Review

Anthropological and demographical study of the potential athletes from 9-14 years old, from a mountainous municipality

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Abstract

It was performed a non experimental and transversal research, to identify physical anthropological patterns on children from 9 to 14 years old, from a Cuba's mountainous municipality. To statistical processing the proportions calculation, arithmetic mean, standard deviation, Kendall's W coefficient of concordance, one sample T-student test, Kolmogorov-Smirnov and Levene tests was applied. It was concluded that the researched population: are experimenting a strong crossbreeding process, where even predominates individuals whose ethnic external traits show certain Amerindian trend; have different growth and development patterns in relation to the rest of Cuban nation; and due to their inferior stature regarding to the rest of the country, possesses conditions little favorable for those sports whose structure of performance demands very high statures.

Key words: genetic pile; crossbreeding; growth and development

Resumen

Se realizó un estudio no experimental, transversal, con el objetivo de identificar patrones antropológicos físicos en los niños y niñas de 9-14 años de un municipio montañoso de Cuba. Para el procesamiento estadístico se aplicó el cálculo de proporciones, la media aritmética, la desviación estándar, el coeficiente de concordancia W de Kendall, la prueba T-student para una muestra, la prueba de bondad de ajuste de Kolmogorov-Smirnov y la prueba de Levene. Se

concluyó que la población en estudio: experimenta un fuerte proceso de mestizaje, en el que aun predominan los individuos cuyos rasgos étnicos externos muestran cierta tendencia amerindia; posee patrones de crecimiento y desarrollo diferentes al resto de la nación cubana; debido a su estatura promedio inferior al resto del país, posee condiciones poco favorables para aquellos deportes cuya estructura del rendimiento exija estaturas elevadas.

Palabras clave: acervo génico; mestizaje; crecimiento y desarrollo

Introduction

Buey Arriba municipality, placed on the biggest mountainous chain of Cuba, the Sierra Maestra, it belong to one of the more populated provinces of this country, nevertheless, it occupy the antepenultimate place in population within this, with 31.652 inhabitants (Oficina Nacional de Estadísticas e Información, 2017). In addition, its mountainous features make of the sports practice a difficult phenomenon of extend to all its geography, what limits also the amount of practitioners in sports areas, placing it in disadvantage regarding to majority of municipalities from the province, more populated and less rural. From a so adverse situation, it is inferred that the Municipal Direction of Sports must, more that any another municipality, to perfect its management, with view to increase its competitiveness within province.

Ancestral lineage study from a population and, with this, of ethnical basis over which it was creating the crossbreeding of current inhabitant, could become in starting point to identify population's predisposition toward the performance in certain sports specialty.

An important example of the relevance of such knowledge is constituted by African genetic lineage: the countries with better results in endurance events of Athletics are the East Africans, while the countries with better marks in speed are those which population have a high percentage of genes that proceed from West Africa, like United States and anglophone Caribbean countries.

One of the most common questions between boyarriban specialists it is related with the fact of that, historically, sports like volleyball and basketball, have contributed little regarding to promotion of athletes from municipality to the high performance, due, most of all, to a bad quality in the matriculation, from which, traditionally, it emerges very few individuals of great size, what lead to consider the possible existence of growth and development patterns, typical of local inhabitant.

In front of this incognita, having in count that phenotype of an individual is resulting of interaction of their genes among themselves and with environment with which it is related (Berovides, 2014;

Marcheco, 2013), it was decided to perform the current study, with aim of to identify growth and physical development patterns in children from 9 to 14 years old, from Buey Arriba municipality, in the light of their genetic pile and secular demographic trends.

POPULATION AND SAMPLE

It was realized a non experimental and transversal research. The population under consideration it comprised to the 2.720 children from 9 to 14 years old from Buey Arriba municipality, apt for sports practice, being observed 1 409 (51,8 %): 675 females and 734 males. Sample selection was developed by mean of a randomized sampling, stratified by Popular Council.

It was used, as theoretical methods of research: inductive-deductive, analysis-synthesis. As empiric methods: observation and measuring.

Firstly, it was effectuated an analysis of secular demographic trends of local population, determining its historical evolution starting from migratory movements, migratory balance and population pyramid.

