Key words : Intellectual handicapped, Triglyceride, principal component analysis

An analysis and estimation of several people who are low Triglyceride in the blood in an intellectual handicapped facility

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Introduction

On an annual health examination in an intellectual handicapped facility, we found by chance a group of residents that is showing specifically low Triglyceride in the blood. However, a physique of this group was not inferior in a body mass index (BMI) than the standard group in the facility. So, we retrospectively examined Triglyceride level of this group in successive year. As the results, it had always been showing the low level. For such a fact, we attempted to elicit the background characteristics of this group from the biochemical and nutritional situation. The physique, nutritional intake, and the various lipid levels in this group had not differed from the facility mother population, except Triglyceride, after all. However, the facility population also itself was lower than the national average of the same age on these items. We next examined several biochemical markers, and found the significant difference on several items between a general criteria and facility criteria. This time we reported the significance of differences in these biochemical markers among the standard criteria, facility criteria and the low Triglyceride specimen (the specimen). Moreover, we reported here characteristics of this low Triglyceride population (the specimen) from principal component analysis.

Materials and Methods

Subjects : Among the resident of one facility of intellectual handicapped in Ehime prefecture, we selected 15 people as subjects (11 male and 4 female) who are a specifically low Triglyceride in the blood. We classified these subjects as a facility specimen (the specimen). The specimen was few, so we examined male and female as the combined group. An age of specimen was 38～70, an average was 56.4±7.8. Next, we selected all the residents in the facility (except in the specimen), as the facility mother population. The facility mother population was 75 people (38 male and 37 female), age was 32～73, an average was 51.0±6.9, and they were significantly younger than the specimen ($p = 0.0058$, Mann-Whitney test). We treated it as combined subjects both male and female as same as the specimen. Then, in this report, we often used a term "facility

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criteria (or FC)" as a synonym of the facility mother population.

Items of the examination : We calculated a body mass index (BMI) from the body height and the weight. Then we defined the BMI as the marker of the physique. Next we calculated the energy intake, and the intake of three major nutrients (protein, fats, and carbon hydrate), from the menu in this facility. Moreover, we measured various biochemical markers (biomarkers) for comparison of characteristics of each group. Examined items are as follows; Triglyceride (Neutral fat), HDL-cholesterol (HDL-c), LDL-cholesterol (LDL-c), Apo proteins (Apo-A1, Apo-A2, Apo-B, Apo-C2, Apo-C3, Apo-E), total protein (TP), albumin (Alb.), AST, ALT, γ-GT, creatinine (CRE), uric acid (UA), blood glucose (BS), and Hb-A1c (JDS). We obtained these materials from the blood in hungry time in the early morning. We compared the body height, body weight, BMI, energy intake per one day, energy from the three main nutrients, and the lipid components to the national standard. We used the mean value of 50～59 age in the national nutritional survey of 2010 as a standard of comparison. This survey is performed by Ministry of Health, Labor and Welfare in every year. BML Inc. is performing the biochemical examination on medical examination in this facility. So we compared the value of each biochemical item of this facility with the standard of BML. Namely, here "the standard criteria" in biochemical examination, indicates the BML standard. In these comparisons, we applied the extent t-test (a test for the mother extent) for statistical analysis. Moreover, we compared the facility standard and the specimen value by the Mann-Whitney test. We defined $p<0.05$ is statistically significant and $p<0.1$ is a trend. Moreover, we analyzed the specimen by principal component analysis. Principal component analysis is a method to gather multivariable data that makes one or the small number of independent synthetic variables. The synthetic variable is called as Z_1, Z_2...Z_m. General Equation is as follows; $Z_1=w_1x_{11}+w_{12}x_1+...+w_{1p}x_p$, $Z_2=w_{21}x_1+w_{22}x_2+...a_{2p}x_p$, $Z_m=w_{m1}x_1+a_{m2}x_2+...a_{mp}x_p$. Z_1 is first principal component, Z_2 is second principal component, and Z_m is "m" principal component. Thus we obtained their characteristics. Murakami A. planned and performed this study. Kaneko H. had done statistical analysis and wrote the report of this study. Nakanishi K. and Murakami E. performed field work and sampling.

Results

Fig. 1 showed the comparison of the physique of the population in this facility and that of the national average. First, both of the body height and the weight were significantly less than the national average. Moreover, the BMI showed the lower limit of the normal area, it was showing the population of this facility is the smaller physique. Next, the body height and the weight were not different in the comparison of the facility mother population and the specimen. However, the BMI was lower in the specimen, and suggested the specimen is smaller physique than the mother population.

