NUTRITIONAL HEALTH IN ADULTS WITH DOWN SYNDROME LIVING IN URBAN NORTH-EASTERN ROMANIA

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NUTRITIONAL HEALTH IN ADULTS WITH DOWN SYNDROME LIVING IN URBAN NORTH-EASTERN ROMANIA **(**Abstract**):** Down syndrome is a genetic disorder typically linked with developmental delays, mild to moderate intellectual disability, and distinctive physical features. With a high prevalence of overweight and obesity, weight management strategies designed for the general population may not be suitable due to physiological and cognitive disparities in adults with DS. Weight issues in individuals with DS often stems from excessive calorie intake and inadequate physical activity, underscoring the importance of addressing dietary patterns. **Materials and methods:** We conducted a cross sectional study in the Cardiovascular Rehabilitation Clinic at Iasi Clinical Rehabilitation Hospital between July 1, 2022, and February 1, 2024. The study included 28 patients diagnosed with DS. We used SGA to assess nutritional status. **Results:** Among the patients, 25% were overweight and 39.3% were obese. Most obese individuals were from single-parent families (72.2%), performed minimal physical activity (81.81%), and exhibited poor dietary habits. In contrast, the overweight group had a more balanced diet, and superior hand grip strength, even outperforming the normal weight group. The obese group was the only one where we found scores of SGA over 9 points indicating an immediate need for nutritional intervention. **Conclusions**: Healthcare providers must address the unique challenges faced by adults with DS, including health conditions, feeding difficulties, and barriers to physical activity, while recognizing the critical role and stress experienced by caregivers. Despite the heightened risk of obesity, effective weight management is achievable with proper screening and intervention. **Keywords**: DOWN SYNDROME, NUTRITIONAL HEALTH, OBESITY.

Historically, weight gain was seen as a sign of health and prosperity. However, with industrialization and better living standards, obesity has become a major global health concern, affecting both children and adults (1). Obesity is now recognized as a leading cause of death, surpassing traditional health issues like infectious diseases (2). Despite advancements in diet, exercise, and treatments, obesity rates continue to rise, posing significant public health challenges (3).

The concept of genetic susceptibility to obesity was introduced in the early 20th century. Advances in genetics have since clarified specific forms of obesity linked to genetic defects (4).

BMI is commonly used to classify obesity in adults, defined by a value of 30 kg/m² or higher. However, BMI does not differentiate between muscle and adipose tissue. Waist circumference is often used as a practical measure of abdominal fat and related health risks (5, 6).

The International Association for the Scientific Study of Intellectual Disabilities (IASSIID) highlights the impact of obesity on individuals with intellectual disabilities, including Down Syndrome (DS) (7). DS is a genetic disorder characterized by intellectual disability and distinct physical traits, which currently has a life expectancy of around 60 years. (8, 9).

Recent studies show that adults with DS are at a higher risk of obesity due to factors like slower metabolism and low muscle tone, combined with challenges in maintaining healthy habits. Nutritional deficiencies and thyroid dysfunction are also more common in this group, requiring careful dietary management (10, 11). While general nutritional strategies apply, assessing nutritional status in adults with DS remains challenging due to limited research (12).

To our knowledge, this study represents the first comprehensive evaluation of the nutritional status within this particular population, addressing a significant gap in the literature, as no prior research has been conducted on the nutritional health of adults with Down syndrome in Romania.

MATERIALS AND METHODS

Study design

We conducted a descriptive cross-sectional study at the Cardiovascular Rehabilitation Clinic of the Iasi Clinical Rehabilitation Hospital between July 1st, 2022, and February 1st, 2024. The study cohort comprised 28 patients diagnosed with DS through genetic testing, selected from a total of 505 patients admitted to the clinic. Inclusion criteria for the study were: age over 18 years, a confirmed diagnosis of DS through genetic testing, and provision of informed consent. There were excluded: patients with recent surgical procedures, neoplasia, and those who were unable to complete the proposed assessments.

All participants were evaluated using a standardized clinical protocol by a single investigator. Demographic and clinical data included age, gender, body mass index (BMI), abdominal and calf circumference and handgrip strength. Additionally, data on family support, and whether the patient was from a single-parent household were gathered. The anamnesis also covered dietary habits, meal planning, and water intake.

