blood counts (RBC): low erythrocytes (< $4.5 \times 10^{12}/\text{l}$ for men and < $4.2 \times 10^{12}/\text{l}$ for women), low haemoglobin (<14 g/dl for men and <12 g/dl for women), or low hematocrit (<38% for men and <36% for women). Among the participants with RBC abnormalities, macrocytosis was present in 18 men and 6 women, while microcytosis (<77 fl) was present in only 2 men.

Anthropometric measurements

Mean \pm SD values and ranges for the anthropometric measurements of the study group are presented in Table 2. Mean BMI values, for both men and women, were in the normal range for body weight. Six (3%) men and 2 (7%) women were underweight based on their BMI (<18.5), 58 (33%) men and 7 (26%) women were overweight (BMI 25–29.9), 9 (5%) men and 2 (7%) women were obese (BMI \geq 30).

Five (3%) men had depleted subcutaneous fat stores (TSF below 3.5 mm), and only 8 (5%) men had low body fat stores (<10%). All the homeless women in the study had sufficient fat stores (\geq 15%). Almost half the women (48.1%) had fat

Characteristic	Men (n = 174)	Women (n = 27)	Total (n = 201)
	n (%)	n (%)	n (%)
Age			
19–24	9 (5)	1 (4)	10 (5)
25–34	34 (20)	1 (37)	35 (17)
35–54	105 (60)	24 (55)	129 (64)
\geq 55	26 (15)	1 (4)	27 (14)
Duration of homelessness (n = 174, n = 26)			
<0.5 yrs	66 (38)	12 (46)	78 (39)
0.5–2 yrs	56 (32)	9 (35)	65 (32)
2.5–5 yrs	30 (17)	2 (8)	32 (16)
>5 yrs	22 (13)	3 (11)	25 (13)
Type and total length of education			
Primary, 8 yrs	38 (22)	17 (63)	55 (27)
Apprentice training school, 11 yrs	77 (44)	8 (29)	85 (42)
Secondary, 12 yrs	58 (33)	1 (4)	59 (30)
University, \geq 16 yrs	1 (1)	1 (4)	2 (1)

Table 1 Background characteristics of Prague homeless

Variables of study group	Men (n = 174)		Women (n = 27)	
	mean ± SD	range	mean ± SD	range
Body mass index (kg/m ²)	24.3 ± 3.9	14.1–44.6	24.1 ± 5	18.4–41.0
Mid-arm circumference (cm)	29 ± 3.2	17–42.5	26.9 ± 3.2	22–36
Mid-arm muscle circumference (cm)	26.2 ± 2.6	14.6–33.4	22.8 ± 2.1	19.7–27
Body fat (%)	17.4 ± 5.1	4.8–32.7	26.8 ± 5.7	19.4–40.4
Triceps Skinfold (mm)	8.9 ± 4.7	3–37	13.1 ± 6.4	7.2–38
Albumin (g/l)	42 ± 4	31–52	41.8 ± 4	34–50
Prealbumin (g/l)	0.3 ± 0.1	0.1–0.5	0.3 ± 0.1	0.01–0.5
Transferin (g/l)	2.6 ± 0.6	1.4–5.3	2.6 ± 0.7	1.7–4.2
γ-glutamyl transferase (μkat/l)	0.8 ± 0.1	0.2–18.1	0.6 ± 1.8	0.2–5
White blood cells (10 ³ /μl)	8.5 ± 0.18	3.6–17.2	8.1 ± 0.5	4.2–12.9
Lymphocytes (10 ³ /μl) (n = 173, n = 27)	2.1 ± 0.6	0.7–4.5	2.1 ± 0.7	1.2–3.3
Red blood cells (10 ⁶ /μl)	4.5 ± 0.03	3.3–5.5	4.2 ± 0.1	3.3–5
Haemoglobin (g/dl)	14 ± 0.1	8.8–17.1	12.9 ± 0.2	10.6–15.4
Haematocrit (%)	42.1 ± 0.3	28–51	39 ± 0.6	33.5–46.2
Mean corpuscular volume (fl)	92.4 ± 7.5	33.5–105.4	92.8 ± 5	82–101.4
Platelets (10 ³ /μl)	262.7 ± 5.1	54–55	262.6 ± 14.7	99–482

Table 2 Anthropometric measurements and laboratory indicators in Prague homeless

stores $\geq 25\%$ while 53 (30%) men had body fat stores $\geq 20\%$. Only one man (0.6%) had wasted muscle mass based on MAMC (<17.7 cm). Values for women were within normal limits. Prevalence of PEM parameters are given in Table 3. Involuntary loss of more than 10% of normal body weight over a period of 6 months (or 7.5% in 3 months/5% in 1 month/2% in 1 week) is considered to represent a high risk for protein-energy malnutrition (PEM). Eighty-two (41%) participants reported having lost weight in such a way. Oddly, significant weight loss did not correlate with the amount of time spent homeless.

