Ischemic stroke prevention.

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Research Article

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Abstract

Health prophylaxis is the most effective way to reduce the incidence of diseases, and the knowledge of factors predisposing to the increase in the incidence of a given disease directs actions aimed at maintaining health. The proprietary stroke prevention program was used, which consisted in introducing dietary changes, health education and increasing the physical activity of the respondents. At quarterly intervals, each examined person was measured: blood pressure, glucose level, total cholesterol and its fractions, triglycerides, sodium and potassium levels, prothrombin time (PT), INR, PT activity, INR. The study included 40 randomly selected women (the research and control group consisted of 20 people) aged 40–60 years from the Michałowo Commune in the Białystok poviat. Additionally, an interview was collected with the completion of the proprietary questionnaire. The most important conclusions are: people aged 40–60 are the group most at risk of stroke; stroke prevention significantly reduces the likelihood of developing a stroke; normalization of test results (in the experimental group there was a decrease in body weight, normalization of blood pressure, increase in HDL level) improves the biopsychosocial state. The analysis performed is a sample and it is recommended to repeat the study on a large population.

Introduction

Health prophylaxis is the most effective way to reduce the incidence of diseases, and the knowledge of factors predisposing to the increase in the incidence of a given disease directs/defines the activities aimed at maintaining health. There are modifiable (human-dependent) and non-modifiable factors (not human-dependent, e.g. age, gender, race)[1]. A publicly funded study as part of the statutory work of the Medical University of Bialystok No. N / ST / MN / 18/003/3310 confirmed that prophylaxis reduces the likelihood of a stroke.

The WHO (World Health Organization) reports that about 15 million people suffer from a stroke every year. The most common stroke is ischemic (incidence 70-80%), while 20-30% of the occurring strokes are hemorrhagic strokes. Subarachnoid hemorrhage (SAH) accounts for 5-7% of all strokes. The venous stroke is the least common as its incidence is 1-5 / 1000 strokes [2]. Death due to stroke is reported in 5.5 million of the world's population [3] / A total of 5,5 million people die due to brain stroke [3]. It is also the main cause of disability (50% of patients diagnosed with stroke) and the second cause of dementia (25% of patients suffering from stroke). After heart disease and cancer, it is the leading cause of death among the population of highly developed countries [3,4]. The likelihood of developing a stroke increases with age. The literature reports that after 55 years of age it increases by 50% in the next ten years of life [5]. In people aged 35 - 44, the incidence of stroke ranges from 30 to 120 per 100,000 people per year, at the age of 55-64 the first episode happens in 300 / 100,000,while for the population aged 65 to 74 years, 670 - 970/100,000 people per year [3.6]. In children, a stroke occurs with a frequency of 2.5-2.7 in 100,000 people per year and usually affects boys up to 6 years of age. Under 18 years of age, ischemic stroke is less common than hemorrhagic stroke, accounting for 30-45% of cases[7]. The INTERSTROKE study including 13,447 strokes and an adequate number of controls, conducted in 32 middle-income and low-income countries, showed that approximately 90% of strokes involve 10 modifiable risk factors: 1) hypertension, 2) diabetes, 3) heart causes, 4) smoking tobacco, 5) abdominal obesity, 6) hyperlipidemia, 7) lack of physical activity, 8) alcohol consumption, 9) diet, and 10) psychosocial stress and depression [8].

BMI (Body Mass Index) is an indicator of stroke predisposition which is independent of the effects of hypertension, diabetes and cholesterol. As BMI is a modifiable risk factor, preventing stroke may be another benefit of treating obesity. Body weight shows a relationship directly proportional to the occurrence of ischemic episodes of the heart and brain. In addition, it has an affinity to other factors leading to stroke, including hypertension and diabetes. However, the data on the overall association of obesity and stroke, as well as the subtypes of stroke, are limited and inconclusive [9].

Diabetes is considered to be an independent factor of stroke, which is underestimated in diagnostics [10]. The literature shows that the mortality of patients with type II diabetes aged 45+ increases 6-8 times and by 12 times in the presence of hypertension. Moreover, it is emphasized that diabetics are twice as likely to develop atherosclerosis, which directly contributes to thromboembolic stroke [10].

An ischemic stroke of thrombotic origin can be caused by too numerous blood clotting factors. In order to determine the efficiency of the coagulation system, the prothrombine time (PT) is used [11]. Oral contraception when it is incorrectly selected or conducted affects the thickness of the blood and may lead to thrombosis [12].

Hemorrhagic stroke may be caused by too high INR (international normalized ratio) value [12]. Taking into consideration the above, people taking preparations that affect the coagulation system are at risk of suffering a stroke.

Cholesterol is a lipoprotein that is part of the cell membranes, but is also responsible for the proper functioning of the circulatory system [13]. There are HDL and LDL fractions. HDL (High Density Lipoprotein) is high density cholesterol and is colloquially called good cholesterol. Its main task is to transport fats from the peripheral tissues, where they will be metabolized [14]. Normal HDL concentration in women should be above 50 mg / dl, and in men> 40 g / dl [15]. The LDL (low-density lipoprotein) fraction is low-density cholesterol and is commonly known as bad cholesterol. The acceptable level of LDL is 115 mg / dl (3.0 mmol / l) [15, 16]. Its task is to transport fat particles to the peripheral cells [17]. Due to the fact that it distributes lipids throughout the body, it causes plaque formation. The cholesterol level depends on, among others, physical activity and diet [18,19]. Dyslipidemia causes atherosclerosis, coronary artery disease and stroke [13]. Triglycerides (TGs) are fat molecules that have two important functions in the human body. The first is providing energy for the body, while the second is storing fat molecules in the cytoplasm of the fat cell. Their level should not be higher than 150mg / dl (1.7mmol / l) [15.20]] The risk of an ischemic stroke is that fat cells aggregate on the atherosclerotic plaque, thereby reducing the lumen of a blood vessel. The final effect may be complete obstruction of the vessel or formation of a thrombus on the atherosclerotic plaque. An ischemic stroke occurs when a blood vessel closes, which may be caused by a detached plaque or by a blood clot formed on its surface.

Methods

The author’s stroke prevention program consisted in introducing dietary changes, health education and an increase in the physical activity of the respondents.

At quarterly intervals, blood pressure, glucose level, total cholesterol and its fractions, triglycerides, sodium and potassium levels, prothrombin time (PT), INR, PT activity were measured in each person included in the study. The study group consisted of 40 randomly selected women (the test and control group included 20 women each) aged 40-60 years from the Michałowo Community in Białystok poviat, who had a comparable economic and social status. The project was financed from public funds as part of the statutory work No. N / ST / MN / 18/003/3310.

Additionally, an interview was collected with the completion of the proprietary questionnaire, which was created on the basis of the SF-36 Life Quality Assessment Questionnaire - Polish version. Statistical analysis was performed based on the Shapiro-Wilk distribution normality test and the t-student probability test.

The analysis performed is a sample and it is recommended to repeat the study on a large population.

Result

During the stroke prevention program, the experimental group showed a statistically significant decrease in BMI values. Table 1. below presents the data obtained with the correlation between the measurements.

BMI0 - measurement before the implementation of the prevention program; BMI1-3- measurements at 3-month intervals.

The control group showed no statistically significant changes. Table 2. below presents the data obtained.

BMI0 - measurement before the implementation of the prevention program; BMI1-3- measurements at 3-month intervals

The above data are presented in the form of histograms (Figs. 1 and 2). In the test group, both the body weight and the deviation from the mean value decreased. In the control group, the graphs overlap and no significant changes can be seen.

Another positive result of the health prophylaxis was an increase in HDL value and a reduction in LDL. LDL values dropped significantly in the experimental group. However, in the control group, in most cases, they remained at a similar level or slightly increased.

The graphs below (Figs. 3 and 4) present the individual test results. Additionally, the threshold of the maximum acceptable value is marked. LDL0 - measurement before the implementation of the prevention program; LDL1-3- measurements at 3-month intervals.

The HDL values were proportionally related to the LDL values, i.e. they increased in the experimental group (Fig.5.) and decreased in the control group (Fig.6.). In order to observe the annual change, the data obtained are presented in the diagram. HDL0 - measurement before the implementation of the prevention program; HDL1-3- measurements at 3-month intervals.

The value of triglycerides is one of the assessments of atherosclerosis risk in the form of atherosclerotic plaques.

The values of blood clotting indices did not change statistically significantly in the study group and in the control group during the entire study. The results were within the range of normal values for healthy people.

Moreover, correlations between the increase in the blood glucose level and the increase in body weight were observed at the significance level of $p < 0.05$. The graph below (Fig. 9) illustrates the quarterly change in blood glucose in the experimental group.

Table 3 below shows the lack of a statistically significant correlation between blood glucose levels and body weight.

Different values were obtained in the control group. The obtained data are presented below - Fig. 10, Tab. 4.

The value of systolic and diastolic pressure was analyzed. In the experimental group, a significant decrease in the values of systolic and diastolic blood pressure was reported in most of the respondents. After 3 months, 5 patients had an increase in systolic blood pressure (by a maximum of 10%), regardless of the value of diastolic pressure. On the other hand, an increase in the value of systolic (up to 20%) and diastolic (up to 25%) pressure was determined in the majority of cases in the control group. Graphs (Fig. 11-14) illustrating the data obtained are presented below.

