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DIET AND PHYSIOTHERAPY IN THE TREATMENT OF OBESITY AND ITS COMORBIDITIES

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Abstract

Historically considered an aesthetic benefit, obesity was first regarded as a disease only in the twentieth century, along with the proliferation of medical studies that have highlighted the systemic echo of obesity on the human body. There are practically no body structures, devices, systems or organs which are not affected by obesity. Under these conditions, obesity is, in most cases, a decisive or contributory factor for the occurrence of numerous comorbidities, which progressively damages the health of individuals. Given that in recent years in Romania there has been an alarming increase in the incidence of obesity in both genders in all age groups, the author attempts to highlight the role of physiotherapy, not only in weight loss but also in preventing and ameliorating affections caused by obesity. A kinetic program adapted to both age and fitness level in overweight patients can help reduce body weight and its comorbidities in optimal conditions. This experimental study was conducted during October 2014 - September 2015 on a sample of 30 subjects aged 21-80 years consisting of overweight females with BMI (body mass index) initially varying between 30 and 45. After data processing, one can observe that, by applying a kinetic program adapted to the residual effort capacity, as well as a 1200 Kcal per day diet, both the body mass index and obesity-related complications were improved. The studied parametric values showed beneficial impact in overweight patients during 12 months of a systematic and individualized kinetic program, in the subjects of the experimental group.

Keywords: Obesity, "BMI, comorbidities, diet, physiotherapy.

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1. Introduction

Obesity is a metabolic nutritional disorder induced by multiple factors, such as genetic, familial, socioeconomic and so on. Over time, from being considered an aesthetic benefit, obesity started to be regarded as a disease late in the twentieth century, along with the deepening medical studies that have marked the systemic resounding of obesity on the human body. Basic there is no organism structure, system or organ, which is not affected by being overweight. In the US, a country where obesity is a real national health problem, with its frequency among the general population hovering at 30.6%, medical expenses generated by obesity and its comorbidities represent up to 5% of the total health budget (Harvard Medical School, 2016).

Carefully designed programs of medium to submaximal intensity, will influence weight loss. In the case of morbid obesity, the program prescribed should ensure that the exercises should not affect the lower limbs' joints, the venous flue and should not be performed with a blocked thorax.

In female subjects, the weight loss by exercise and diet is less significant than in males (Bhogal & Langford (2014), which is why this study focuses on female patients.

WHO defines obesity as "abnormal or excessive fat accumulation that may impair health" (WHO, 2017). Obesity is frequently associated with a series of metabolic afflictions (comorbidities) (Khaodhiar, McCowen & Blackburn, 1999): insulin-resistance and type 2 diabetes, high blood pressure, dyslipidemias, sleep apnea, biliary diskinezia, hyperuricemia and gout, osteoarthritis etc. In chronic forms, obesity is associated with cardiovascular diseases, stroke, and respiratory diseases with restrictive ventilatory disorders.

The following discussion focuses in some detail on the comorbidities associated with obesity in view of the focus of this study to attempt to see if a planned kinetic program can help reduce such comorbidities in the selected study sample.

There are frequently reported psychic disorders as depression (Keddle, 2005, 2006), which might be caused due to the hypothalamic-pituitary-adrenal disorder (HPA axis). This complex is responsible for the secretion of the "stress" hormone – known as cortisol in the Anglo-Saxon school, which, among others, determines abdominal fat storage. However prolonged straining leads to depression due to the depletion of the adrenal glands. Another explanation for obesity and associated depression could be the social stigma and exclusion, leading in time to psychic disorders (Nemiary, Shim, Mattox & Holden 2012).