Alcohol consumption

Most of men (159, 91%) and about half of women (15, 56%) reported drinking alcoholic beverages, while 23 (13%) men and 2 (7%) women admitted having received therapy for alcohol problems in the past. Results of the CAGE test suggested alcoholism (2 positive answers out of 4) in 30 (17%) men and 2 (7%) women, while 22 (13%) men and 2 (7%) women had a strong indication of alcoholism (3 or 4 positive answers).

Food sources

More women (19; 69%) than men (50; 29%) reported that they ate at charities on a daily basis, another 38 (22%) men reported that they ate at charities at least once a week. When asked about their most important food sources (using questions with multiple answers), most of the participants reported charities (132 men, 76%; 20 women, 74%) and supermarkets (134 men, 77%; 12 women, 44%). Men preferred pubs/snack-bars (66, 38%) to friends/relatives (36, 21%). Women, on the other hand, favored friends/relatives (5, 19%) over

Table 3 Prevalence of protein-energy malnutrition (PEM) according to different parameters

Prevalence of PEM parameters	Men (n = 174)	Women (n = 27)	Total (n = 201)
	n (%)	n (%)	n (%)
prealbumin <0.16 g/l	7 (4)	2 (7)	9 (5)
transferin <1.6 g/l	3 (1.8)	–	3 (1.5)
albumin <33 g/l	4 (2)	–	4 (2)
BMI <18.5 kg/m ²	6 (3)	2 (7)	8 (4)
MAMC <17.7 cm (men)/ <16.2 cm (women)	1 (0.6)	–	1 (0.5)
TSF <3.5 mm (men)/ <7 mm	5 (3)	–	5 (2.5)
Body fat (%) $<10\%$ (men)/ $<15\%$ (women)	8 (5)	–	8 (4)

pubs/snack bars (4, 15%). Only 2 (1%) homeless reported begging and only 7 (3.5%) reported that they ate food from trashcans.

Overnight stay

Participants were asked where they slept overnight with respect to season (multiple answers were possible). About half of the study participants reported staying in hostels provided by charities during the winter. Other options during cold months included railway stations and riding on night trams. Staying with friends or relatives in the winter was more common among women (6, 22%) than men (24, 14%), whereas the use of cheap commercial accommodation was more common among men (26, 15%).

During the summer, men slept outside more often than during the winter. Other summer locations included charities,

commercial accommodations and railway stations. Women reported that they spent the summer with friends or relatives, in charities, in tents, in railway stations or sleeping outside.

Discussion

Apart from reports of local organizations working with the homeless and a study on the mental health of Prague's homeless population²¹, our project was the first, in the Czech Republic, to describe the nutritional status of Prague's homeless adult population, with particular attention to protein-energy malnutrition (PEM). Additionally, there is a general shortage of data regarding the overall prevalence of PEM in the Czech Republic. Data which is available is limited to major anthropometric measurements and lipid profiles of the general population. In our study, we expected to find a high prevalence of PEM in Prague's homeless population (which we assessed through blood proteins and anthropometric indicators). We expected this because, of what we generally accepted as, nutritional challenges associated with lifestyle, health status and living conditions of homeless populations. However, our results failed to confirm this hypothesis.

The homeless lifestyle makes studies of health and nutritional status, especially anthropometric and biochemical investigations very difficult. Our success in this regard makes our work unique.

The mean BMI in the Czech Republic is 26.5 kg/m² for men and 25.7 kg/m² for women (unpublished results from Life Style and Obesity Study, Czech Republic, 2006). Results from this study show that 1 % of Czech men and 3 % of Czech women are underweight based on their BMI (<18.5 kg/m²). In our homeless sample, mean BMI values were within normal limits, and when divided into categories according to WHO [16], we found that only 3 % of the men and 7 % of the women had BMIs below normal (<18.5 kg/m²). Furthermore, for men, we found that only 3 % had low TSF (<3.5 mm) and only 5 % had body fat <10 %. Reduced muscle mass, characterized by mid-arm muscle circumference, was only seen in one male participant (0.6 %). Our findings are consistent with the findings of studies such as Luder et al. [10] who reported that 39 % of their homeless sample were obese, while only 6 % were underweight (BMI <18.5 kg/m²). However, other studies have reported a much higher prevalence of underweight homeless, with values ranging from 20 % – 44 % [2, 3, 7, 9, 12] found low TSF measures in only 8 % of the men and 3 % of the women, while low MAMC values were seen in 36 % of the men and 13 % of the women. Langnäse & Müller [2], using arm muscle area as a criterion, found undernutrition in 29 % of the studied participants.