Fig. 2 is the comparison of the daily energy intake and each nutrient intake. The number in the parenthesis is the expectation value of each item from the chi-square test. In comparison of the intake of daily energy, protein, fat, and carbon hydrate, all of them were lower in the facility than national criteria, specifically in fat.

Fig. 3 is the comparison of the serum lipid. The level of serum HDL cholesterol (HDL-c) in the facility (both of the facility mother population and the specimen) was not different from the standard criteria. The facility level of the LDL cholesterol (LDL-c) and Triglyceride (TG) in total were lower than the standard criteria. Specifically, the TG

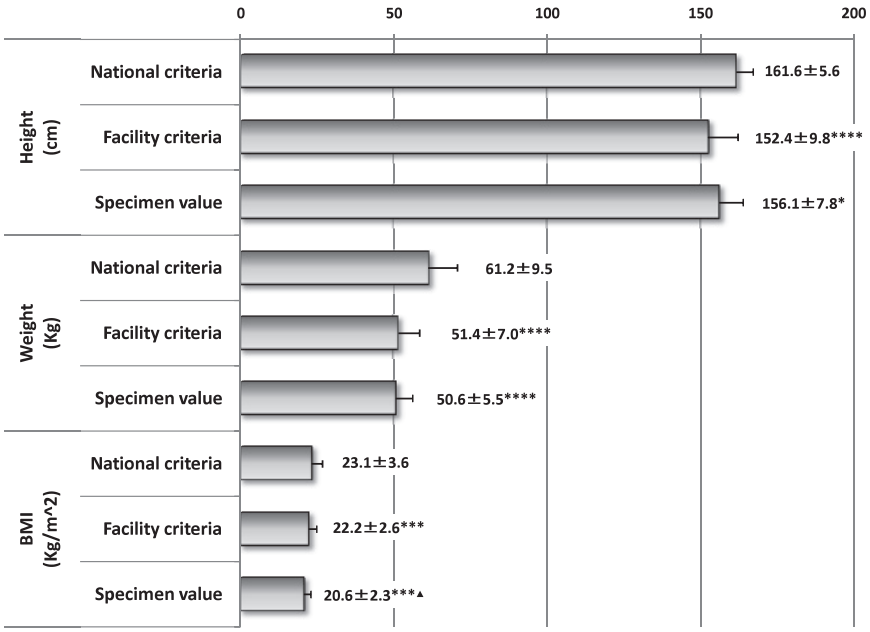

Fig. 1 The comparison of the physique among the specimen value (SV), the facility criteria (FC), and the national criteria (NC). **p<0.01, ***p<0.001, ****p=0.000, NC vs FC and SV (t-test). ▲p<0.05, FC vs SV (Mann-Whitney test).

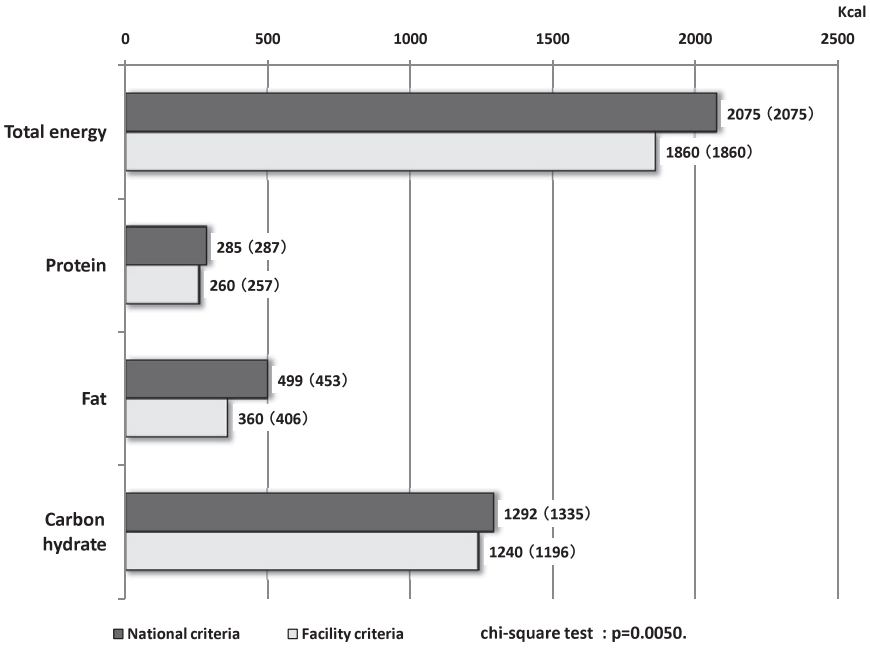

Fig. 2 The comparison in energy intake, total and three main nutrients element intake between the national criteria and the actual menu in the facility. The total energy and three main nutrient intakes in the facility were significantly lower than national criteria. (Chi-square test; p=0.005).

level of the specimen was remarkably low not only than the standard criteria but also the facility criteria as mentioned above.