It is worth underlying that the correlation between the increase in the systolic to diastolic pressure in both groups is statistically significant at the level of $p < 0.5$

The obtained data divided into the study and control group were distributed as follows:

1. a) Study group: systolic0: diastolic0: 0.6569; systolic1: diastolic1: 0.6375; systolic2: diastolic2: 0.5818; systolic3: diastolic3: 0.4963
2. b) Control group: systolic0: diastolic0: 0.9218; systolic1: diastolic1: 0.8981; systolic2: diastolic2: 0.9186; systolic3: diastolic3: 0.8707

It was checked whether there was a correlation between the change in the systolic blood pressure value and the level of weight loss during each control. The data obtained showed no statistically significant (p> 0.5) relationship in the value of body weight and systolic pressure in the experimental group: weight0: systolic0 -> 0.1826; mass1: systolic1 → 0.1420; mass2: systolic2 -> 0.0831; mass3: systolic3 -> - 0.0168. In the control group, the results were statistically significant (p <0.5): weight0: systolic0 -> 0.5800; mass1: systolic1 → 0.5696; mass2: systolic2 → 0.5362; mass3: systolic3 -> 0.5424.

The situation was repeated during the analysis of the relationship between the diastolic blood pressure and the body weight. No statistical significance (p> 0.5) was found in the study group: systolic0 -> 0.2781; mass1: systolic1 → 0.2639; mass2: systolic2 → 0.2497; mass3: systolic3 -> 0.1000. In the control group, the results were statistically significant (p <0.5): weight0: systolic0 -> 0.6558; mass1: systolic1 → 0.6592; mass2: systolic2 -> 0.6044; mass3: systolic3 -> 0.6851.

Interestingly, a statistically significant correlation at the level of p <0.5. was established between the increase in systolic to diastolic blood pressure in both groups.

The study population throughout the experiment had normal sodium (135-146 mg / dL) and potassium (2.5-5 mg / dL) levels. The dependence of the change in heart rate on the value of systolic and diastolic pressure was compared. In the study group, a correlation was obtained between the values of systolic blood pressure and pulse at the significance level of p <0.5, while a statistically significant correlation of both systolic and diastolic pressure in relation to the pulse value was obtained in the control group.

In the experimental group, the blood pressure and heart rate values were regulated. The systolic blood pressure decreased in direct proportion to the pulse rate, and the diastolic blood pressure decreased irrespectively of the systolic blood pressure and HR. On the other hand, in the control group, the increase in the systolic and diastolic pressure increased proportionally, as did the pulse value. The correlation was in the range of 0.56-0.78.

During the 9-month period, no statistically significant change in the TG level was observed in the study and control groups (p> 0.05). In both groups, the value of triglycerides has a statistically significant and directly proportional (correlation 0.6) effect on the level of systolic blood pressure and the level of total cholesterol. In the experimental group, the values decreased, while in the control group they increased.

In the experimental group, correlations between the values of LDL and total cholesterol were observed. There was no correlation between HDL and total cholesterol. In the control group, the value of LDL increased proportionally and statistically significantly with the level of total cholesterol with a simultaneous decrease in HDL (the value was not statistically significant). The data obtained are presented below (Tables 6. and 7.).

In the experimental and control groups, no statistically significant (p> 0.05) correlation was found between the values of LDL and TG, and LDL and glycemia, although in the experimental group the values of LDL, glycemia and TG decreased and increased in the control group.

Markedly, proportionality was maintained in the increase in LDL level , decrease in HDL as well as the increase in the body weight in the control group, in contrast to the experimental group, in which no correlation was found at the level of statistical significance of the above variables. Table 8. below presents statistically significant data obtained in the control group.

At the end of the experiment, the proprietary patient satisfaction questionnaire was conducted, which showed that all people in the experimental group felt a significant improvement in their well-being and health condition. However, they were not sure if they would maintain their new life habits, as 60% of family members showed no willingness to support the change. The control group described their condition as average in 75%, 15 people - as worse, and 2 people - that they did not notice any changes.

Discussion

In 1974, the Canadian health minister introduced health dependencies in the form of "health fields." Health condition is determined mainly by: lifestyle (50%), physical and social environment (20%), genetic factors (20%) and health care (10%) [21].

Lifestyle includes physical activity, diet and exposure to stressors. In analyzing the factors of stroke, they all influence its development. It is also observed that a high body mass index (BMI) may increase the risk of ischemic stroke [9]. Another parameter is the ratio of the length of the hip belt to abdominal obesity (but not with BMI) or have no relationship [22-23]. As a result, overweight is not included in the prognosis of stroke risk, nor is it listed as a major risk factor for stroke by the National Institutes of Health or the American Stroke Association [24,25]. However, obesity is listed as a key modifiable risk factor for stroke in the American Heart Association guidelines [26]

It is emphasized in the literature that during controlled physical exercise the tendency to aggregate blood cells decreases, HDL increases while LDL decreases, which results in a 27% decrease in the risk of stroke and death [19]. The study conducted confirms some of the assumptions. The experimental group showed a significant decrease in weight, an increase in HDL levels and a decrease in LDL. However, there was no correlation between the weight loss and the decreased LDL levels. The situation was different in the control group, in which a correlation between the increase in the level of "bad" cholesterol and the increase in the body weight was shown. Interestingly, a slight change was determined in the value of TG in the study and control group. In the professional literature, it is emphasized that TG should decrease together with a decrease in LDL and an increase in HDL [13]. In our own research, due to the fact that no abnormalities were observed in the INR before the experiment, the impact of a stroke prevention program on the level of blood coagulation could not be assessed.

Patients at risk of CVD, by performing aerobic exercise for 30 minutes 3-5 times a week, reduce the likelihood of suffering a stroke by 15% [27]. The study participants had two of the following diseases: hypertension, diabetes, and atherosclerosis. The stroke prevention program consisted in participating twice a week in 60-minute aqua fitness classes conducted by a qualified instructor. In the professional literature, this form of training is reported to be significantly better than exercise, for example in the gym [28]. The most important advantages of the above include: teamwork, cooling the body during exercise and the fact that the work of many muscle groups de-stresses and improves the functioning of the circulatory and respiratory system. Moreover, Kinet confirms that exercise in the water – aqua aerobic improves physical fitness and reduces the risk of CVD [18].

One of the most beneficial diets for vascular diseases is a vegan or Mediterranean diet. Switching from saturated fatty acids to EFAs or complex carbohydrates reduces the relative risk of stroke by 25% [29, 30]. It is recommended to consume about 30 grams a day of walnuts, hazelnuts or almonds, but in a natural form, without the addition of spices [16].

The level of glycemia also has a significant impact on the development of stroke, which is due to the fact that as a result of glycogenogenesis, sugars are transformed into fat particles, consequently, increasing the level of lipids [31]. Carbonated drinks are sweetened and have a significant effect on blood sugar levels, so it is recommended to replenish/supplement liquids with mineral water with a low sodium content. In the present study, a clinical dietitian created a diet that was introduced by the experimental group. It contained a set of 5 balanced meals, which consisted of products that were chosen by people from the study group as the ones they like and use in everyday life. For the dietitian's copyright reasons, it has not been described in this article. However, it was based on the above-mentioned guidelines.

The data obtained confirm that a diet and physical activity significantly affect the level of blood pressure. The above was also confirmed by Nagashima [32]. An interesting fact is that in the study group there was a correlation between the decrease in the heart rate and the decrease in the systolic blood pressure, but there was no correlation between HR and DBP. In the control group, there was a correlation between the increase in the parameters such as heart rate and systolic and diastolic blood pressure. The literature data suggest that blood pressure should increase with increasing heart rate [33]. The above results were also confirmed by the results in the control group. Pilis et al. [34] observed that physical activity and a rational diet positively influenced the level of glycaemia. The data obtained from the studies conducted show that glycemia is normalized among women in the study group. However, no correlation was found between the glycaemia value and LDL, HDL and TG in the control and experimental groups. The literature confirms that LDL levels decrease and HLD levels increase as a result of weight loss, with the simultaneous normalization of blood sugar levels [35-36]. In the present study, it was found that after the experiment, the blood glucose level was normalized in the group that actively participated in the stroke prevention program.

The emotional state affects the entire body. Stress, aggression, disapproval and rejection are powerful stimuli that affect the behavioral and hemodynamic zones. Negative emotions cause the vascular endothelium to form atherosclerotic plaque on its surface. Secondary hypertension, on the other hand, is caused by the release of catecholamines and cortisol, and stimulated macrophages intensify the inflammatory process and result in the increased aggregation of blood cells [37, 38].

The examples listed confirm the definition of health provided by WHO, i.e. "health is not only the complete absence of disease or disability, but also the state of complete physical, mental and social well-being" [4,39]. This definition explains that the focus should be on enhancing health through prophylaxis (disease prevention) and not solely on treatment.

