B. A. NIKITYUK, M. I. RUBINOV

THE ANTHROPOLOGICAL TREND IN DEVELOPMENT GENETICS

Age, sexual and ethno-territorial peculiarities of intra-pair similarity of the monozygous and dizygous twins in body size, physiometric characters and in physical fitness indexes.

The research of twins is realized both in biology and in the medicine by the so-called twin method introduced by Francis Galton about 100 years ago. Later the method was widely used in the medical and biological research, it served mainly for the assessment of the genetic and environmental influences upon ontogenesis. The method however did not work satisfactorily mainly due to the following causes:

a) Imperfect methodical procedure of establishing whether the twins are monozygous or dizygous;

b) Conventional mathematical processing of the data about the twins, aimed at obtaining the integral index of the endogenous (hereditary) conditionality of the phenomenon.

The first obstacle has been overcome, but the other one is still present. The development of twin research has been hindered also by the lack of a sufficiently broad conception and by a comparatively narrow subject of our scientific programme, resulting in scarce scientific results.

The Director of the Medico-Genetic Institute of M. Gorki Professor S. G. Levit began to reassess the twin method forty years ago. He traced out new directions of twin research, connected with detailed intra-population and inter-population research (G. Levit, 1934). The purpose of the inter-population research is to study twins of various sex, age, of various ethnical backgrounds and comming from different geographical regions and environments. It is believed that the share of the endogenous influence upon the development of the morphological and functional characters in above mentioned situations is not equal. It is necessary to extend the scope of our research by increasing maximally the number of the followed characters inside the studied groups, since it can be presumed that the effect of the endogenous factors upon the development of various characters is varying.

On analysing the hitherto twin research methods S. G. Levit and his collaborators in the Medico-Genetic Institute have improved also the mathematical processing of twin data. They found that M. V. Ignatiev (1934) was right in assessing the role of the hereditary factors and of the environmental influence. On the other hand, the use of Ignatiev's formula for the assessment of the environmental influences determining the intra-familiar correlation was often misleading, since the result had negative sign. The imperfectness of his mathematical procedures proposed for finding out the quantitative characteristics of the endogenous and exogenous influences requires a great deal of caution. Therefore when analysing the causes of the difference between two individuals of a twin pair it is preferable to use the results of correlation analysis and to compare the degree of identity of the twin pairs arranged into groups according to the aims of research. The use of the twin method in anthropobiology can explain:

a) The degree of character identity in twins;

b) Age peculiarities of twin identity and endogenous conditionality of the characters;

c) Sexual differences in the identity of twins and the endogenous conditionality of the characters;

d) Special features in the identity of twins and of the exogenous conditionality of characters in dependence on the ethnic background of the twins;

e) Share of the environment in the appearance of hereditary influences.

For solving the problem mentioned sub 'd' it is necessary to study monozygous twins of the same type of zygosity, sex and age, living under identical environmental conditions but having different racial types. Task 'e' can be solved by comparing pairs of twins identical in all possible characters, but living under different environmental conditions.

The recommendations of S. G. Levit have not been fully realized up to these days. The method suggested by him can be called anthropological method, since it is based on anthropological methodology, i.e. the research is based on the analysis of variability in the genetic regulation of characters and in the assessment of factors determining this variability.

Remarkable achievements were reached by a team of the Medico-Genetic Institute (G. V. Soboleva, M. V. Ignatiev and others in 1936), and recently by the anthropologists of the school of D. Kadanov (D. Kadanov et al. 1970), though their researches did not comprise the whole versatility of variability factors. The anthropological direction was methodologically all right, but it showed little progress as regards conception, and in discovering the forms and causes of variability in twin studies.

We have contributed to the development of the ideas of S. G. Levit by realizing a morphofunctional research of 168 pairs of twins 3—7 years old, attending kindergartens in Moscow and in Andijan. Among the studied twin pairs there were 92 Russian pairs of the same sex, 10 Russian twin pairs of various sexes from Moscow, 20 Russian pairs of the same sex and 6 Russian pairs of different sexes from Andijan, 34 Mongoloid pairs (Uzbeks, Tatars) of the same sex and 6 Mongoloid pairs of different sexes from Andijan. Zygosity assessments were realized by comparing the dermatoglyphic, odontoglyphic and physiognomic similarities. We are very grateful to A. G. Bagdasaryan for processing of the dermatoglyphic data, to V. N. Vinnikova and A. A. Zubov for studying odontoglyphic peculiarities and S. S. Fingert for her assistance during the statistical processing of the results. 90 pairs have been diagnosed as monozygous, and 78 as dizygous.