Fig. 4 showed the comparison of classified various Apoprotein. Apoprotein was not measured as a routine examination in the facility. Therefore, these items were compared only in the standard criteria and the specimen. Significant difference in Apo-A was not between the standard criteria and the specimen. However, Apo-A2, B, C2, and C3 in the specimen were significantly lower than the standard criteria. In contrast, Apo E showed significant high value in the specimen.

Fig. 5 is the comparison of various biomarkers in the standard criteria, the facility criteria, and the specimen. All of values in TP, Alb., γ-GT, CRE, UA, BS, and Hb-A1c were lower in the facility criteria and the specimen than the standard criteria. Additionally, γ-GT in the specimen was lower than the facility criteria. Though value on AST was not different in these three group standards, ALT in the specimen was significantly lower than the standard criteria. However, ALT was not significantly different between the standard criteria and the facility criteria.

Fig. 6 showed analyzed results of the principal component in the facility criteria and the specimen. The characteristic of both the facility criteria (population) and the specimen was able to explain from the age and BMI. The characteristic of the specimen was guessed from the distribution map of the main ingredient score. The score of the main ingredient in the specimen was distributing significantly lot on the area of "relatively young and small in the physique" compared with the other quadrant. The distribution of the principal component score in the facility criteria was not different among the figure of quadrant. However, these distribution ingredients were slightly different in the facility criteria and the specimen as a trend. Therefore, the specimen was considered to be the obviously characteristic population.

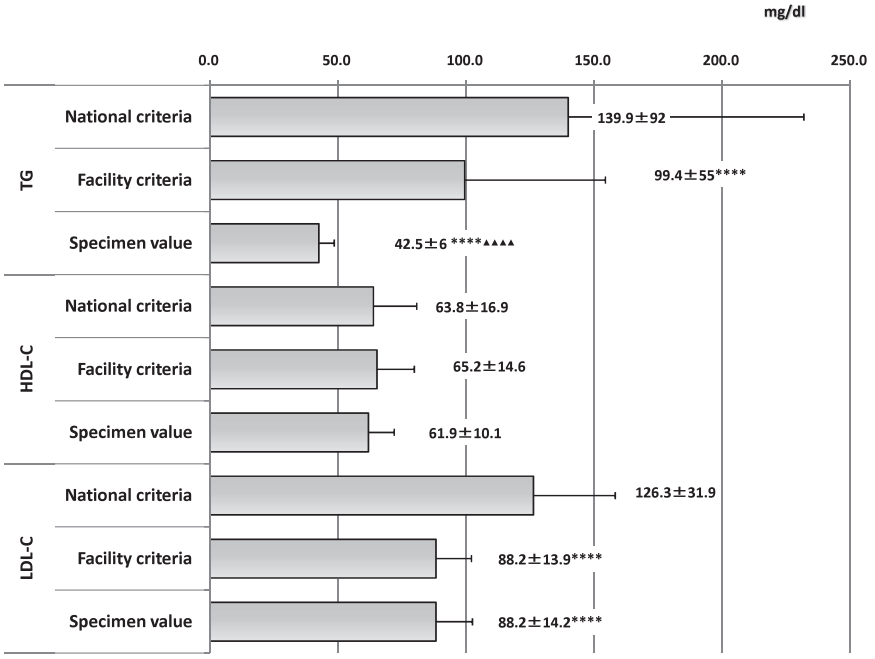

Fig. 3 The comparison of lipid components among the national criteria, the facility criteria, and the specimen value. ****p = 0.000, NC vs FC and NC vs SV (t-test). ▲▲▲▲p = 0.000, FC vs SV (Mann-Whitney test).