Digestive disorders are often linked to obesity. There are frequently reported a number of disorders commonly known as "functional gastrointestinal disorders" (FGIDs) (Huseini et al., 2014). Chronic diseases such as dyspepsia or irritable bowel syndrome (IBS) are most commonly encountered. It seems that these afflictions are caused by mechanical disorders induced by obesity, without finding objective correlations between these diseases and obesity. This is because, although in the United States 1 of 3 people is obese (having a BMI of over 30 kg/m^2), only the third of these patients have IBS. Another condition that is more common in the obese than in the general population is the gastroesophageal reflux disease. The authors (Nemiary, Shim, Mattox & Holden, 2012) have classified functional digestive disorders that accompany obesity with greater frequency in respect to the symptomatology as follows:

1. Oral symptomatology (ulcerations or growths of mucosa, gingival bleeding, dental disorders, persistent sour taste);

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2. Throat symptoms (general or selective dysphagia (for solids or liquids), nausea, "lump throat");

3. Eso-gastric symptomatology (persistent sour taste, nausea, eructation, retrosternal pyrosis, vomit);

4. Abdominal pain ("hunger pain" or postprandial pain);

5. Bowel disorders (diarrhea, anorectal incontinence, flatulence, abdominal bloating, excessive gas emissions, constipation, colorectal bleeding etc.).

The authors have identified the most commonly affected group are overweight women aged between 45 and 50 years.

In our opinion, the digestive functional disorders are mostly mechanically caused and are mainly due to increased intra-abdominal pressure, a phenomenon that causes a contradictory behaviour of the intestinal walls (either speeding up, slowing down the bowel or an alternation of the two phenomena), gastric stasis and consecutive esophageal reflux, dyskinetic type disorders of the gallbladder wall, dyspeptic syndromes of different intensities etc.

The dyspeptic syndrome, most commonly secondary to other afflictions, both digestive (aerophagia with gastric's fornix distention, inflammation, ulcers or gastric cancers, irritation of the colonic mucosa, intestinal parasites), or extradigestive (hyperthyroidism, diabetes mellitus, renal failure, alcohol consumption, or either unexpected or prolonged administration of NSAIDs, cortisone, antibiotics, digitalis etc (Solomon, 2014).

A clear relationship has not been established between obesity and type II diabetes, but the association of obesity and inactivity seem to worsen the diabetic patients' condition, due to the overweight gradually developing insulin-resistance (Rogers & Still, 2009). Authors have stated that weight loss improves blood sugar levels, until normalization. On the other hand, insulin treatment of type I diabetes can cause weight gain, facilitating absorption, intracellular capture and storage of glucose into fat deposits (by activation of glycolysis and lipogenesis). Moreover, with the start of insulin treatment, the diabetic's body does not need the same amount of food because the glucose utilization increases (Still et al., 2014).

Delgado, Barranco & Quirce (2008) declared that obesity is a risk for the emergence or worsening of asthma by reducing pulmonary compliance, decreasing respiratory volumes and membrane-type airway compression. Also, the increased intra-abdominal pressure decreases venous return and, consecutively, pulmonary functional circulation, affecting the circulation - perfusion ratio.

Regarding the appearance and/or worsening of lipid metabolism disorders in obesity, Howard, Ruotolo & Robbins, stated in "Obesity and dyslipidaemia" (2003) that parallel with weight gain, frequent dyslipidaemic hypertriglyceridemia, decreased HDL and with the emergence of LDL with abnormal structures will be encountered. The same authors show important relationships between lipid metabolism and changes in the frequency and/or severity of cardiovascular diseases, which in obese patients have higher incidence than in the general population. In the same article it is stated that exercise and weight loss, even though the BMI (body mass index) does not reach optimum values, decrease cardiovascular risk and reduce cholesterol and blood lipids values.

Also, Klopp, Elte et Cabezas (2013) reported the obesity-dyslipidaemia relationship and the development of insulin resistance in peripheral tissues.

According to Bardet-Biedl Syndrome UK Registered Charity, the Bardet-Biedl Syndrome is a genetic disorder, autosomal recessive transmitted, which is manifested by ocular disorders (reporting

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dystrophy in rods and cones cells, atypical retinitis pigmentosa, nocturnal hemeralopia, strabismus, astigmatism, cataracts, macular edema, achromatopsia, optic nerve atrophy etc) that evolve along with decreased visual acuity to total blindness, central truncal obesity, type II diabetes, polydactyly, syndactyly, morphological abnormalities of renal and urinary tract, congenital heart defects, facial abnormalities (hypertelorism, prominent forehead), micrognathia, malocclusion, faulty implantation of teeth, changes in tooth enamel, growth disorders or delayed growth, distal muscle weakness, capsule-ligament hyperlaxity (genu valgum frequently appears), arthralgia, impaired balance and coordination (dyspraxia, dysdiadochokinesia) which cause ataxic gait, difficulty in learning, immaturity and emotional instability, difficulty in understanding abstract concepts, speech disorder, hearing loss (albeit rarely) etc. (Beales, Elcioglu, Woolf, Parker & Flinter, 1999).