The programme of our investigation contained the establishing of the body weight, the measuring of the body length, circumference of the chest, biacromial and bicristal breadths (only in Russians living in Moscow), dynamometry of the right and left hand, the establishing of vital capacity of lungs, the effects of 10m walking and running, of a standing jump and throwing a tennis ball — the frequency of pulse and respiration were measured before and after the physical exercises.

The data have been calculated by the variational statistical method. The twins were grouped according to their age, sex, zygosity, national and geographic background. The coefficient of intergroup correlation with the errors and heredity indexes (H) were calculated for each group. The heredity indexes (H) according to Holzinger's formula are:

$$H = \frac{\sqrt{MZ} - \sqrt{DZ}}{1 - \sqrt{DZ}}$$

where — MZ and DZ = correlation coefficients for monozygous and dizygous twins.

In view of the conventionality of this index we based our research on the analysis of correlation coefficients. On assessing the results of the research we shall make allowance for the role of the separate factors determining the variability of the intrapair similarity.

1. AGE FACTOR

The Russian male and female monozygous pairs constituted one group, while the Russian male and female dizygous pairs — the other one. Both groups were divided into two age-groups — to the group of children of 3—5 years, and to those of 6—7 years. Let us compare the correlation coefficients of the two groups *(Table 1)*.

According to Table 1 monozygous twins manifest a higher degree of similarity than dizygous twins of the same age. In the group 3—4 years twins the correlation coefficients are higher than in the 6—7 years age group. In the monozygous group this fact can be followed in 12 characters out of 16 (the difference in two cases is statistically reliable) and in the dizygous group it appears in 13 characters out of 16 (the difference is statistically reliable in four cases).

2. SEXUAL DIFFERENCES

Let us compare the similarity indexes in the groups of monozygous and dizygous twins (Russian children from Moscow) grouped according to their age, but divided into two sexual groups *(Table 2)*.

According to the prevailing number of characters (13 from 16 in the monozygous, and 12 from 16 in the dizygous twins) the degree of similarity is higher in the male pairs than in the female ones. If we consider only the statistically reliable differences in the similarity indexes we shall see that in boys they prevail in monozygous twins in four cases from six, and in dizygous twins — in four cases from four. We can see that this tendency is stronger in the dizygous pairs than in the monozygous ones. At the same time sexual differences in the degree of similarity between two partners of the same pair are less frequent in monozygous twins than in dizygous ones; statistically reliable differences were discovered in 6 characters from 16 in monozygous pairs, and in 4 characters (from 16) in dizygous pairs.

TABLE 1

Coefficients of intra-pair correlation in groups of twins of younger and older children (Russians from Moscow).

No. of character	Monozygous twins		Dizygous twins	
	3—5 years N = 45	6—7 years N = 18	3—5 years N = 11	6—7 years N = 13
1	0.980 ± 0.02	0.950 ± 0.02	0.900 ± 0.02	0.792 ± 0.07
2	0.870 ± 0.07	0.930 ± 0.02	0.659 ± 0.15	0.659 ± 0.11
3	0.810 ± 0.09	0.910 ± 0.04	0.774 ± 0.10	0.755 ± 0.18
4	0.710 ± 0.14	0.910 ± 0.04	0.623 ± 0.13	0.551 ± 0.14
5	0.840 ± 0.10	0.750 ± 0.10	0.813 ± 0.08	0.409 ± 0.16
6	0.610 ± 0.17	0.710 ± 0.09	0.610 ± 0.16	0.630 ± 0.11
7	0.710 ± 0.13	0.634 ± 0.10	0.577 ± 0.16	0.520 ± 0.17
8	0.910 ± 0.05	0.821 ± 0.05	0.873 ± 0.08	0.513 ± 0.14*
9	0.970 ± 0.02	0.940 ± 0.03	0.850 ± 0.04	0.810 ± 0.06
10	0.940 ± 0.03	0.720 ± 0.04*	0.869 ± 0.02	0.400 ± 0.16*
11	0.980 ± 0.01	0.950 ± 0.01*	0.950 ± 0.01	0.871 ± 0.03*
12	0.950 ± 0.03	0.945 ± 0.02	0.927 ± 0.01	0.870 ± 0.05
13	0.810 ± 0.03	0.478 ± 0.18	0.319 ± 0.22	0.375 ± 0.17
14	0.800 ± 0.12	0.550 ± 0.11	0.570 ± 0.09	0.388 ± 0.17
15	0.610 ± 0.09	0.470 ± 0.13	0.420 ± 0.12	0.364 ± 0.17
16	0.699 ± 0.07	0.570 ± 0.11	0.621 ± 0.08	0.393 ± 0.17