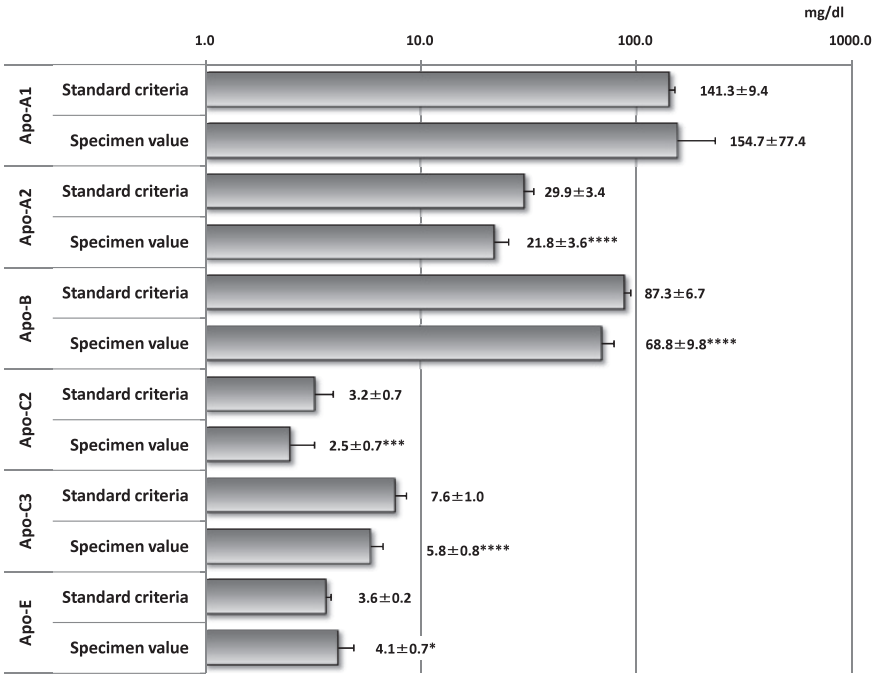

Fig. 4 The comparison of the apolipoprotein between the laboratory (BML) criteria (using as standard criteria: SC) and the specimen value (SV). *p<0.018, ***p<0.002, ****p=0.000, SC vs SV (t-test).

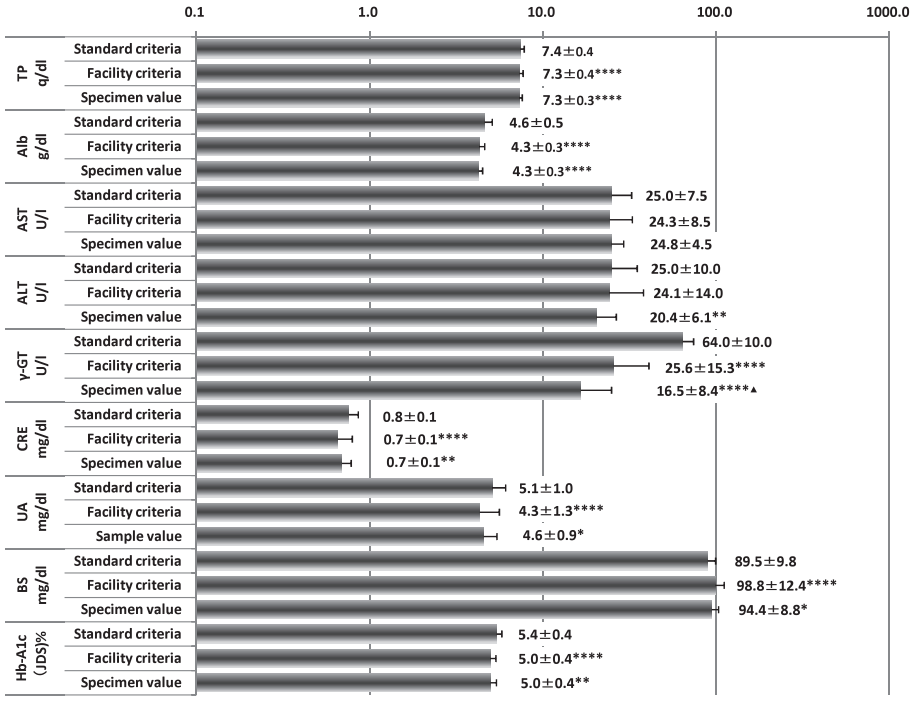

Fig. 5 The comparison of various biomarkers among the standard criteria, the facility criteria, and the specimen value. *p<0.05, **p<0.01, ****p=0.000, SC vs FC and SV (t-test). ▲p<0.05, FC vs SV (Mann-Whitney test).