Although obesity and hypothyroidism are common conditions, it could not be proved that obesity has a role in the occurrence of hypothyroidism (Ruiz-Tovar et al., 2014). On the other hand, hypothyroidism often causes weight gain and metabolic disorders, the proper treatment of the glandular condition leading to BMI improvement (Biondi, 2010). The coexistence of the two disorders makes it difficult to improve weight in order to improve the BMI (Trentini, 2013).

Both hyperuricemia and obesity are part of the metabolic syndrome that includes hypertension and dyslipidemia (Lohr, 2017). On the other hand, like obesity, hyperuricemia is influenced by familial predisposition and is recognized as an intake metabolic disorder; therefore, the two conditions have, to a large extent, parallel developments (Bonomini, Rodella & Rezzani, 2015).

Obesity correlates with increased mortality from chronic cardiovascular disease (myocardial infarction) (Mehta & all, 2016). Coronary and systemic atherosclerosis has as main etiological factors dyslipidaemia and hypercholesterolemia, which are more common in the overweight and the sedentary (Eckel, 1997). A higher risk of acute heart failure was calculated in overweight patients, as well as of cardiomyopathy occurrence (associated with sudden death) (Chandra et al. 2014). Additionally, more cases of hypertension were observed, and its progress was more serious, resulting in concentric hypertrophy in the left ventricle. In the quoted article Eckel (1997), lists as cardiovascular complications of obesity the pulmonary embolism, the coronary artery hypoplasia, the presence of cardiac arrhythmias and myocardial delayed repolarization phenomenon etc. Although most alterations regard the left side of the heart, there have been reported disorders in the right ventricle (hypertrophy, dilatation, progressive dysfunctional phenomena to acute failure).

Regarding the venous circulation, after studying comparative limb movements of 23 lean individuals and 22 obese ones, Willenberg et al. (2010) observed that the return blood flow is significantly different in the two groups, due to the abdominal fat deposits which exert mechanical compression on the large veins at this level. Therefore, obese people have an increased risk of developing thrombophlebitis of the lower limbs and chronic venous insufficiency phenomena (Davies, Popplewell, Singhal, Smith & Bradbury, 2017).

2. Problem Statement

Obesity and the resultant afflictions can be circumvented with appropriate physiotherapy and methodical dieting. These interventions have an essential role to play in weight maintenance. Thus far, an

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intervention comprising elements of physiotherapy and methodical dieting have not been adequately assessed in terms of testing for weight loss and concurrent reduction on comorbidities.

3. Research Questions

3.1What are the effects determined by physiotherapy and diet in weight loss?

3.2 Does the weight loss result in any decrease in the afflictions associated with obesity associated or secondary afflictions?

4. Purpose of the Study

The purpose of this study was to apply a kinetic program appropriate to the age and degree of training in overweight patients, to see if it could help reduce body weight and obesity comorbidities under optimal conditions, without risk and without triggering other metabolic complications.

5. Research Methods

This study, based on the experimental method, was conducted during the period October 2014 - September 2015 on a sample of 30 overweight women, between 21-80 years, with an initial BMI in the 30-45 range. The subjects were selected from among the patients of a nutrition and body reshaping cabinet of Bucharest where they were monitored by an accredited physician and a nutritionist for the duration of the program. The participation was voluntary.

The diet therapy was individually established, attempting to maintain each subject's own food preferences, containing daily caloric intake of 1000-1200 kcal. It comprised five meals (food intakes) per day, aiming to decouple the meals principles, as follows:

- Morning (700 hours) protein (egg or lean meat) and slow carbohydrates (hypocaloric bread);
- 1000 hours: fruits (250 g);
- Noon (1300 hours): protein from fish and lean meat and vegetables (salad or stuffed);
- 1600 hours: fruits (250 g);
- Dinner (19-20 hours): protein from fish and lean meat and vegetables – similar in dose and composition to the lunch.

