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## Analysis of the Lipid Profile, Fasting Glucose Levels, and Their Familial Dependence in Warsaw Adolescents

### Analiza profilu lipidowego i stężeń glukozy na czczo wśród młodzieży warszawskiej. Zależność od uwarunkowań rodzinnych

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#### Summary

**Introduction.** Abnormal lipid profile and altered glucose metabolism are considered to be risk factors for cardio-metabolic diseases in adults. However, the processes leading to the onset of these diseases often have their origins in childhood. A tendency to develop certain disorders can be inherited.

**Aim.** The purpose of this study was to analyze the lipid profiles and glucose levels among young people in Warsaw, and to determine whether the tested values correlated with the occurrence of cardio-metabolic diseases in their immediate family.

**Material and methods.** The studied group consisted of 309 adolescents representative for the population of high-school students in Warsaw. Participants and their parents were required to provide information regarding the occurrence of obesity, diabetes, hypertension, hyperlipidemia and cardio-vascular diseases in their close families. Fasting glucose, triglycerides, total cholesterol, HDL and LDL levels were measured.

**Results.** All the above mentioned family factors occurred frequently. The most common were hypertension and ischemic heart disease. Abnormal LDL and HDL levels were the most often occurring abnormalities. Correlations was noted between the total cholesterol in the participant and both the occurrence of hyperlipidemia in the family, and the total count of all family factors.

**Conclusions.** Lipid and glucose metabolism disorders are not unique in young people. Although their prevalence is under a strong influence of dietary and lifestyle factors, certain tendencies depend on the occurrence of cardio-metabolic disorders among relatives. Study suggests, that the closer monitoring is need for children with history of cardio-metabolic diseases in close family.

Key words: lipid profile, adolescents, family factors

#### Streszczenie

**Wstęp.** Zaburzenia profilu lipidowego oraz gospodarki węglowodanowej są uważane za istotny czynnik ryzyka kardio-metabolicznego u osób dorosłych. Jednak procesy prowadzące do ujawnienia się tych chorób niejednokrotnie mają swój początek już w dzieciństwie. Nie ulega również wątpliwości, że skłonności do występowania wielu zaburzeń mogą być dziedziczone.

**Cel pracy.** Celem niniejszego badania była analiza profili lipidowych i stężeń glukozy wśród młodzieży warszawskiej oraz określenie, czy oceniane wartości wykazują korelację z występowaniem zaburzeń sercowo-naczyniowych i metabolicznych w najbliższej rodzinie badanych.

**Materiał i metody.** Przebadano 309 uczniów z dwóch liceów w Warszawie. Uczestnicy badania i ich rodzice wypełnili kwestionariusze dotyczące występowania otyłości, cukrzycy, nadciśnienia tętniczego, hiperlipidemii oraz chorób sercowo-naczyniowych u najbliższych krewnych badanych. Określono również stężenie glukozy, triglicerydów, cholesterolu całkowitego, cholesterolu HDL i LDL we krwi uczniów.

**Wyniki.** Wymienione zaburzenia występowały często w rodzinach uczniów. Najczęściej były to nadciśnienie tętnicze i choroba niedokrwienna serca. Nieprawidłowy poziom cholesterolu LDL i HDL we krwi stanowił najczęstsze odchylenie w badaniach biochemicznych. Odnotowano występowanie korelacji między całkowitym stężeniem cholesterolu we krwi a występowaniem hiperlipidemii w rodzinie oraz całkowitą liczbą wszystkich uwarunkowań rodzinnych.

**Wnioski.** Zaburzenia gospodarki lipidowej oraz węglowodanowej wśród młodzieży nie należą do rzadkości. Choć ich występowanie bez wątpienia pozostaje pod wpływem czynników dietetycznych oraz stylu życia, to zależą także od występowania zaburzeń kardio-metabolicznych wśród bliskich krewnych. Badanie wskazuje na potrzebę ściślejszego nadzoru zdrowotnego nad dziećmi z obciążeniami rodzinnymi w zakresie zaburzeń metabolicznych i chorób sercowo-naczyniowych.