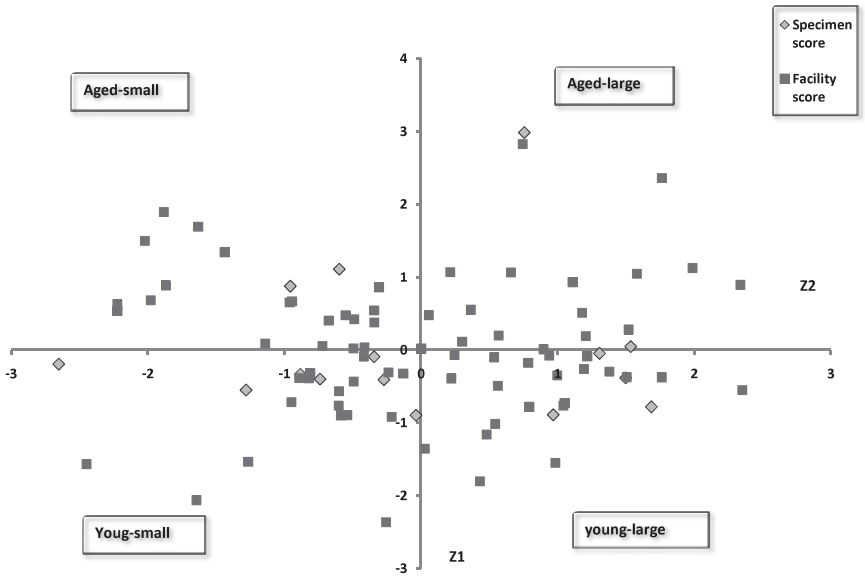

Fig. 6 The distribution of the main ingredient score in the quadrant area. In the low triglyceride subjects (the specimen), the explanatory variables in the principal component analysis were the age and the BMI. The eigenvalue of the age was 1.5802, the BMI is 1.0034, and the cumulative contribution ratio was 86.1%. Therefore, the specimen properties were able to explain from the age and the BMI. In the facility criteria, explanatory variables in the principal component analysis were the age and the BMI. The eigenvalue of the age was 1.3169, BMI was 0.9193, and cumulative contribution ratio was 74.5%. Therefore, population properties in the facility were almost able to explain from the age and the BMI. The distribution of main ingredient score of the specimen on each quadrant area was significantly different ($x^2 = 11.91$, $p = 0.008$). However, such difference was not in the facility population. The main ingredient score of the age and BMI in the quadrant area was not significantly different between the specimen and the facility population. However, it was different as a trend ($p = 0.055$, chi-square test).

Discussion

Several studies are reporting a nutritional state of an intellectual handicapped person is fatty obese from boyhood. Moreover, a person who lives in the home is said to be more obese than a resident in a facility, as a trend[1)~4)]. When these obese and intellectual handicapped people became an adult, most of them suffer from "lifestyle disease" including metabolic syndrome. Therefore, prevention of obesity in these handicapped people is very important. The ratio of obesity from the sex is said to be more in female than male. Though the reason why many populations in an intellectual handicapped person are obese is not distinct, several characteristics are able to find. An intellectual handicapped person takes as a trend an excess food, many snacks, an allotriophagy (eating a thing except food), and unbalanced diet even if a facility resident. Moreover, in a home resident, there is a risk that they eat favorite food to the full stomach from the indifference of the caregiver. Previously, though many obese residents were in the facility, obese person remarkably reduced after Murakami A. performed dietary intervention. When we started the study