*NOTE: 1 — body length. 2 — body weight, 3 — circumference of the chest, 4 — biacromial breadth. 5 — bicristal breadth, 6 — dynamometry of the right hand, 7 — dynamometry of the left hand, 8 — vital capacity of lungs, 9—10 — results of walking and running to the distance of 10 metres, 11—12 — length of standing jump and throwing a ball, 13—14 — frequencies of pulse before and after the physical exercises, 15—16 frequencies of respiration before and after the physical exercises. * — the difference of correlation coefficients is reliable at $p < 0.05$.*

TABLE 2

Coefficients of intra-pair correlation in groups of boy and girl twins (Russians from Moscow).

No. of character	Monozygous twins		Dizygous twins	
	boys N = 38	girls N = 25	boys N = 14	girls N = 15
1	0.988 ± 0.01	0.961 ± 0.01	0.965 ± 0.02	0.861 ± 0.04*
2	0.955 ± 0.02	0.831 ± 0.06	0.919 ± 0.02	0.662 ± 0.04*
3	0.910 ± 0.03	0.874 ± 0.05	0.832 ± 0.09	0.764 ± 0.11
4	0.868 ± 0.04	0.963 ± 0.01*	0.693 ± 0.05	0.815 ± 0.04
5	0.867 ± 0.04	0.844 ± 0.06	0.408 ± 0.22	0.685 ± 0.08
6	0.736 ± 0.07	0.516 ± 0.12	0.650 ± 0.16	0.605 ± 0.07
7	0.919 ± 0.01	0.748 ± 0.06*	0.754 ± 0.12	0.669 ± 0.11
8	0.912 ± 0.03	0.719 ± 0.06*	0.824 ± 0.08	0.539 ± 0.13
9	0.913 ± 0.03	0.977 ± 0.01*	0.857 ± 0.02	0.847 ± 0.07
10	0.871 ± 0.04	0.877 ± 0.04	0.850 ± 0.07	0.821 ± 0.06
11	0.987 ± 0.01	0.855 ± 0.04*	0.977 ± 0.01	0.540 ± 0.08*
12	0.937 ± 0.02	0.696 ± 0.01*	0.840 ± 0.06	0.529 ± 0.12*
13	0.621 ± 0.07	0.600 ± 0.09	0.560 ± 0.18	0.497 ± 0.14
14	0.610 ± 0.07	0.533 ± 0.10	0.553 ± 0.15	0.453 ± 0.07
15	0.588 ± 0.08	0.545 ± 0.14	0.467 ± 0.14	0.468 ± 0.14
16	0.605 ± 0.06	0.720 ± 0.10	0.493 ± 0.14	0.668 ± 0.10

NOTE: *see notes beneath Table 1.*

3. ENVIRONMENTAL CONDITIONS

On comparing children of the same ethnic groups (Russian children) living in different towns (Moscow, Andijan) we can see the presence or absence of the conditions drawing together or separating the partners of the pair.

In most cases similarity between two twins was higher in Russians living in Moscow than between Russians living in Andijan: in 10 characters from 14 in monozygous twins and in 12 characters from 14 in dizygous twins. If we consider only the statistically reliable differences of the correlation coefficients we shall see a higher degree of intra-pair similarity in two cases from five in the Russians living in Andijan and in three cases in Russians living in Moscow. The relatively low number of observations enables us to draw only preliminary conclusions about these trends. The higher degree of intra-pair similarity in Russians living in Moscow shows that in the capital city probably exist certain factors drawing together the partners of the same pair, but this conjecture should be checked properly.

4. ETHNIC BACKGROUND

On comparing the degree of similarity of partners of a Europeoid twin pairs with a twin pairs of Mongoloid children (Uzbeks and Tatars), living

TABLE 3

Coefficients of intra-pair correlation of Russian twins from Moscow and Andijan.