The Subjective Global Assessment (SGA) is a widely validated tool for assessing malnutrition, combining clinical judgment with a detailed nutrition history and physical exam. It evaluates nine parameters: weight changes, food intake, gastrointestinal symptoms, functional capacity, comorbidities, subcutaneous fat, muscle loss, BMI, and serum albumin. Scores of 0-1 require reassessment, 2-3 suggest patient education, 4-8 call for dietary intervention, and scores over 9 need immediate nutritional intervention (13, 14).

Muscle strength was evaluated using an EH101 electronic dynamometer. Handgrip strength was measured with one familiarization trial and one test trial for both hands,

assessing maximal contraction over 4 seconds with verbal encouragement. We applied cut-off values from the European Working Group on Sarcopenia in Older People (EWGSOP): <30 kg for men and <20 kg for women.

Informed consent was obtained from all participants prior to their inclusion in the study. The study protocol received approval from the Ethics Committee of the "Grigore T. Popa" University of Medicine and Pharmacy Iasi (208/9.07.2022) as well as the Iasi Clinical Rehabilitation Hospital (13/22. 06. 2023).

Data analysis

Statistical analysis was performed using SPSS version 20.0 (Statistical Package for the Social Sciences, Chicago, IL, USA). Variables that followed a normal distribution were reported as mean values with standard deviations and compared using the Student's t-test. For variables that did not follow a normal distribution, data were presented as medians with interquartile ranges and analyzed using the Mann-Whitney U test. Statistical significance was determined at a threshold of $p \leq 0.05$ for all analyses.

RESULTS

Our study included 28 patients, with a mean age of 28.07±9.51. All lived in urban area, were non-smokers and had family support.

As indicated in first table i, 25% of the patients were classified as overweight, and 39.3% as obese, predominately men. Within the obese group, 72.2% were from single-parent households and exhibited low physical activity levels (81.81%).

TABLE I.
General characteristics of the study group

	Normal Weight (n=10)	**Overweight** (n=7)	**Obese** (n=11)	p
Gender				
- Women	4 (40%)	3 (42.85%)	4 (36.36%)	0.96
- Men	6 (60%)	4 (57.15%)	7 (63.63%)	
Age	27.80±11.82	25.57±5.62	29.90±9.56	0.65
Environment				
- Urban	10 (100%)	7 (100%)	11 (100%)	-
- Rural	0 (0%)	0 (0%)	0 (0%)	
Smoker	0 (0%)	0 (0%)	0 (0%)	-
Physical activity				
- Minimal	5 (50%)	6 (85.71%)	9 (81.81%)	0.06
- Moderate	5 (50%)	1 (14.28%)	2 (18.19%)	
Family support	10 (100%)	7 (100%)	11 (100%)	-
Single parent family	5 (50%)	4 (57.15%)	8 (72.72%)	0.58

Obese adults with DS included in the study demonstrated poor dietary habits, including frequent fast food consumption (81.81%), low water intake (90.90% con-

suming only 500-1000 ml/day), and inadequate protein intake (only 36.36% regularly eating meat and 9.10% consuming fruits/vegetables more than twice a week or dairy daily). Hence, SGA scores above 9 points were found only in the obese group.

The mean BMI for the overweight group was towards the lower end of the range. In addition, they had the lowest mean SGA value (3.71 points) (tab. II).