this time, physique characteristics in this facility resident were significantly lower in the body height, weight, and BMI than the national criteria. Therefore obese populations were not in the facility. Moreover, significant differences on the value of these items were not between the facility criteria and the specimen. An intake of the total energy, protein, fat, and carbons hydrate as the menu in this facility was lower than the national criteria. Fat intake was especially low. The level of HDL-c was not different in the national criteria, the facility criteria and the specimen. However, LDL-c and TG were significantly lower (specifically in TG) than the national criteria. Some research is reporting that BMI is associating with a cognitive function, and is an independent risk factor for cognitive disorder[5),6)]. BMI in this facility population and the specimen was smaller than the national criteria. Moreover, BMI in the specimen was significantly small even if comparison to the facility criteria. However, BMI is calculating from the height and weight, so that increases also in a case of overweight caused by excess muscular development. Therefore, increased BMI is not always a proof of a fatty excess state, and that is not also a risk factor of cognitive disorder. This time, we could examine the value of various Apoprotein within only in the specimen. So we compared the value of it with the standard (laboratory) criteria. As the result, though Apo-A1 in the specimen was not different from the standard criteria, Apo-A2, Apo-B, Apo-C 2, and Apo-C3 were significantly low in the specimen. It was unclear to us why this examination elicits an above result. However, it is well-known Apo-C3 well correlates with a level of TG. Therefore, the fact the specimen that was low value in TG was low in Apo-C3 also was interesting. Moreover, Apo-E was significantly high in the specimen. The relation of Apo-E4 (an isoform of Apo-E) and Alzheimer type dementia is a new interesting topic in recent years. Kanemaru K. et al. is saying the risk into dementia of Alzheimer type is high in a person who is having Apo-E4[7)]. However, we did not examine about isoform of Apo-E, so we cannot directly talk about the relation of Apo-E4 and Alzheimer. TP and albumin that reflects a nutritional condition were lower in both of the facility criteria and the specimen than the national criteria. However, these were not less than 3.7 g/ml. Therefore, either low protein or low albumin is probably not related to an intellectual disability at the range of our study. An increase in ALT is said to be related to an increase of subcutaneous fat. In addition, a certain research study is reporting rise of both of Hb-A1c and γ-GT, and also reporting a relation with subcutaneous and visceral fat increase[8)]. However, values of these items (including BS) in the facility residents were lower than the national criteria, and γ-GT in the specimen was lower than the facility criteria. CRT which reflects a renal function and UA which is an index of protein metabolism were lower in the specimen and the facility criteria than the national criteria. However, these differences were a difference within the normal range in criteria of these examination values. Increased CRT except a disease is said to be a proof of muscle development. However, BMI of the facility residents is smaller than the national criteria. That's why the small physique is maybe a reason for low CRT in the facility residents. We performed principal component analysis to differentiate the characteristics of the specimen from the facility criteria about above mentioned items as the final estimation. For the purpose of this analysis, we chose the age, BMI (which are probably related with the level of TG), and γ-GT that is significantly different alone among values of the specimen and the facility criteria, as explanatory variables to elicit the principal component. Both of characteristics in the

specimen and the facility mother population were able to explain from age and BMI on variables, as the result. We showed the equation for calculation of the principal component "Zn" in each group as follows.

1) Principal component in the facility population were calculated as follows.
   The first principal component;
   $Z_1 = 0.4643*Age - 0.6046*BMI$
   The second principal component;
   $Z_2 = 0.8673*Age + 1.9626*BMI$
2) Principal component in the specimen were calculated as follows.
   The first principal component;
   $Z_1 = 0.7059*Age - 0.7077*BMI$
   The second principal component;
   $Z_2 = 0.0786*Age + 0.3671*BMI$

From the above results, we found the specimen in low TG is younger on age and smaller in BMI in comparison with the facility criteria, as the characteristics. However, the facility population had not shown differences in characteristics of physique and age in the main ingredient score distribution of the quadrant. Moreover, in comparison with the specimen and the facility criteria, we could not find the significant differences on the main ingredient score distribution, but it was found as a trend ($p = 0.055$, chi-square test). Nutritional state and physique of this facility were lower than the national criteria.

Conclusion

We examined the background of the people who was specifically low Triglyceride (TG) in an intellectual handicapped facility. Nutritional state and physique of this facility were lower than the national criteria. From the result of principal component analysis, we concluded the characteristic of the low TG specimen in this facility is younger in age and smaller in physique in comparison with the facility criteria.

Limits of the study

Biomarkers including TG are different in age and sex even if homogenized measurement condition. We performed this study without considering of difference of the sex. The reason is the number of the low TG specimen was very small. Degrees of intelligence in the facility residents were also not examined. These problems may have induced the bias on results in this study. Therefore, we should carefully eliminate these weak points in next research study.

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ある知的障害者更生施設における低中性脂肪血症者の検討

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愛媛県の某知的障害者更生施設の入所者で，他の入所者と比較して体格は異ならないにも関わらず，特異的に血清中の中性脂肪の低い集団を認めた．この集団は毎年行われている定期健康診断で経年的に低中性脂肪血症を示した．そこで我々はこの集団の特異性について栄養学的，血液生化学的見地より検討を行った．その結果この集団は体格，栄養摂取量，中性脂肪を除く脂質レベルにおいては施設母集団との間に差を認めなかったが，同年代の全国平均基準より低い事が分かった．また各種の生化学的指標について検討した結果，幾つかの項目について基準値との間に有意の差を認めた．今回これらの差異について知的障害者と健常者における特性を比較考察すると共に，主成分分析法によってこの集団の背景特異性を明らかにしたので報告する．

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