No. of character	Monozygous twins		Dizygous twins	
	Russians from Moscow N = 63	Russians from Andijan N = 11	Russians from Moscow N = 29	Russians from Andijan N = 9
1	0.950 ± 0.01	0.990 ± 0.03	0.820 ± 0.04	0.831 ± 0.07
2	0.030 ± 0.01	0.930 ± 0.03	0.790 ± 0.05	0.616 ± 0.16
3	0.880 ± 0.02	0.870 ± 0.04	0.780 ± 0.05	0.630 ± 0.15
6	0.710 ± 0.04	0.900 ± 0.03*	0.692 ± 0.07	0.675 ± 0.13
7	0.740 ± 0.04	0.880 ± 0.03*	0.700 ± 0.06	0.672 ± 0.12
8	0.950 ± 0.01	0.870 ± 0.07	0.680 ± 0.07	0.536 ± 0.17
9	0.980 ± 0.004*	0.970 ± 0.01	0.890 ± 0.02	0.816 ± 0.08
10	0.970 ± 0.004*	0.880 ± 0.04	0.920 ± 0.02	0.720 ± 0.11
11	0.990 ± 0.001*	0.920 ± 0.03	0.937 ± 0.01	0.840 ± 0.07
12	0.970 ± 0.001*	0.870 ± 0.04	0.860 ± 0.03	0.735 ± 0.11
13	0.700 ± 0.04	0.640 ± 0.13	0.384 ± 0.11	0.573 ± 0.17
14	0.780 ± 0.03	0.570 ± 0.15	0.559 ± 0.09	0.436 ± 0.19
15	0.542 ± 0.06	0.530 ± 0.15	0.500 ± 0.10	0.488 ± 0.18
16	0.637 ± 0.05	0.510 ± 0.16	0.600 ± 0.08	0.440 ± 0.19

NOTE: *see notes beneath Table 1.*

TABLE 4

Coefficients of intra-pair correlation of twins of Europeoid and Mongoloid origin from Andijan.

No. of character	Monozygous twins		Dizygous twins	
	Europeoids N = 11	Mongoloids N = 16	Europeoids N = 9	Mongoloids N = 18
1	0.990 ± 0.03	0.972 ± 0.08	0.831 ± 0.07	0.857 ± 0.04
2	0.930 ± 0.03	0.910 ± 0.02	0.616 ± 0.16	0.726 ± 0.06
3	0.870 ± 0.04	0.890 ± 0.04	0.630 ± 0.15	0.736 ± 0.08
6	0.900 ± 0.03*	0.770 ± 0.05	0.675 ± 0.13	0.652 ± 0.07
7	0.880 ± 0.03	0.860 ± 0.03	0.672 ± 0.12	0.740 ± 0.05
8	0.870 ± 0.04	0.880 ± 0.04	0.536 ± 0.17	0.733 ± 0.05
9	0.970 ± 0.01	0.960 ± 0.04	0.816 ± 0.08	0.820 ± 0.02
10	0.880 ± 0.04	0.870 ± 0.02	0.720 ± 0.11	0.750 ± 0.05
11	0.920 ± 0.03	0.920 ± 0.02	0.840 ± 0.07	0.680 ± 0.09
12	0.870 ± 0.04	0.930 ± 0.02	0.735 ± 0.11	0.760 ± 0.07
13	0.640 ± 0.13	0.580 ± 0.12	0.572 ± 0.17	0.420 ± 0.14
14	0.570 ± 0.15	0.620 ± 0.11	0.436 ± 0.19	0.540 ± 0.10
15	0.530 ± 0.15	0.530 ± 0.09	0.488 ± 0.18	0.420 ± 0.14
16	0.510 ± 0.16	0.480 ± 0.10	0.440 ± 0.19	0.400 ± 0.14

NOTE: *see notes beneath Table 1.*

in the same town and attending the same kindergarten, we can pick out the intra-pair similarity factors caused by the ethnic origin of the children *(Table 4)*.

By comparing twin pairs of Europeoid (Russian) and Mongoloid (Uzbek, Tatar) origin we did not find any prevailing of intra-pair correlations inside these racial groups. The coefficients of correlation of the monozygous twins are especially very close to each other, although in one case the difference of indexes is statistically reliable (dynamometry of the right hand). Table 4 shows that the peculiarities of the genotype connected with race have no influence upon the degree of similarity of monozygous or dizygous twins.

5. THE GRADIENT OF CORRELATION

We shall use the data of *Table 3* — let us start with Russian twins living in Moscow. We shall present here the characters according to the decreasing correlation coefficients.

Monozygous twins: standing jump distance — 10 m walking time — 10 m running time — distance of ball throwing — body length — vital capacity of lungs — body weight — circumference of the chest — pulse frequency after loading — dynamometry of the left hand — dynamometry of the right hand — pulse frequency before and after loading — frequency of respiration after loading — frequency of respiration before loading.