Słowa kluczowe: profil lipidowy, młodzież, uwarunkowania rodzinne

## INTRODUCTION

The epidemic of obesity and related cardio-metabolic disorders, among which the most important are: atherosclerosis, coronary mellitus heart disease, insulin resistance and type 2 diabetes mellitus is a huge problem for health care systems around the world. It seems, that many of the processes leading to the development of the disease may have its onset in childhood. Abnormal lipid profile and altered glucose metabolism are considered to be very important risk factors for the above mentioned diseases in adults, but the impact of their presence in the childhood on developing the disease in adult life has not yet been sufficiently clarified. The relationship between elevated total cholesterol levels and the development of atherosclerotic plaques was proven. A key role in the initiation and conduction of the process, however, is attributed primarily to LDL fraction (1). Importantly, LDL in its native form does not contribute to vascular sclerosis. It must undergo the process of oxidation to its oxLDL form, which accumulates within macrophages (2). As far as LDL is the end product of triglyceride-rich lipoproteins metabolism, the fact that their role in the pathogenesis of atherosclerosis, has not been sufficiently clarified may be surprising. The significance of the correlation between the cardio-vascular risk and triglycerides serum levels varies in different studies, depending on some additional factors (3). There is also a negative correlation between HDL-cholesterol levels and atherosclerosis and coronary heart disease, which is attributed to antioxidant properties of the molecule and its central role in the reverse lipid transfer to the liver (4). Impaired glucose metabolism also contributes to the formation of atherosclerotic plaques, insulin resistance and, consequently, to the development of diabetes in the future.

Although cholesterol and glucose plasma concentrations are under the strong influence of dietary factors and physical activity, genetic and social factors are not without significance (5). Family history of disorders such as hyperlipidemia, obesity, diabetes, hypertension, and coronary heart disease may strongly influence child's lipid and carbohydrate metabolism child's body, thus affecting the risk of cardio-metabolic complications in the future. Identification of the risk factors in children may contribute to a decrease in the disease incidence in adult population.

## AIM

The aim of this study was to determine the prevalence of lipid and glucose abnormalities among Warsaw high school students, and verify whether they were associated with the occurrence of cardio-metabolic disorders in the family.

## MATERIAL AND METHODS

The data were obtained during a population study conducted in two secondary schools located in the Żoliborz district between 20th and 30th of May 2013, intended to evaluate the anthropometric parameters, obesity indices, blood pressure and laboratory indicators of lipid profile and glucose homeostasis in adolescents in Warsaw. The studied group consisted of 479 adolescents aged 17 to 19 (284 girls and 195 boys), representative for the population of high school students in Warsaw. All participants were provided with information regarding the aim and the design of the study. A written consent was obtained from participants, or legal guardians, for every individual under the age of 18.

Participants and their parents were required to provide information regarding certain family factors i.e. the occurrence of several specific diseases in the participant's close family. In order to obtain those information a questionnaire was distributed along with the consent forms. In the questionnaire parents were asked whether any of the close relatives of the participant (parents, parent's siblings, grandparents) suffered from any of the following conditions: obesity, diabetes type 2, hypertension, hyperlipidemia and ischemic heart disease. 309 participants (195 girls and 114 boys) responded to the questionnaire, consequently constituting our study group.

All included subjects had their blood drawn for fasting triglycerides, total cholesterol, HDL and LDL. Blood samples were collected between 7:30 and 10:00 am, by trained nurses, from the intermediate cubital vein. All samples were analyzed with the application of the same laboratory method. In order to determine fasting glucose levels a glucometer was applied and blood was drawn from the participant's little finger.

The statistical analysis was performed using Statistica version 10 software. For all tests a value of  $p < 0.05$  was deemed statistically significant.

## RESULTS

309 students who were enrolled in the primary study succeeded to provide sufficient information regarding their family history to be included in this analysis. We divided them into two subgroups based on the participant's gender. The specific information about the occurrence of family factors in both groups are presented in table 1.

Table 1. Occurrence of obesity, type 2 diabetes, hypertension, lipid disorders and cardio-vascular diseases in students families.

| Family Factor          | Girls (n = 195)  | Boys (n = 114)  |
|------------------------|------------------|-----------------|
| Obesity                | 35.38% (n = 69)  | 29.82% (n = 34) |
| Type 2 diabetes        | 40.00% (n = 78)  | 37.72% (n = 43) |
| Hypertension           | 62.56% (n = 122) | 57.89% (n = 66) |
| Hyperlipidemia         | 42.56% (n = 83)  | 42.11% (n = 48) |
| Ischemic heart disease | 49.23% (n = 96)  | 43.86% (n = 50) |

All the family factors that we inquired about occurred very frequently both in the population of girls and boys. The most commonly occurring family factors were hypertension and ischemic heart disease. 62.56% of girls and 57.89% of boys had at least one close family member treated for hypertension, 49.23% of girls and 43.86% of boys had family members suffering from ischemic heart disease.

The results of laboratory investigations are presented in table 2.