Summing up, the prevention of stroke has a significant benefit for people at risk of the disease, to prevent its occurrence (primary prevention), but also for people who have had an episode of stroke (secondary prevention). The current state of knowledge indicates the significant and constantly growing importance of non-pharmacological activities undertaken as part of primary prevention of stroke, which are complementary to pharmacological therapy and an equally important area of intervention. The first one is mainly related to the minimization of risk factors. Methods of non-pharmacological prevention include, on the one hand, appropriate targeting and introduction of the patient's regular activity, and, on the other hand, the need for early and common education on the purpose, scope and benefits of introducing the broadly understood principles of a healthy lifestyle. In the secondary prophylaxis, in addition to pharmacological treatment, a broadly understood lifestyle modification is important, which helps to control better individual risk factors. It should also be remembered that an effective form of lowering the incidence of diseases evidently involves support from the family and loved ones who motivate each other to control their lives.

Declarations

Compliance with ethical standards

Authors declare that they have no confict of interest. The consent of the Bioethics Committee of the Medical University of Bialystok was obtained for the research.

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Tables

Tables 1-8 are available in the Supplementary Files.

Figures

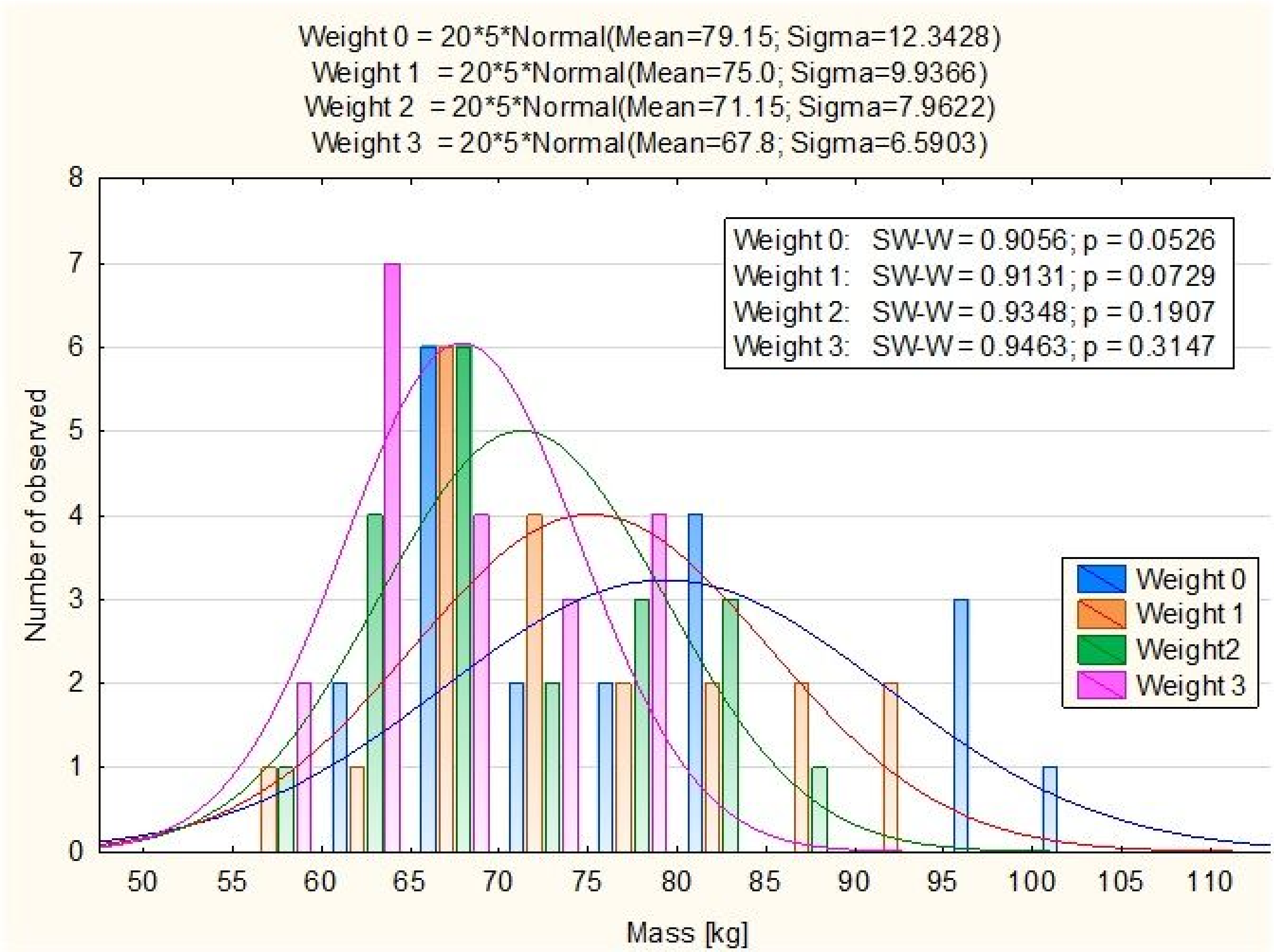

Figure 1

Graph of body weight in the experimental group over the period of 9 months.

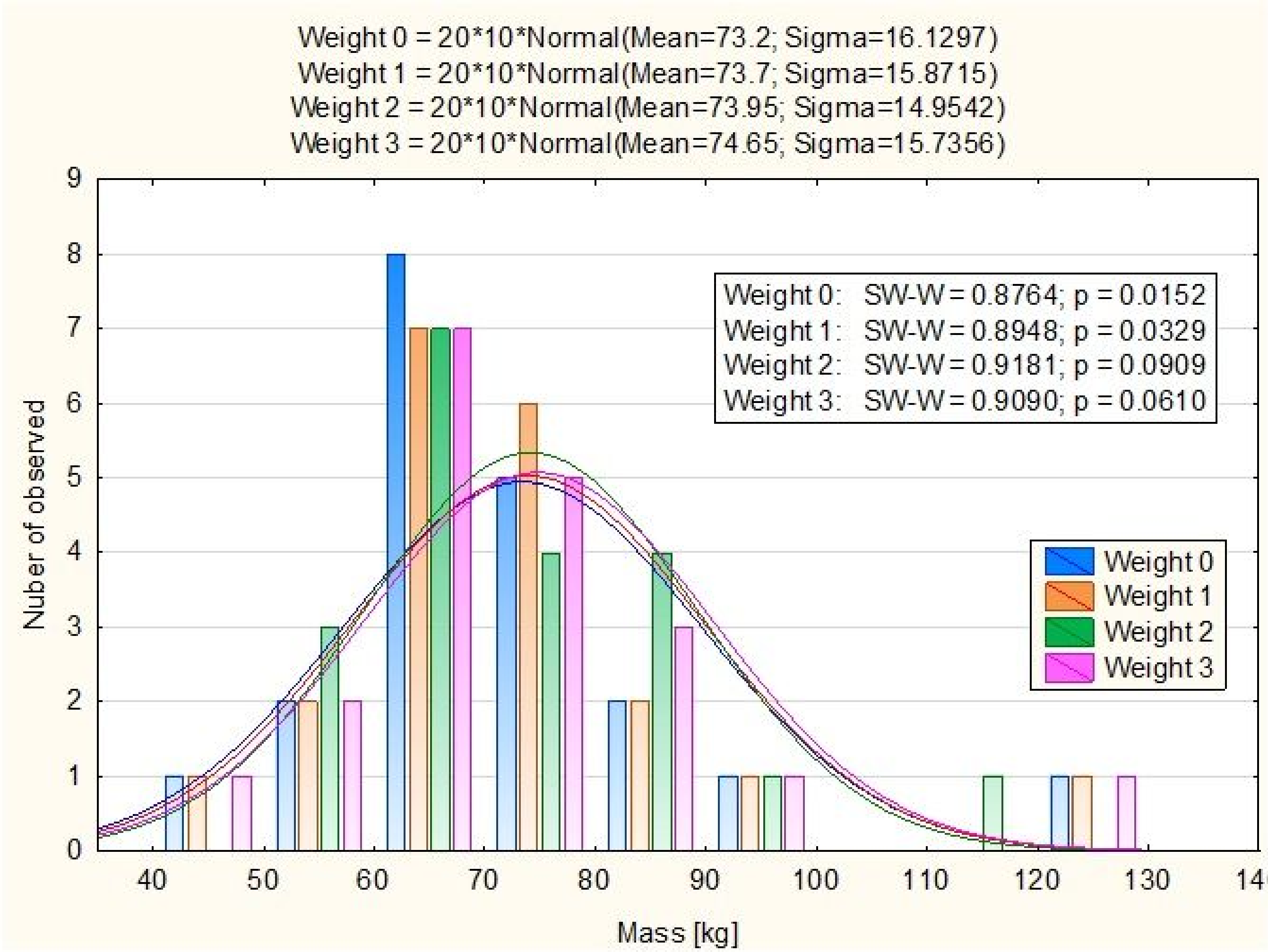

Figure 2

Graph of body weight in the control group over the period of 9 months.