Low levels of serum proteins can indicate catabolism associated with reduced food intake. In our study, only a small percentage of the men had low levels of albumin, transferrin or prealbumin. In women, 7 % showed low prealbumin levels, while other serum proteins were normal. In general, there have been few studies which examined levels of blood proteins in homeless populations. Austin et al. [4] studied the nutritional status of homeless veterans in the USA and published albumin levels which were consistent with our results.

We found the percentage of those suffering from undernutrition, in our study, to be much smaller than we had originally expected. It is possible that our sample underrepresented the homeless which were difficult to recruit – those that were “hard to reach,” those living without utilizing the services of charitable organizations.

Additionally, polymorbidity of the homeless which is often described in the literature [1–3] may not be necessarily caused by PEM. Instead, factors, or a combination of factors, such as poor hygiene, stress, smoking and alcohol consumption, lower availability of medical care etc., might be a more significant cause.

Despite the very low prevalence of PEM in our sample, a high percentage of the participants reported having lost a significant amount of weight over a short period of time. This type of weight loss can lead to muscle wasting, decreased immunocompetence, and an increase in disease complications. Significant weight loss was reported by 41 % of the participants; however, their BMIs did not drop below 18.5 kg/m². Since it is unlikely that the participants had a way to quantify their weight loss, subjective overestimation of weight loss by participants may be considered a viable explanation of this disparity.

Most of the men and half of the women reported drinking alcoholic beverages. We used the CAGE test to screen for alcoholism [20]. The results of the CAGE test gave a strong indication for alcoholism in 12 % of the sample and suggested outright alcoholism in another 16 %. The prevalence of alcohol dependence in homeless populations is generally high and can be as high as 86 % [22]. Very high (73 %) lifetime prevalence rates (defined as the percentage of individuals who report having been diagnosed with the disorder in their lifetime, regardless of current diagnostic status) were reported by Fichter & Quadflieg [23] in male homeless adults in Munich; lower rates have been found elsewhere – Madrid 28 % [24], Paris 25 % [25]. In Los Angeles, alcoholism was detected in 60 % of homeless men. We found that 21 % of the homeless participants in our study had been treated for alcoholism at some point in their life. When assessed alcohol abuse, in addition to the questionnaire, we also examined biochemical markers commonly used as a measure of

high-alcohol consumption. The markers included: mean corpuscular volume, the liver enzyme (GMT) and triglycerides [26]. Very few of the homeless participants in our study had abnormal levels of GMT; however, 15 % had macrocytosis and 13 % had hypertriglyceridemia. With regard to hypertriglyceridemia, it's worth mentioning that it can be high in the obese and those with a genetic predisposition. However, in these cases, we believe the hypertriglyceridemia is likely due to alcohol consumption. The absence of hypoalbuminemia indicates no serious liver cirrhosis in the majority of our sampled population. Elevated GMTs in only 5 out of 201 study participants also supports this conclusion. The impaired blood counts might be partially explained by alcohol abuse, but poor food quality, irregular food intake, neglect of illnesses or injuries etc., definitely play a role as well. Additionally, alcohol and, especially, beer can be a significant source of calories, which can, to a certain extent, prevent energy deficiency.

In conclusion, our results failed to confirm protein-energy malnutrition in Prague's homeless population. This group is able to obtain enough calories to prevent PEM, however the high (though questionable) prevalence of significant weight loss and impaired blood counts, suggest that this population

might be predisposed to protracted recoveries from injuries and illnesses, and increased morbidity, relative to the general population.

Our results should not be construed to suggest that the homeless population is without need of public health intervention. The relatively sound nutritional condition of the homeless may very well reflect the success of local charities at keeping the nutritional status of the "reachable" homeless population at satisfactory levels. The importance of their work needs to be emphasized and additional efforts need to be directed towards this approach. Problems with alcohol abuse, as well as other aspects of the homeless lifestyle call for long-term interventions in order to address the needs of this vulnerable group of the Czech population.

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