It was recommended that patients not consume alcoholic drinks or sweetened liquids, but for adequate hydration about 2 l of fluid per day - water or tea.

A program of physical therapy was simultaneously introduced which, as stated, was individualized and followed according to each patient's exercise capacity and associated pathology. The program was conducted in three stages, while the patients lost weight and was maintained over a period of three months for each patient. The program comprised:

a. Passive Kinetotherapy consisting in muscle electrostimulation, on the abdominal, gluteal and calf muscle groups (anterior, medial and posterior) in parallel with thermotherapy at warm temperatures of 38-40ºC;

b. Active Physical Therapy executed in positions without loading (supine); at this stage the active exercise with thorax blocking and generalized isometry is forbidden;

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c. Physical Therapy executed in antigravity positions and active load/resistance, crawl exercises, mechanotherapy, workout on cycloergometer-dosed effort etc.

The program of 1.5 - 2 hours was carried out three times a week, alternating kinetic means within the same week. The patients conducted, in the same period, programs consisting of running on level ground, on their own pace, one-hour daily.

The treatment was completed with cellulite massage and general lymphatic drainage - one session per week.

6. Findings and Discussion

The patients comprising the experimental group were monitored throughout the course of the treatment. Evolution of weight and comorbidities of each patient were summarized in Table 01. (Age=A; Height=H; Initial/Final Weight=IW/FW; Body Mass Index=BMI; Initial=I; Final=F).

Table 01. Patients' Record

No.	Age	H	IW	FW	BMI		Associated disorders	Comorbidities evolution
					I	F		
1	21	171	95	84	34	28.6	Hypercholesterolemia	Improved
2	27	174	102	93	33.7	30.7	IBS; Slow intestinal transit	Improved
3	32	171	93	85	31.6	29	Constipation	Improved
4	36	168	90	82	31.9	29	Hypothyroidism	Unchanged
5	38	166	105	93	38	33.8	Hyperuricemia	Improved
6	41	169	98	91	34.3	32	Asthma	Improved
7	42	164	114	105	42.4	39	Hypercholesterolemia	Improved
8	46	161	89	83	34.3	32	Dyslipidaemia	Improved
9	49	165	91	86	33.4	31.6	Diabetes; Circulatory Disorders	Improved
10	54	158	102	95	41	38	Dyslipidaemia; Varix	Improved
11	35	160	85	80	33.4	30	Slow intestinal transit	Improved
12	60	157	115	103	45	40	Osteoporosis; Diabetes	Unchanged
13	55	162	90	84	41	39	Varix	Improved
14	33	153	70	60	30	26.3	Hypothyroidism	Unchanged
15	75	171	94	84	40	35	Hypercholesterolemia	Improved
16	64	168	103	90	41.3	38	IBS	Improved
17	42	183	130	101	38.8	30	Slow intestinal transit	Improved
18	39	180	120	115	39	35	Dyslipidaemia	Improved
19	29	160	89	70	31	28.2	Thrombophlebitis	Unchanged
20	27	165	93	77	33	30	BARDET-BIEDL Syndrome	Unchanged
21	58	169	104	96	40	37.2	Hypertension; Diabetes; Circulatory disorders	Improved
22	72	160	95	90	39.4	33.3	Hyperuricemia	Improved
23	80	167	82	78	43.1	38.5	Asthma	Unchanged
24	39	172	98	88	36.9	30.4	Circulatory Disorders; Asthma	Improved
25	23	164	80	70	34	31.1	Slow intestinal transit	Improved
26	30	170	95	86	32.7	29	Dyslipidaemia	Improved
27	33	172	100	81	32.5	29.3	Hypertension; Circulatory Disorders	Improved
28	47	163	113	97	34.4	31.7	Hypercholesterolemia	Improved
29	42	170	100	90	35	29	Hypertension	Improved
30	48	174	123	103	39.7	30.2	Hypothyroidism	Unchanged

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1. The study group comprised 30 female patients. The group's structure in respect to the subjects' age is displayed in Fig. 01.