Dizygous twins: standing jump distance — 10 m running time — 10 m walking time — distance of ball throwing — body length — body weight — circumference of the chest — dynamometry of the left hand — dynamometry of the right hand — vital capacity of lungs — respiration frequency after loading — pulse frequency after loading — respiration frequency before loading — pulse frequency before loading.

We can see that the highest degree of intra-pair similarity is reached in physical exercises (the average correlation coefficients of the monozygous and dizygous groups for four characters are 0.97 and

0.90), then the body dimensions follow (the average correlation coefficients for three characters are 0.90 and 0.77), then physiometric characters come (dynamometry and vital capacity of lungs with an average correlation coefficients of 0.80 and 0.69) and then the cardio-vascular and respiratory organs reactivity indexes come (with the average coefficients of 0.66 and 0.51).

The indexes of hereditary conditioning of characters (Holzinger's indexes) calculated according to the similarity indexes have in Russian children living in Moscow the similar distribution. In the results of physical exercises (running, walking, standing jump, ball throwing) and in the vital capacity of lungs Holzinger's indexes are 0.62—0.84. In the anthropometric dimensions the values of Holzinger's indexes are 0.45—0.72. The reactivity Holzinger's indexes of the cardio-vascular and respiratory system and of the muscle strength are equal to 0.06—0.52. The distribution of Holzinger's indexes in Russian and Mongoloid children living in Andijan is approximately the same *(Table 5)*.

TABLE 5

Holzinger's indexes in twins from Andijan.

	Russians from Andijan	Mongoloids from Andijan
Results of physical exercises	0.50—0.83	0.48—0.77
Anthropometric values	0.65—0.94	0.58—0.78
Physiometric values	0.63—0.76	0.34—0.55
Cardio-vascular and respiratory system values	0.08—0.23	0.13—0.27

The indexes of the results of physical exercises and of the total body dimensions are higher than the physiometric indexes and the cardio-vascular and respiratory system reactivities indexes both in the correlation coefficients of the monozygous and dizygous twin groups and in the degree of hereditary conditioning conventionally characterized by Holzinger's index.

DISCUSSION

Twin researches were realized mostly in selected groups with no age differentiation, as a result of the small number of observations. The work of D. Kadanov, L. Tsacheva and B. Pandova (1970) is an exception — they studied the intra-pair differences in body dimensions and head dimensions of twins of the same sex or different sexes in connection with the age of the studied children. The degree of intra-pair difference in twins of the same sex is decreasing from the age of 7—8 years to 11—12 years, from the age of 16—18 years it is increasing again. The authors explain the increase of intra-pair variability of the characters at the age of 13 years with the boisterous pre-pubertal growth of children.

In the literature we can find the same interpretation of the increase of character variability in children in population researches (L. P. Nikolayev, 1925; Ju. M. Aul, 1961; A. M. Uryson, 1962). It means that the decrease of intra-pair character similarity from twins of 3—5 years towards twins of 6—7 years is a result of the activization of their growth and development. From the literature we know about the problem of the so-called semi-growth jump (J. Tanner, 1968). The activization of growth process at the age of 6—7 years could be a proof of the existence of such a jump in the studied pairs, though a full proof would require to demonstrate also the drop of growth activity after the age of 7 years, but we have no such materials at our disposal.

The study of similarity between sisters and brothers inside the same family including the study of twin pairs is used in anthropogenetics for studying the autosomous and gonosomous mechanisms of character inheritance. It is believed that the prevalence of similarity in sister-sister pairs over brother-brother pairs proves that the inheritance of these characters is connected with X-chromosome (M. V. Ignatiev, 1937). Though this method was criticized by V. V. Bunak (1937), today it is widely used. Garn and his collaborators (S. Garn et col., 1960, 1969) showed that X-chromosomes participate in the development of the skeleton and teeth. As far as body length and body weight are concerned, more similarity was observed in pairs of sisters than in pairs of brothers (D. Hewitt, 1957). On studying the carpal bones of twins (B. A. Nikityuk and K. M. Piletski, 1972) we have discovered a higher degree of similarity in phalanxes in twin sisters than in twin brothers. The coefficients of intra-pair correlation for pulse frequency are higher in twin girls than in twin boys: in monozygous girls and boys they are 0.66 and 0.42, in dizygous ones 0.40 and 0.31 (N. N. Malkova, 1934). As to the beginning of teeth eruption, sitting up and walking, there were no considerable differences (L. J. Bosik, 1934), this fact can be considered as a result of autosomous inheritance.