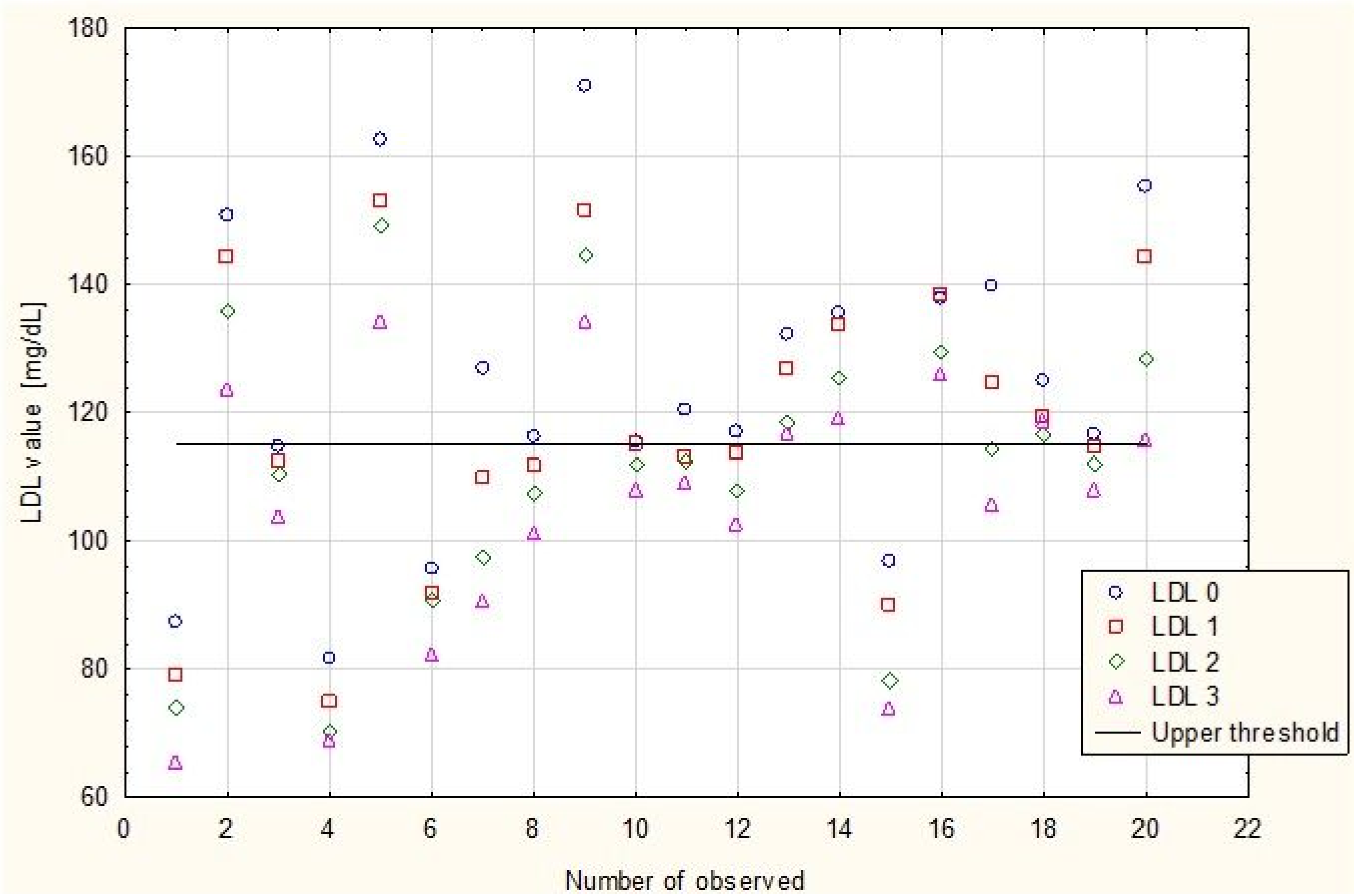

Figure 3

LDL value in the experimental group over the period of 9 months.

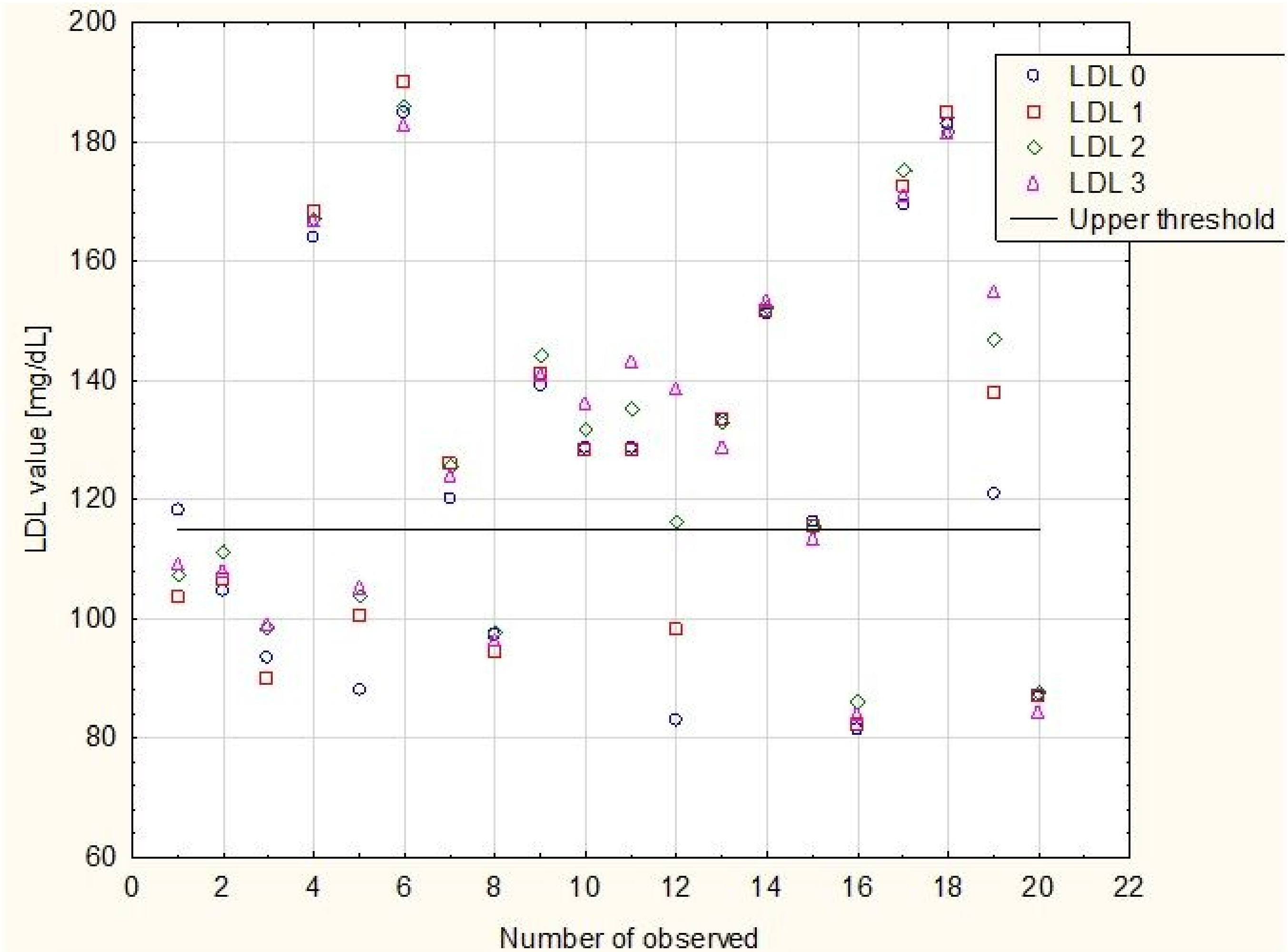

Figure 4

LDL value in the control group over the 9-month period.