Table 2. Lipids and glucose serum levels in Warsaw adolescents.

| Lab. parameter | Girls (n = 195) | Boys (n = 114)  |
|----------------|-----------------|-----------------|
| Glucose        | 0.51% (n = 1)   | 2.63% (n = 3)   |
| TG             | 1.03% (n = 2)   | 3.51% (n = 4)   |
| TC             | 9.23% (n = 18)  | 7.02% (n = 8)   |
| HDL            | 13.85% (n = 27) | 10.53% (n = 12) |
| LDL            | 25.13% (n = 49) | 19.30% (n = 22) |

TG – triglycerides; TC – total cholesterol; HDL – high-density cholesterol; LDL – low-density cholesterol

Abnormalities in glucose homeostasis and lipid profile in the participants proved to be much less common. Increased LDL level was the most often occur-

Table 3. Correlations between specific family factors and biochemical parameters.

| Family factor                | Glucose |         | TG    |         | TC   |         | LDL   |         | HDL   |         |
|------------------------------|---------|---------|-------|---------|------|---------|-------|---------|-------|---------|
|                              | R       | p-value | R     | p-value | R    | p-value | R     | p-value | R     | p-value |
| Obesity (Ff)                 | -0.04   | 0.45    | 0.06  | 0.33    | 0.02 | 0.76    | 0.04  | 0.51    | -0.10 | 0.82    |
| Diabetes (Ff)                | -0.04   | 0.49    | 0.08  | 0.16    | 0.04 | 0.47    | -0.03 | 0.60    | 0.01  | 0.92    |
| Hypertension(Ff)             | -0.12   | 0.04    | 0.04  | 0.50    | 0.10 | 0.10    | -0.03 | 0.64    | 0.04  | 0.47    |
| Hyperlipidemy (Ff)           | -0.09   | 0.09    | -0.01 | 0.81    | 0.12 | 0.03    | 0.06  | 0.26    | 0.10  | 0.08    |
| Cardio-vascular disease (Ff) | -0.06   | 0.29    | 0.08  | 0.19    | 0.11 | 0.06    | 0.07  | 0.25    | 0.03  | 0.56    |
| Total family factor count    | -0.11   | 0.05    | 0.07  | 0.23    | 0.12 | 0.04    | 0.03  | 0.55    | 0.05  | 0.36    |

Ff – family factor; TG – triglycerides; TC – total cholesterol; LDL – low-density cholesterol; HDL – high-density cholesterol

ring abnormality both in girls and boys. As many as 25.13% girls and 19.30% boys had LDL levels above the upper limit of 100 mg/dl. 13.85% girls and 10.53% boys had decreased levels of HDL (below 50 mg/dl for girls and 40 mg/dl for boys). The levels of total cholesterol exceeded the norm (200 mg/dl) in 9.23% girls and 7.02% boys. Only 1.03% girls and 3.51% boys had triglycerides above 159 mg/dl and even less had abnormal levels of glucose – 0.51% girls and 2.63% boys had fasting glucose above 100 mg/dl. Generally, increased total cholesterol, increased LDL and low HDL were more often noted in girls than boys. In comparison boys had more often high triglycerides and glucose. These differences were statistically significant at  $p < 0.05$ .

We examined the relations between the prevalence of the aforementioned diseases in the close family of the participant and the value of the measured lipid profile and glucose values. The associations (presented in table 3) proved to be very weak. The only positive relationship statistically significant was noted between the total cholesterol in the participant and both the occurrence of hyperlipidemia in the close family, and the amount of all family factors.

## DISCUSSION

Associated with atherosclerosis cardiovascular diseases, occurring mostly in adults, are the leading causes of death and morbidity. However, there is growing evidence that atherosclerosis starts early in childhood (6), and that genetic component to the disease is equally important in its pathogenesis as diet and physical activity (7).

In this survey we found that obesity, diabetes, hypertension, lipid abnormalities and cardio-vascular diseases

occur frequently in families of our subjects – Warsaw adolescents, and that hypertension and ischemic heart disease are the most common. Abnormalities in glucose homeostasis were rare which is not surprising, knowing that type 2 diabetes and prediabetes are preceded by a long period of subclinical changes. Increased LDL level and decrease in HDL were the most often occurring abnormalities both in girls and boys, which is alarming, considering the central role of this lipoproteins in atherosclerosis pathogenesis. Abnormalities in total cholesterol and triglycerides were much less frequent. Generally, increased total cholesterol, increased LDL and low HDL were more often noted in girls than boys.

The correlations between the prevalence of obesity, diabetes, hypertension, hyperlipidemia, and cardio-vascular diseases in the close family of the participants and the lipid and glucose serum concentrations were rather weak. The only positive relationship statistically significant was noted between the total cholesterol in the participants and both the occurrence of hyperlipidemia in the close family, and the amount of all family factors. This may indicate the importance of early screening for lipid abnormalities in children with family history of hyperlipidemia.

## CONCLUSIONS

Lipid disorders and altered glucose metabolism are rather uncommon in young people. Although their presence is undoubtedly influenced by dietary factors and lifestyle, certain tendencies depend on the occurrence of cardio-metabolic disorders among close relatives. Study suggests, that the closer monitoring is need for children with history of cardio-metabolic diseases in close family.

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