In 16 morphological and functional characters we found:

1. Prevalence of similarity in brother-brother pairs compared with sister-sister pairs.
2. Higher frequency of statistically reliable inter-sexual differences of correlation coefficients in monozygous twins.
3. In monozygous twins (though in a small number of cases) a statistically reliable tendency of prevalence of intra-pair correlations in sister pairs compared with brother pairs.

The above-mentioned facts can be explained in two ways. On the one hand they can be a proof of autosomous hereditary mechanism in the studied characters. On the other hand in view of the genotypic unity in monozygous twins the sexual differences of correlation coefficients can be attributed to the influence of the environment unevenly separating and drawing together the partners of the same twin pair. It can be assumed that environmental conditions draw together twin brothers and increase their similarity — compared with twin

sisters. This problem, however, should be studied more profoundly by means of additional sociological and psychological observations right in the families. These studies should include also separately-born brothers and sisters, not only twins.

One of the preconditions for the application of the twin method is the acknowledgement of the similarity of environmental influences upon individuals inside the monozygous and dizygous twin pairs. Some authors point out that this precondition is not quite correct (K. Stern. 1965).

In the proceedings of the Medico-Biological (Genetic) Institute of Maxim Gorki there were several attempts to assess quantitatively the 'drawing together' and 'separating' environmental factors (intra-family and inter-family factors, or according to S. G. Lewitt 1936 — factors forming intra-family similarity or not forming it) for various characters; also for twins of different sex and age groups. N. N. Małkova (1934) used *Ignatiev's* formula (1934) and she found the following index values of genetic determination (1), intra-familiar (2) and inter-familiar (3) environmental factors for pulse frequency:

	boys	girls
1	0.22	0.52
2	0.20	0.14
3	0.58	0.34

The above-mentioned values characterize conditionally the share of endogenous (hereditary) and exogenous (environmental) influences.

G. V. Soboleva and M. V. Ignatiev (1936) found a 74 % genetic dependence of body weight. In comparison with it the share of drawing together paratypical factors reaches 17.7 %, and of separating factors 8.3 %.

In connection with this fact the interest of the research team of the Medico-Genetic Institute was limited by studying only Moscow twins, and materials obtained in Moscow were not compared with materials from other Soviet towns, neither the problems of geographical differences of paratypical conditions were discussed. Our observations realized on twins of identical racial type (Russians from Moscow and from Andijan) have shown both in the monozygous and dizygous twin groups a higher degree of intra-pair similarity in the Russian twins living in Moscow. All observed children were brought up in kindergartens of comparatively standardized regimes. We hold on the basis of facts we have gathered that the conditions of life in large cities have more drawing together (less separating) factors than the conditions in a provincial town with lower urbanization level.

The importance of environmental factors has been proved in the above sense also by the intra-pair correlation of children from Andijan. In the same environment we did not find any intra-pair correlation difference in twin pairs of different racial types — Europeoids and Mongoloids. This proves indirectly that differences between Russian twins from Moscow and from Andijan are not necessarily linked with genetic differences of these groups, because greater inter-racial differences have not affected the correlations.

The correlation gradient established in twin groups is in harmony with materials dealing with intrapopulation variability of the same characters. According to non-published observations realized on Russian, German and Tatar children the degree of dimension variability expressed by the variation coefficient is increasing from the anthropological characters and results of physical exercises towards the cardio-vascular and respiratory system reactivity indexes.

In the future we shall have to prove the results of the above twin research also by observations in the families and also by intra-population and inter-population researches.

SUMMARY

1. The degree of intra-pair similarity of twins is decreasing from the age of 3—5 years to the age of 6—7 years.

2. In brother-brother pairs the intra-pair similarity in most cases is greater than in sister-sister pairs.

3. Inside the same racial type twins living in Moscow show a greater degree of intra-pair similarity than twins living in Andijan.

4. In the same town and under identical environmental conditions differences in racial types do not influence the intensity of similarity.

5. The degree of intra-pair similarity decreases usually from the results of physical exercises and anthropometrical dimensions towards the indexes of the cardio-vascular and respiratory system reactivity.

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Prof. B. Nikityuk,
Institute of Children Physiology,
Pogodinskaya ul. 8, Moscow, G-117
(USSR).