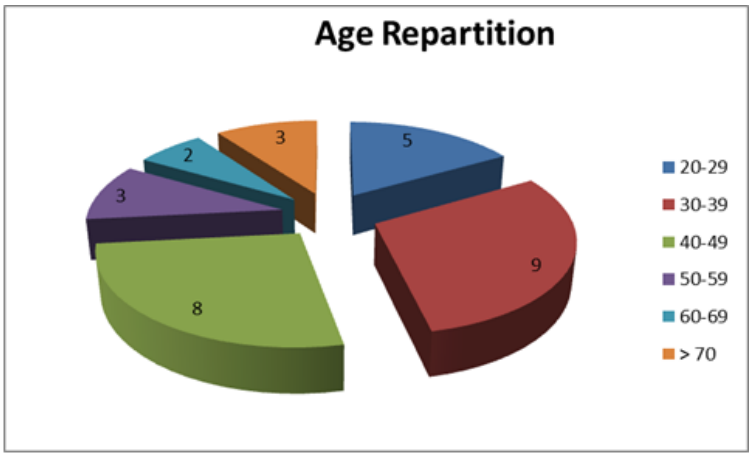

Figure 01. Age Repartition

2.All patients displayed an initial BMI of over 30. The group's structure in respect to the initial BMI is displayed in Fig. 02.

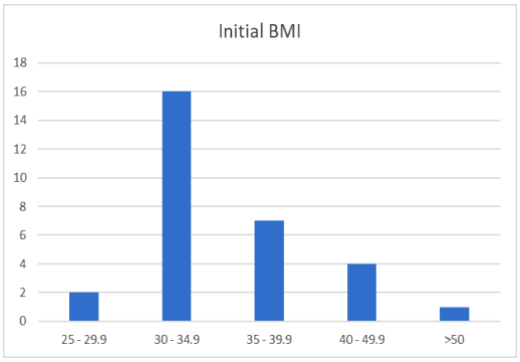

Figure 02. Initial BMI

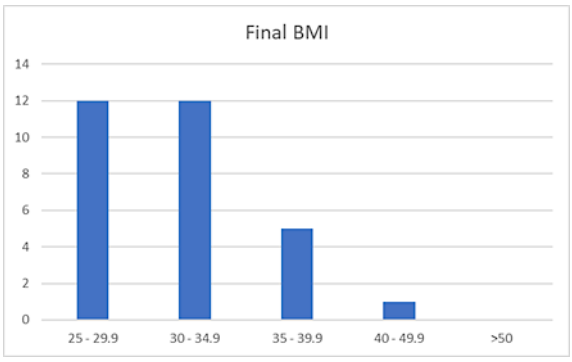

Figure 03. Final BMI

3.The BMI decreased in all patients who underwent the treatment. The group's structure, in respect to the final BMI, is displayed in Fig. 03.

4. The group's structure in respect to weight lost is displayed in Fig. 04.

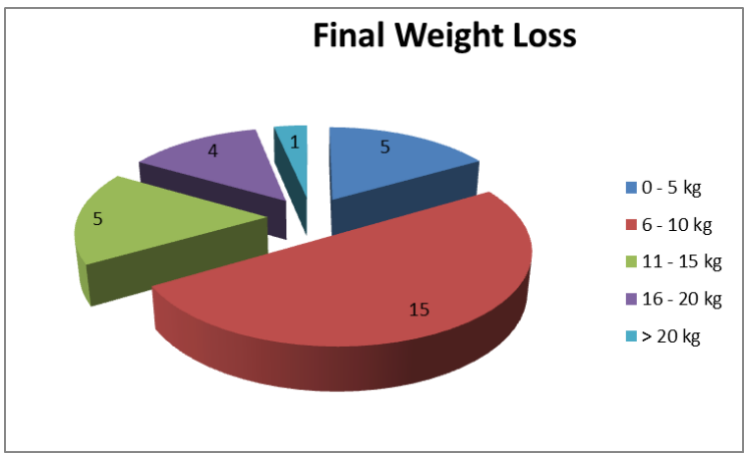

Figure 04. Final Weight Loss

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5. Out of the 30 patients, 6 (20%) suffered from associated polypathology.