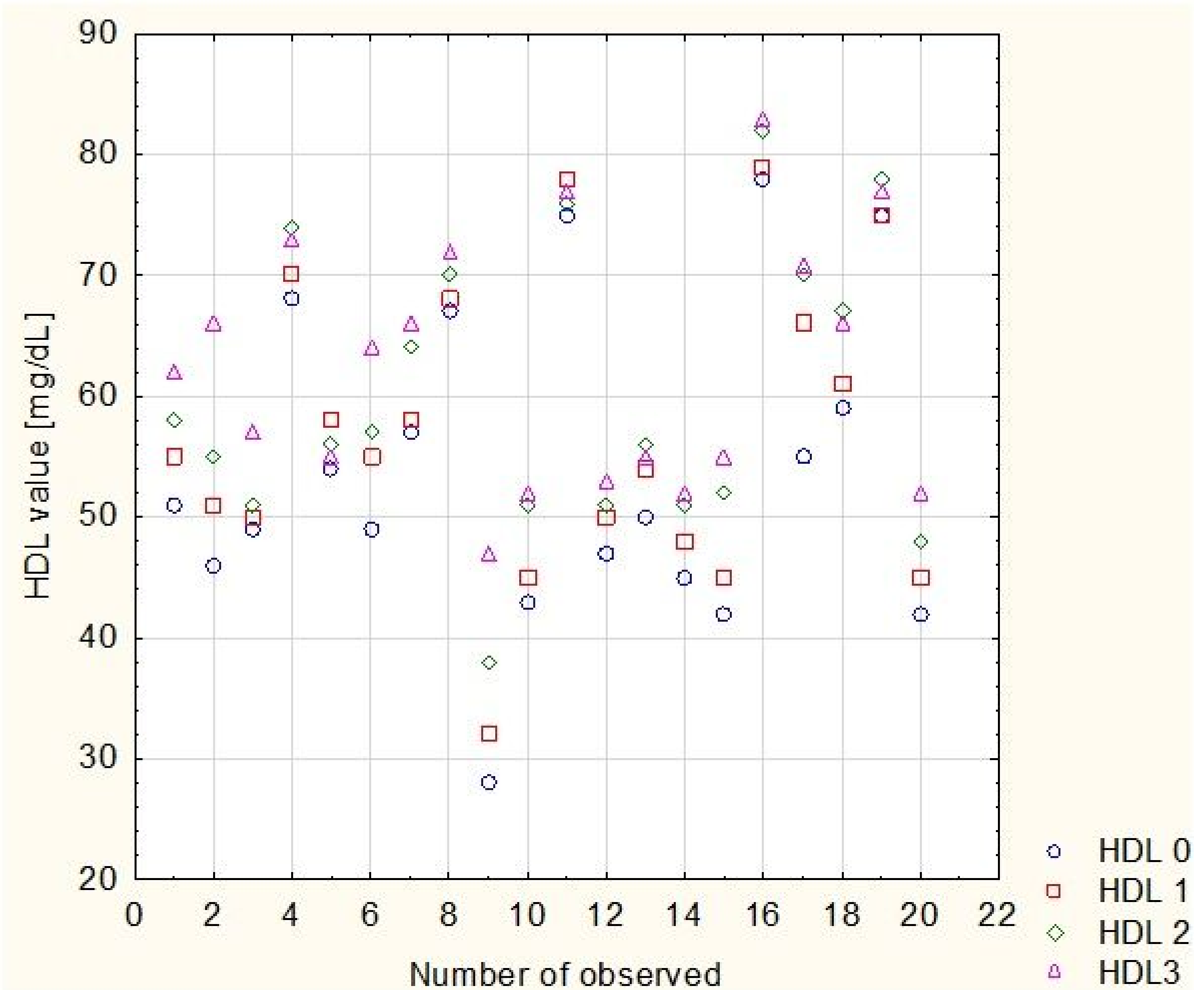

Figure 5

HDL value in the experimental group over the period of 9 months.

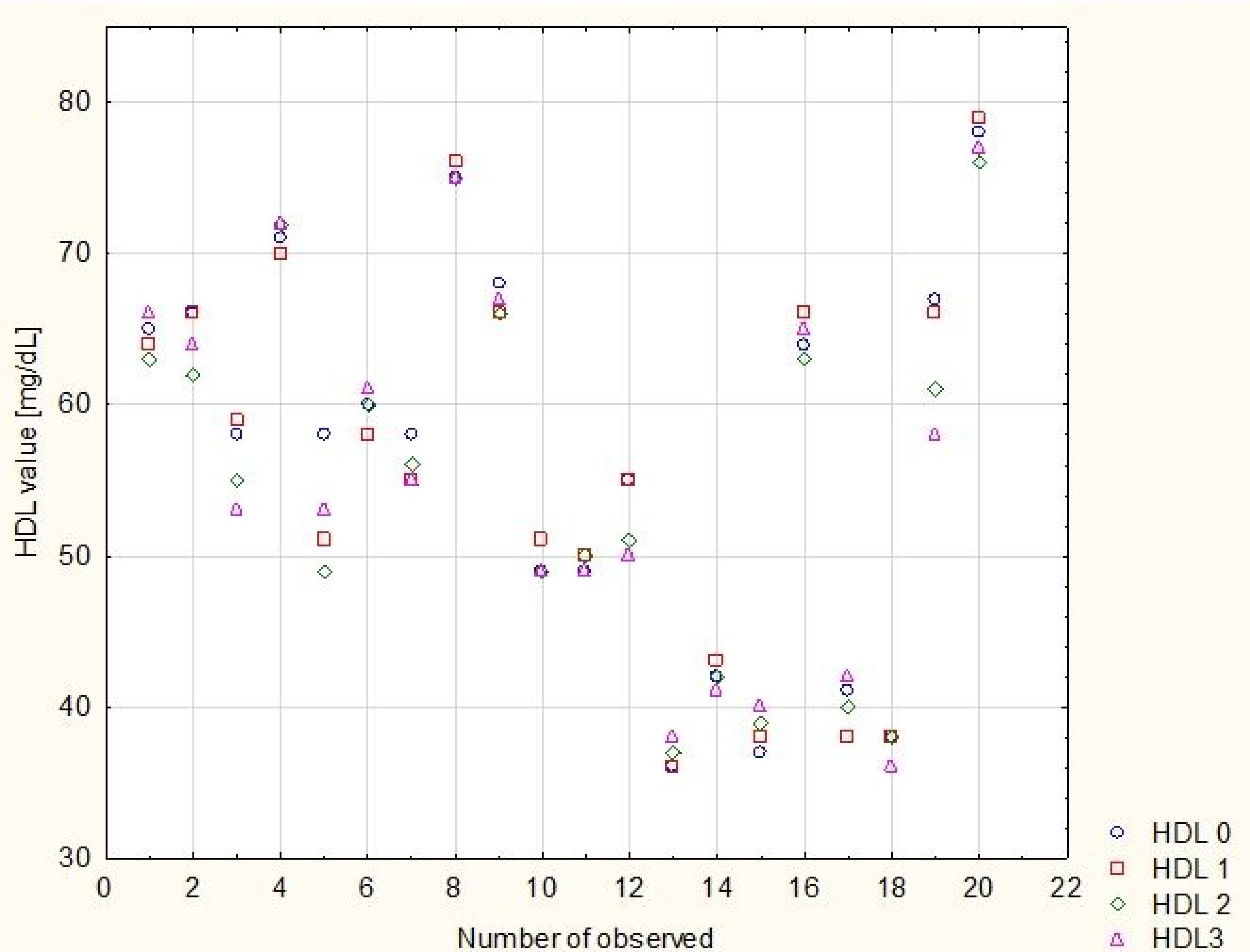

Figure 6

HDL value in the control group over 9 months.

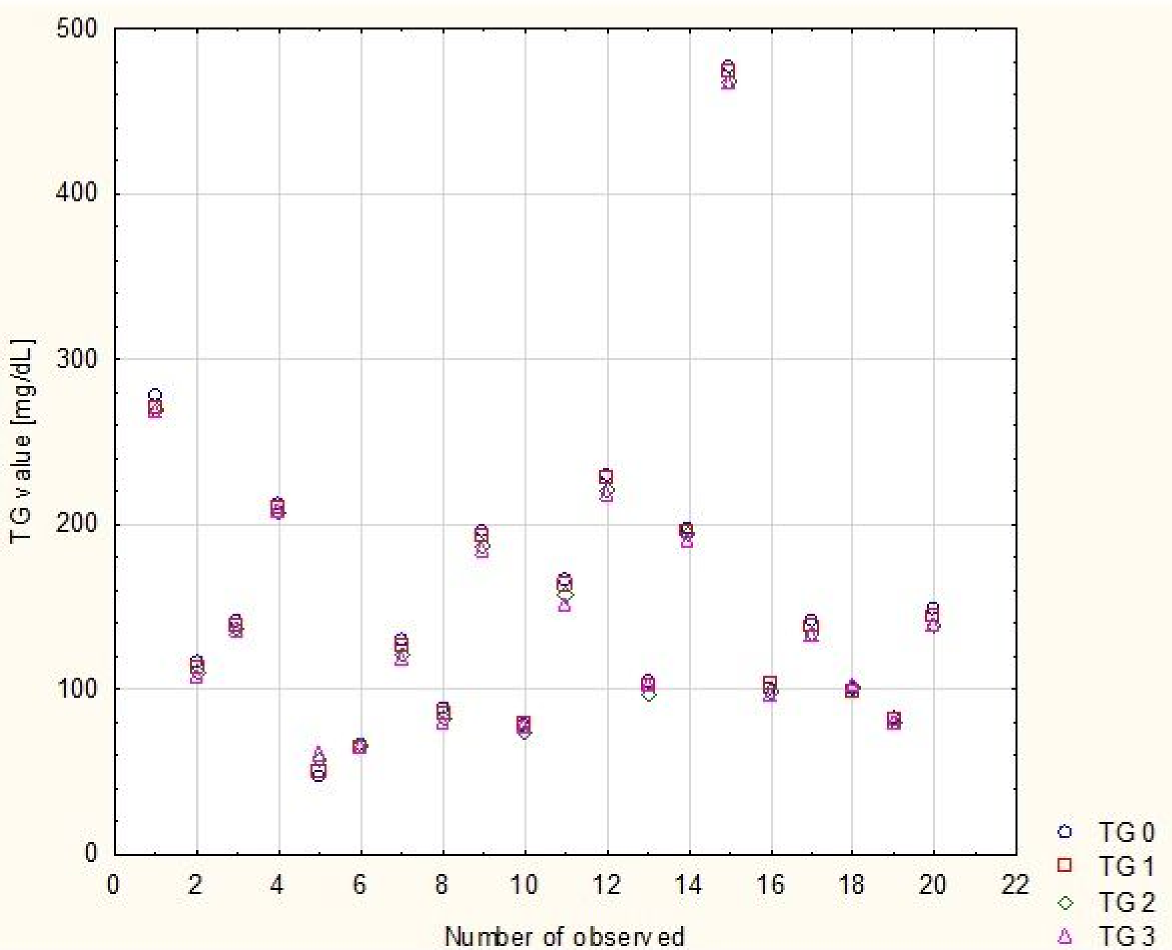

Figure 7

The value of TG in the experimental group over the period of 9 months.