TABLE II.
Physical and nutritional evaluation of the study group

	Normal Weight (n=10)	**Overweight** (n=7)	**Obese** (n=11)	p
Calf circumference (cm)	32.2±1.87	36.21±1.21	42.68±4.33	<0.00001
Abdominal circumference (cm)	85±9.93	91.57±6.79	114.77±12.47	<0.00001
Body Mass Index (kg/m^2)	23.17±1.93	26.77±1.14	38.69±8.52	<0.0001
Handgrip strength (kgf)				
- Dominant hand	14.70±2.89	15.21±4.14	13.90±2.76	0.68
- Nondominant hand	14.41±3.62	15.28±5.34	13.64±3.33	
SGA	4.5±2.01	3.71±1.60	5.90±3.44	0.21
SGA				
- 0-1	0 (0%)	1(14.28%)	0 (0%)	-
- 2-3	4 (40%)	1 (14.28%)	3 (27.27%)	0.53
- 4-8	6 (60%)	5 (71.42%)	6 (54.54%)	0.79
- 9 and above	0 (0%)	0 (0%)	2 (18.19%)	-
Number of meals (per day)	2.4±0.51	2.71±0.48	2.63±0.50	0.40
Milk/Cheese (daily)	8 (80%)	6 (85.71%)	1 (9.10%)	0.0001
Eggs (at least 1 per week)	10 (100%)	7 (100%)	11 (100%)	-
Meat (daily)	7 (70%)	3 (42.85%)	4 (36.36%)	0.30
Fruits/vegetables (>2/week)	3 (30%)	3 (42.85%)	1 (9.10%)	0.26
Fast-food	0 (0%)	1 (14.28%)	9 (81.81%)	-
Water intake				
- < 500ml/day	0 (%)	0 (%)	0 (%)	0.009
- 500-1000ml/day	4 (40%)	2 (28.57%)	10 (90.90%)	
- > 1000ml/day	6 (60%)	5 (71.43%)	1 (9.10%)	

In terms of lipid profile, we observed statistically significant differences in mean LDL cholesterol values. Although not statistically significant, it is worth mentioning that the obese group had the highest average of triglycerides, TSH levels and accentuated inflammatory status (tab. III).

TABLE III.
Biological parameters of the study group

	Normal Weight (n=10)	Overweight (n=7)	Obese (n=11)	p
Hemoglobin (mg/ dl)	14.30±1.12	14.37±1.40	14.38±1.08	0.98
Cholesterol (mg/ dl)	181.70±37.96	215.85±44.63	204.72±30.02	0.16
HDLc (mg/ dl)	59.08±10.42	56.31±22.04	58.57±8.10	0.90
LDLc (mg/ dl)	103.74±25.64	129.68±42.32	134.40±31	0.09
Triglycerides (mg/ dl)	100.78±30.89	88.14±26.21	117.99±33.12	0.14
Total proteins g/ l	7.34±0.45	7.38±0.90	7.25±0.48	0.89
Glucose (mg/ dl)	98.69±9.89	98.85±12.36	96.26±8.65	0.81
TSH (µUI/ml)	3.90 (2.67;6.51)	4.34 (2.53;6.09)	8.24(3.31;9.09)	0.49
ESR (mm/ h)	8 (5;17.75)	10 (7;14)	12 (7;26)	0.37
eGRF (ml/ min/1,73 m^2 sc)	76.45±9.41	81.68±13.94	87.16±13.42	0.15

DISCUSSION

Calories intake versus number of meals

The results in our study show that obese individuals have fewer meals per day compared to those who are overweight. One possible explanation is that meals, even few in number, are much higher in calories.

Our findings are consistent with those in the literature. In a Spanish cross-sectional study of 23 adults with DS, researchers used a consumption frequency questionnaire and the Mediterranean Diet Prevention Questionnaire to qualitatively assess dietary patterns. The study showed low intakes of vegetables, fruits, and dairy products, while the consumption of meat and sweet snacks were notably high (more than twice a week) (15).

Dratwa *et al.* (16) described in a study from 2023, the dietary habits of children and young adults with DS, pointing the importance of parental dietary mistakes. The study found that 62.6% of children had no nutritional restrictions, but some parents opted for a gluten-free (26.2%), lactose-free (28.7%), or no sugar diet (13.3%). The study concluded that while most children with DS have a balanced diet, parents often make nutritional errors.

Glucose levels

The results of the present study showed a mean glucose levels within normal ranges across the entire study group. Nevertheless, the mean glycemic index was notably lower in obese patients. Accordingly, a study conducted by Braunschweig *et al.* (17) in the United States (U.S.) while assessing the nutritional status of 48 adults with Down syndrome, revealed that 89% of participants were either overweight or obese, 54% had large waist circumferences, and none met the recommended guidelines for fruit and vegetable intake. Despite these findings, average glucose levels remained within normal ranges, and the prevalence of hypertension, elevated lipids, and glucose levels was lower compared to the general U.S. population.