6. The associated pathology in the studied group was as follows:

- 8 cases of lipid metabolism disorders – different forms – 26.6%;
- 5 cases of bowel disorders – 16.6%;
- 3 cases of diabetes – 10%;
- 2 cases of hyperuricemia – 6.6%;
- 9 cases of circulatory disorders and high blood pressure (30%);
- 3 cases of bronchial asthma – 10%;
- 3 cases of hypothyroidism – 10%;
- 1 case of osteoporosis – 3.3%;
- 1 case of Barded-Biedl syndrome (genetic disorder) – 3.3%.

7. Concerning the evolution of associated pathology, following the biochemical analysis of laboratory and clinical parameters, it is noted that, in any case, the combined dietary -physical treatment did not worsen the patients' conditions. Improvements in comorbidities were noted as follows:

- 8 cases of lipid metabolism disorder;
- 8 of 9 cases of circulatory disorders – did not yield improvement in the thrombophlebitis;
- 6 bowel disorder cases (IBS, constipation);
- 3 cases of diabetes;
- both cases of purine metabolism disorder (hyperuricemia);
- 2 of the 3 bronchial asthma cases.

8. There were no improvements in the three cases of hypothyroidy, in the Bardet-Biedl syndrome patient, in the patient that also suffered from thrombophlebitis, in one of the bronchial asthma cases and in the osteoporosis patient aged 60.

7. Conclusions

7.1. Regardless of age, all 30 of the study subjects study showed some degree of weight loss, from 4 kg and to 29 kg. In female patients, the age is a limiting factor for the amount of lost weight due to the reconfiguration of the endocrine complex at ages 40-50 years, along with the association of comorbidities, which increase the body's resistance to therapy.

7.2.The associated diseases that were diagnosed during the study were influenced by complex treatments as follows:

- Digestive disorders improved until completely healing;

- Venous circulation disorders (such as varicose veins, venous thrombosis, thrombophlebitis), encountered in 23% of cases were improved due to lower abdominal pressure caused by the disappearance of peri-visceral adiposity;

- The diagnosis of bronchial asthma was present in 3 patients (10% of cases). Although weight loss does not influence bronchial reactivity, lung function across all affected patients improved due to the reduction to healing of the restrictive syndrome.

- Dyslipidaemia was present in 8 patients (26.6% of cases). They are represented by hypercholesterolemia (4 cases) and increased levels of total serum lipids (5 cases). These disorders

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experienced the most dramatic decline, confirming the hypothesis that most are caused by inappropriate nutrition.

- The other metabolic disorders identified were osteoporosis (1 case, 60 year old patient), diabetes (3 cases), hyperuricemia (2 cases). In all these situations, the serum levels of appropriate indicators improved, leading to the conclusion that the evolution of these diseases was slowed.

- Endocrine dysfunctions were recorded in 3 subjects (10%) were hypothyroid-related. Although this condition is cited among those which develop the highest resistance to weight reduction therapy, in one of the cases that we have dealt with, a 48 year old patient achieved a weight loss of 20 kg, representing 16% of their original weight.

7.3. All patients who recorded voluntary weight loss through physical activity and diet, note an improvement in neuro-psychological tonus and obvious positive results in family and socio-professional relationships. The kinetic program, associated with thermotherapy, massage and an individualized food diet is a key factor both in the treatment of obesity and its associated – or secondary – pathology.

7.4. The neuro-psychological factor plays an important role during the treatment. Patients who formulate strong motivations will follow through the required treatment throughout the prescribed duration and will obtain positive results in up to 80% of cases. Conversely, in labile patients, the drop-out rate is higher and the expected results will not be achieved.

8. Implications

This study highlights the importance of weight loss, by the means proposed in this experimental method, on the favourable evolution of various cardiovascular, respiratory, digestive and metabolic afflictions, which are often comorbidities related to obesity. Obesity is a life threatening condition, leading to dsyfuntional physical and psychological consequences for the sufferer. An increasing number of people are potentially leaning towards obesity due to lifestyle choices and while prevention is better than cure, it is also necessary to identify effective interventions that can help these individuals to live a satisfying life. The bigger picture is that such interventions can help reduce the nation's budget on medical expenditure required to treat these people.

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