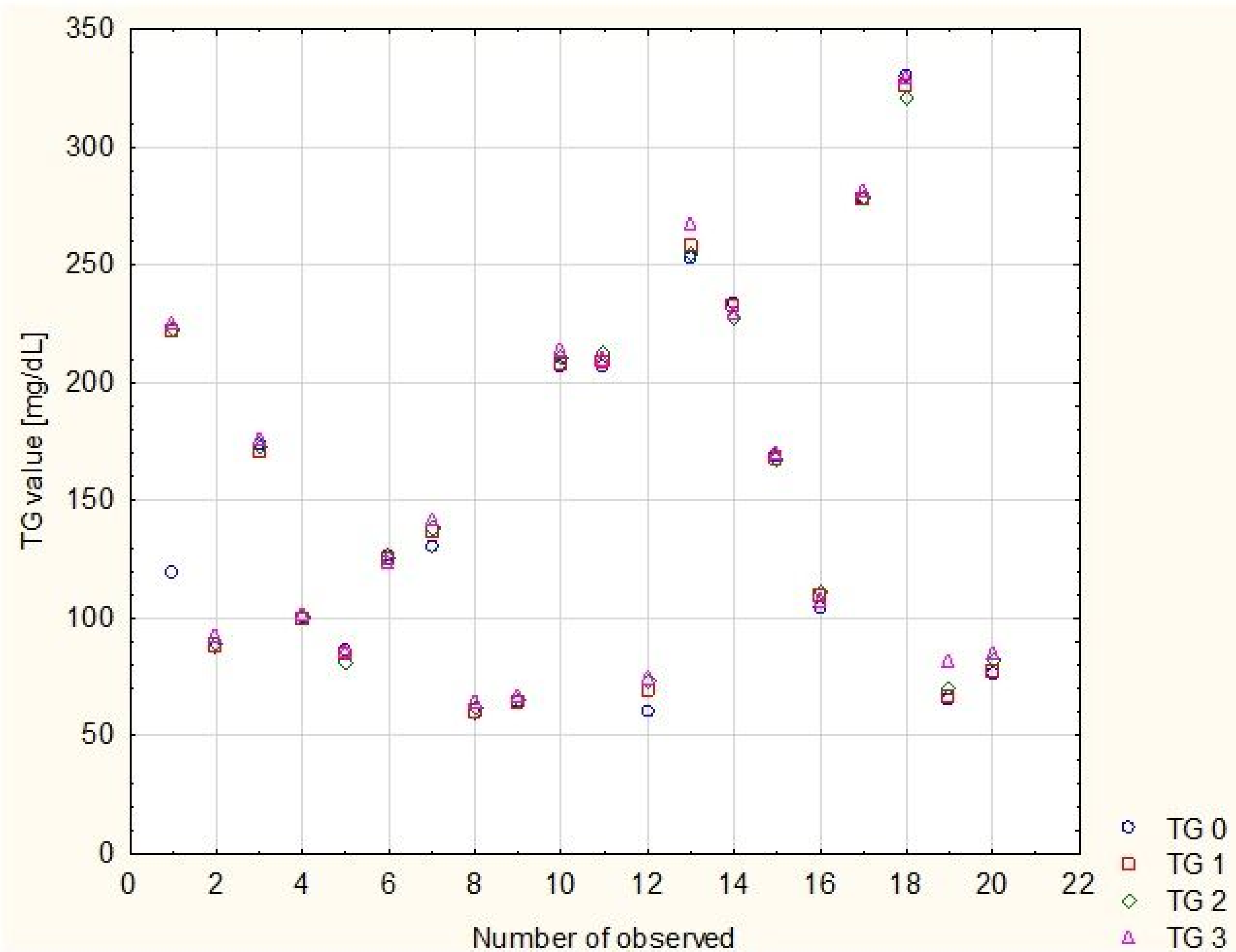

Figure 8

The value of TG in the control group over the period of 9 months

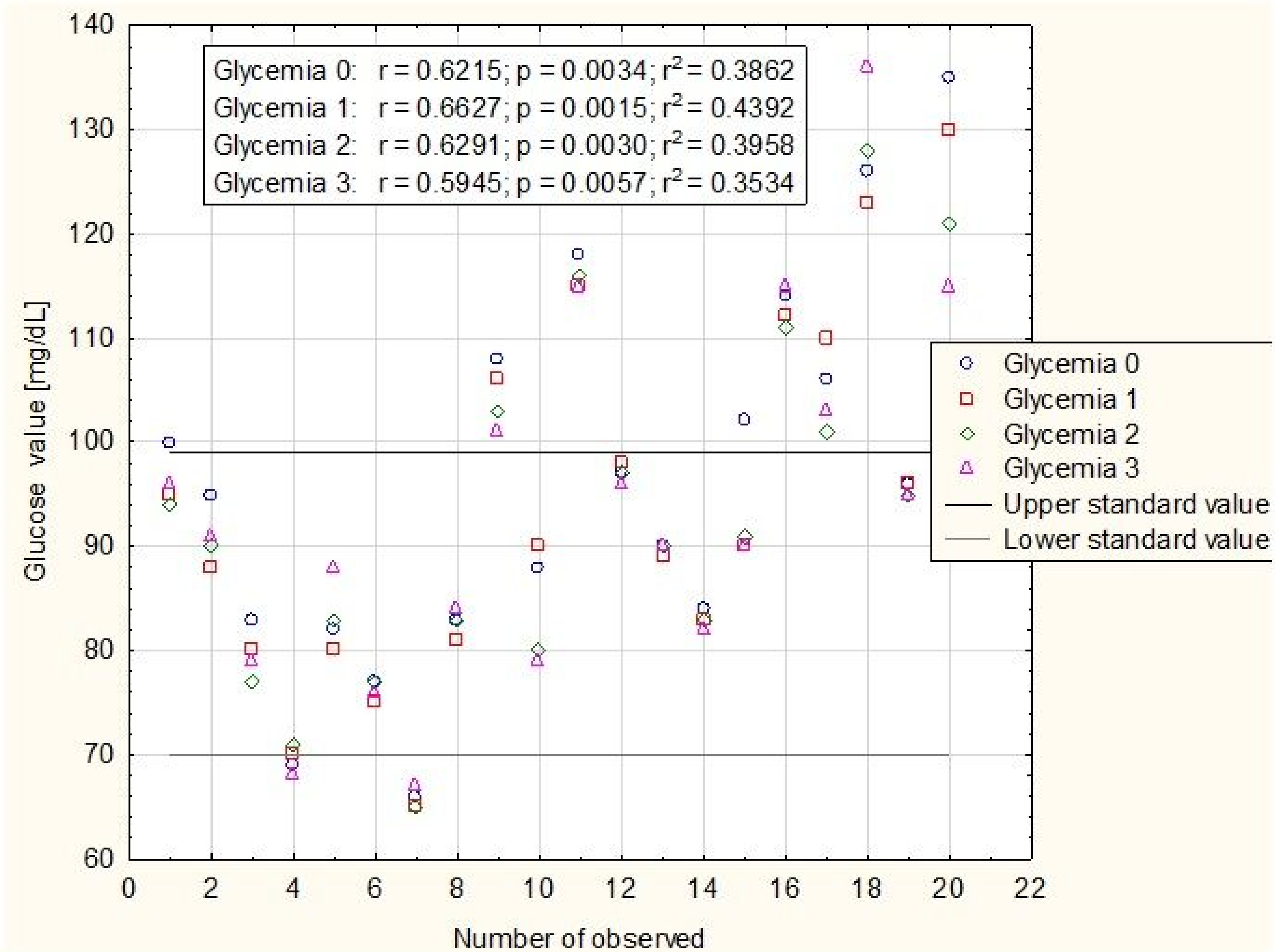

Figure 9

Fasting blood glucose levels in the experimental group over the 9-month period.