Lipid profile

When analyzing the lipid profile, an intriguing paradox emerges: triglyceride levels exhibit the lowest mean values in overweight patients, while total cholesterol levels are highest among this group compared to the other patient categories. Overall, the only parameter that consistently

increases with weight is LDL cholesterol.

In an attempt to understand what leads to possible changes in the lipid variables of people with DS, some hypotheses were raised.

Excess weight and body fat, especially in the abdominal region, common among people with DS, may possibly interfere with lipid levels. Ordonez-Munoz *et al.* (18) found significant correlations between anthropometric variables (BMI, AC) and the lipid profile of young people with DS. However, Asua *et al.* (19) found that adult participants with abdominal obesity, did not present total cholesterol, LDLc, HDLc or triglyceride values different from those who were not identified with excess abdominal fat.

The understanding of thyroid function and its link to obesity in adults with DS is limited due to the scarcity of long-term follow-up data. As to the alterations in the lipid profile of the patients included in our study, hypothyroidism may also be related to changes in cholesterol, especially increased LDL. Studies and scientific papers have demonstrated that reduced thyroid hormone levels lead to decreased synthesis and expression of LDL receptors resulting in high serum levels of LDL and, consequently, increased cholesterol levels. (20).

Subjective Global Assessment

Findings in our study reveal that overweight patients had the best mean SGA score (3.71 points). Notably, 71% of these patients had scores ranging from 4 to a maximum of 8, indicating a clear need for dietary intervention. Conversely, the obese group showed a more urgent requirement for symptom management or nutritional intervention, with 54% of patients scoring between 4 and 8 and 20% achieving scores exceeding 9 points.

This discrepancy may be attributed to the fact that overweight individuals maintained a more balanced diet, with regular dairy and meat intake (70% and 80%, respectively), and a higher rate of adequate water consumption (60% drinking 1000 ml/day). This group also exhibited superior hand grip strength (15.21±4.14 and 15.28±5.34), even compared to the normal weight group, although only 14.28% engaged in moderate physical activity.

Recent literature indicates that SGA is a highly effective tool for nutritional diagnosis, often outperforming traditional methods such as anthropometry and laboratory data. However, its application in individuals with DS has not been extensively explored. This is a notable gap, considering the limited research on nutrition for individuals with DS, where many studies depend on less precise nutritional questionnaires and caregiver assessments (13, 21, 22).

Water intake

Previous research has consistently highlighted a concerning trend of dehydration among individuals with DS (23, 24). This issue is often linked to anatomical changes or muscle hypotonia. Additionally, studies have shown a troubling preference for sweet beverages over plain water in this population (15, 16). This underscores the vital role that family members and caregivers play in steering adults with DS toward healthier dietary and hydration habits.

Our study's findings resonate strongly with these observations, revealing not only insufficient water intake across all patient groups but also a worrying tendency toward fast food consumption, particularly among those with obesity. Most alarmingly, our results indicate a predominant association with a mean renal function gradient (RFG) suggestive of renal distress. One

possible explanation for this issue may be closely tied to the high intake of animal and vegetable protein (70%), further emphasizing the need for targeted interventions to improve dietary habits and prevent serious health complications in this vulnerable population.

Weight management strategies for individuals with DS include portion control, increased fiber and vegetables, and regular physical activity tailored to their abilities. The "GLOBAL Medical Care Guidelines for Adults with DS" provide recommendations, but more research is needed on the combined effects of diet, exercise, and calorie management in this population (25).

Limitations of the study

The limitations of our study include the small sample size and the lack of a control group without Down syndrome DS. These factors may limit the ability to generalize the findings and might impact the strength of the conclusions. They also present challenges in relating variables to accurately represent the broader DS population. Furthermore, the relatively small number of studies on adults with DS, compared to those focused on pediatric populations, underscores the need for additional research targeting this specific group.

CONCLUSSIONS

This study highlights that while overweight status can be relatively manageable for a patient with DS, progression to obesity presents significant health risks and can lead to rapid deterioration in health outcomes. The data emphasize the urgent need for early intervention upon the onset of obesity. It is imperative that families receive targeted education regarding nutritional guidelines and management strategies specifically designed for individuals with DS, due to their distinct obesity-related challenges.

CONFLICT OF INTEREST AND FUNDING

The authors declare that there is no conflict of interest, and they received no specific funding regarding this scientific research.

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