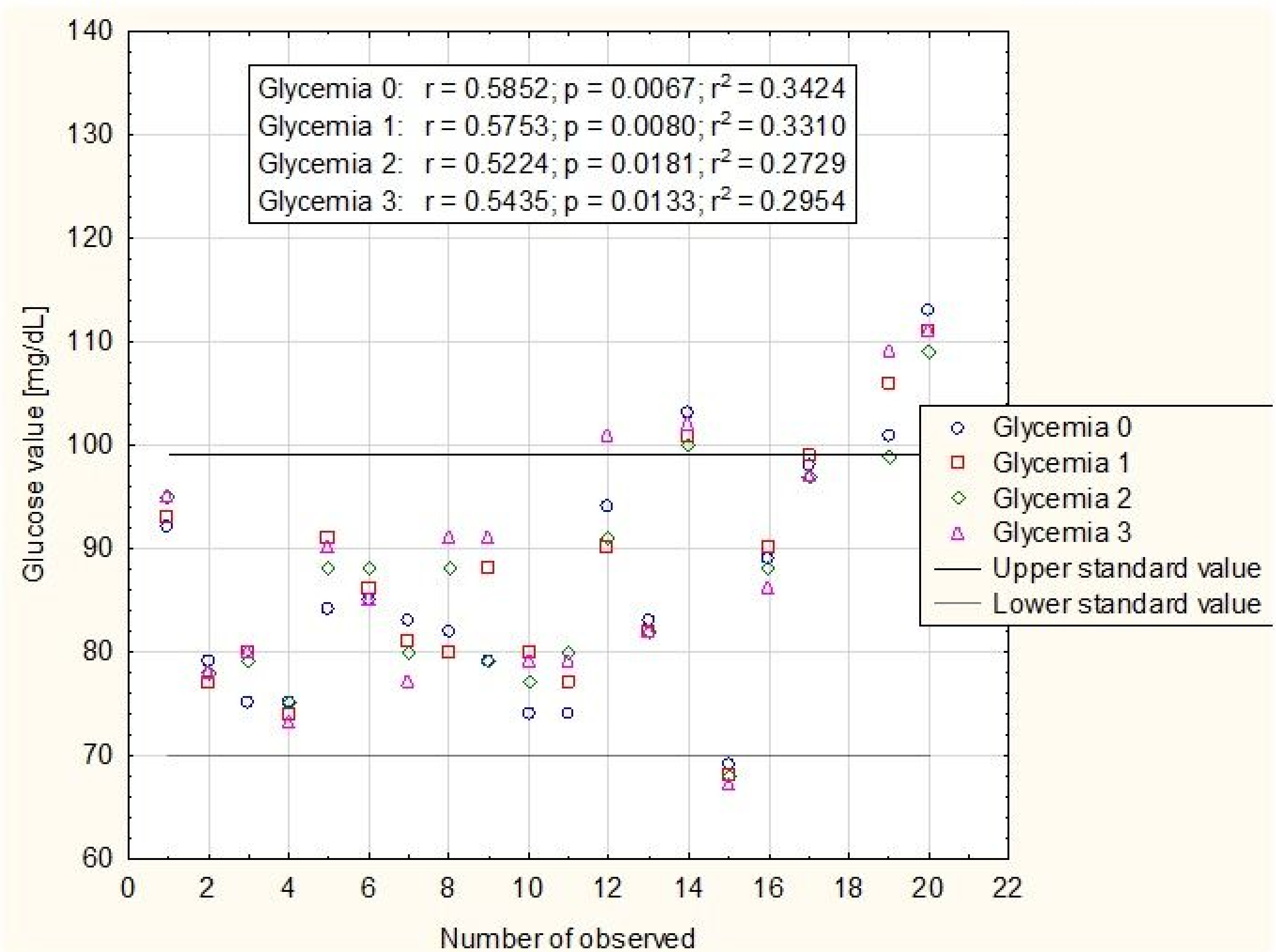

Figure 10

9-month fasting glucose level in the control group.

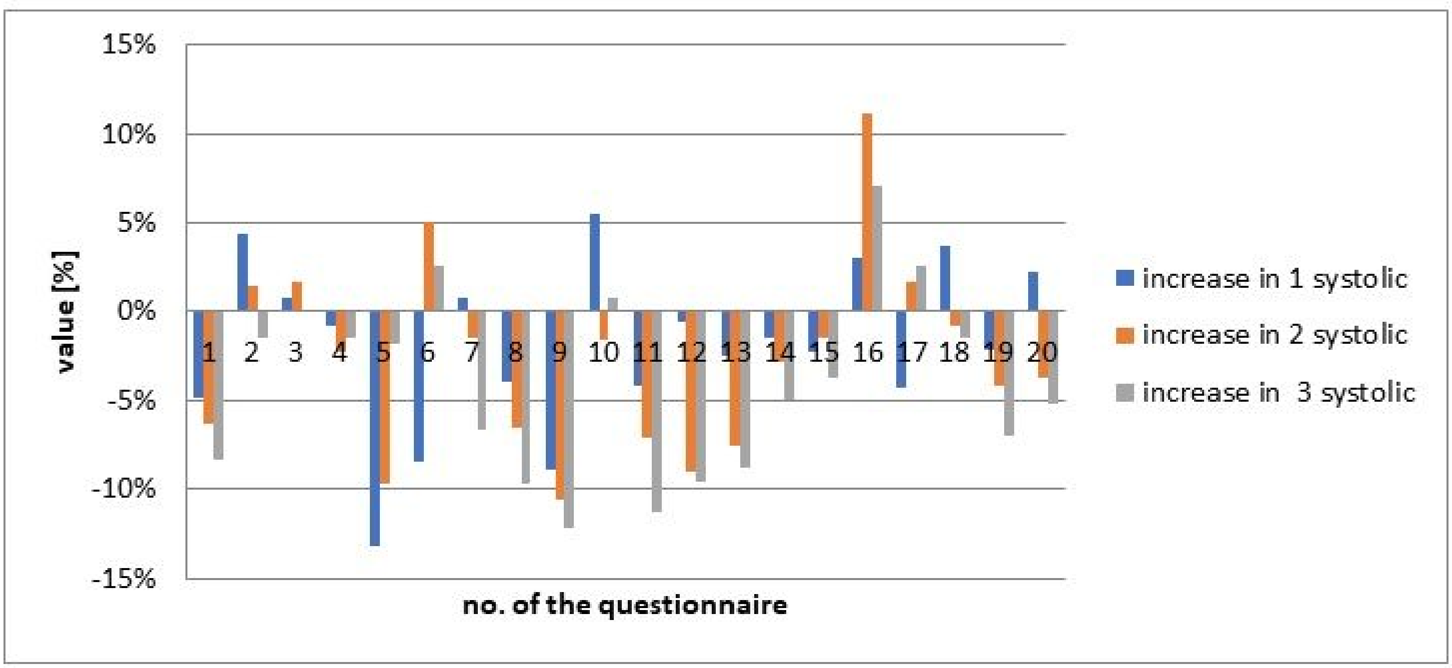

Figure 11

Graph of changes in the value of systolic blood pressure from the initial value in the study group.

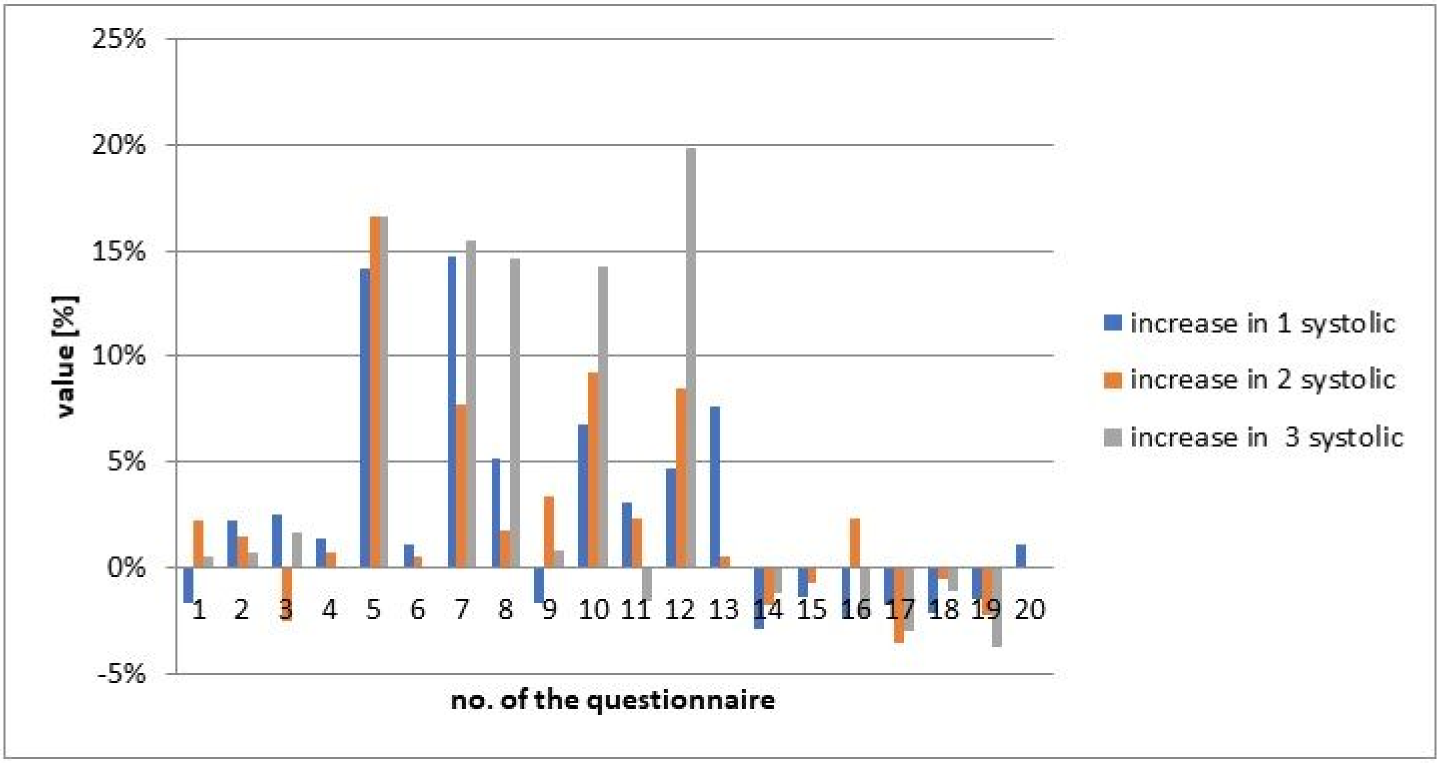

Figure 12

Graph of the decrease in systolic blood pressure from the initial value in the control group.

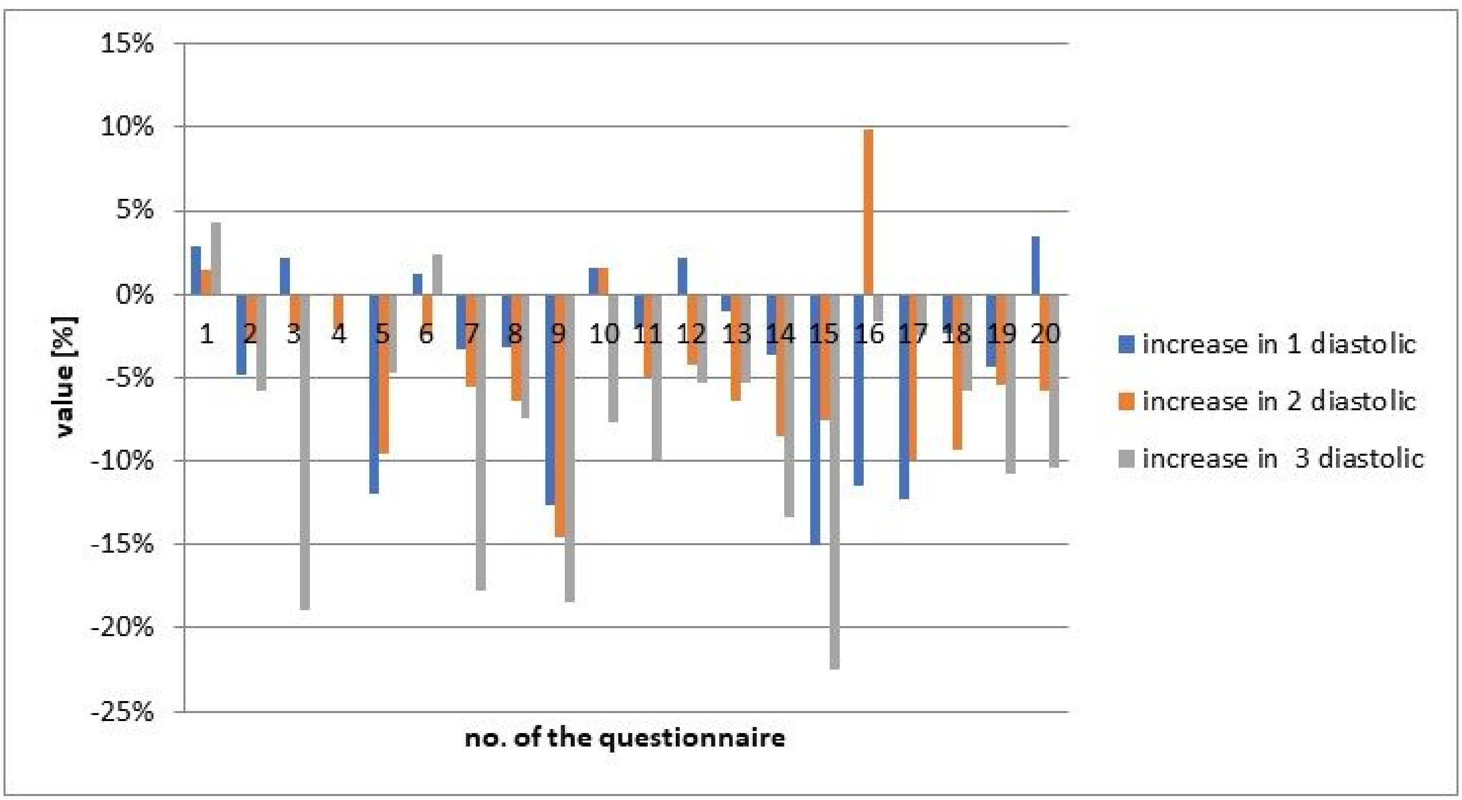

Figure 13

Graph of the decrease in diastolic blood pressure from the initial value in the study group.

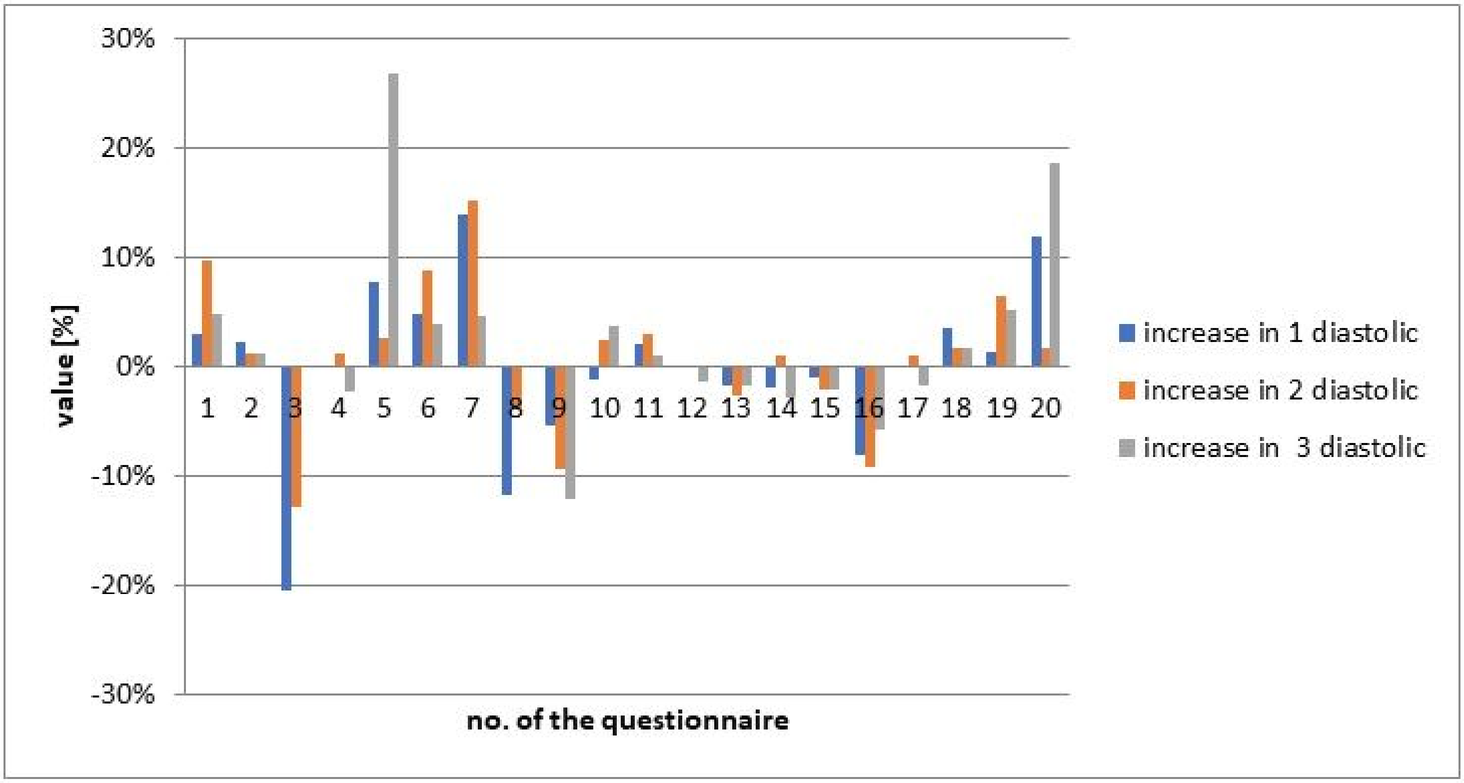

Figure 14

Graph of the decrease in diastolic blood pressure from the initial value in the control group.

Supplementary Files

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