After observers selection and their preparation to information collect, and because indicators of external ethnic features are the more prone to inter-observer variations, influenced by subjectivity, it was applied a test to determine the concordance level between observers when measuring such variable. For this, Kendall's coefficient of concordance (W) was calculated. It was reached a W=0,813, with p=0,000.

As an approach to underlying genetic pile of population under study, it was determined the external ethnic features, starting from skin color and hair type, classifying individuals according to:

- ✓ White: White skin, straight hair.
- ✓ Crossbred I: White skin, curly hair.
- ✓ Crossbred II: Clear-dark skin, straight hair.
- ✓ Crossbred III: Dark-copper or black skin, straight hair.
- ✓ Crossbred IV: Clear-dark skin, curly hair.
- ✓ Black: Black skin, curly hair.

It is convenient to clear that this classification is conventional and arbitrary, and doesn't imply absolutely some hierarchy. In a posterior classification, individuals classified as Crossbreds II and III, was considered with external ethnic features with Amerindian trend; classified as Crossbreds I, Crossbreds IV and Blacks, was considered with external ethnic features with Afro-American trend; classified as Whites, was considered with external ethnic features with Euro-Asiatic trend.

Skin color it was determined in the arm internal face (constitutive pigmentation), near of armpit, because this is a body region with low sun exposition; nowadays is known that skin color is a highly heritable quality, always and when be controlled the most important non genetic factor: exposition to solar light (Clark et al., 1981, cited by Barsh, 2003).

It was used a scale of four phototypes, which constitutes a modification from the scale of six phototypes proposed by Fitzpatrick (Gil, Hernández, & Contreras, 2016):

✓ Phototype I (White skin): clearest skin, with high susceptibility to solar burn, and neither or little capability of bronzed.

✓ Phototype II (Clear-dark skin): skin with moderate susceptibility to solar burn, and good capability of bronzed.

✓ Phototype III (Dark-copper skin): skin with low susceptibility to solar burn, and very good capability of bronzed.

✓ Phototype IV (Black skin): darkest skin, with low or neither susceptibility to solar burn, and excellent capability of bronzed.

In order to determinate the hair type, it was used a classification derived from classification proposed by Company & Gómez-Escalonilla (2008), in function of its structure and physical appearance:

• Straight: it can be smooth (lisotric) where the shape of follicle is circular and it is vertically orientated to skin's surface forming a right angle with it (in Cuba, it is vulgarly know as Chinese hair); or undulating (cinotric), which has oval shape and it is oriented forming an acute angle.

• Curly (ulotric): Has elliptical shape and its orientation is parallel to skin's surface.

As anthropometric indicators it was measured: height (in centimeters –cm–), seated height (cm) and body mass (in kilograms –kg–). It was determined growth and development indicators: Cormic Index (trunk length), Manouvrier Index (legs length), and Body Mass Index (BMI – mass/height ratio–). It was performed three quality controls during observations, through measuring and re-measuring, by observers, to a same set of individuals, while, a technician with expertise tested the measuring quality, watching the individuals posture, the putting of measuring instrument, the reading of measure, joined it to systematic supervision of registered data.

Statistical techniques

It was applied, as statistical techniques:

*Calculation of proportions, arithmetic mean (M), and standard deviation (SD).

*Calculation of Kendall's coefficient of concordance (W), to determinate the concordance degree between observers.

*T-student for one sample, with $\alpha = 0,05$, to compare the height and BMI of children from municipality regarding to rest of country, taking respectively, as test values (TV), the values proposed by national research about growth and development performed in Cuba, published by Medina, Roteta and Barcos (2014), and the obtained for current province of Havana (Facultad de Ciencias Médicas Julio Trigo López, 2015).

All process it was carried out with help of the statistical package IBM SPSS Statistics 23.0 (SPSS Inc, 2014), supported over Windows Seven.

RESULTS ANALYSIS

Secular demographic trends of Buey Arriba population

The conjoin observation of figure 1 and table 1, could carry to conclusion that, Buey Arriba municipality, has reached the fifth phase of demographic transition, because, after of having grown until a population peak, superior to 32.200 inhabitants, in 70's decade of past century XX, and to keep close values, of stable way, during several decennia, it is observed a secular trend toward decrease, in a process started at year 2007; however, such conclusion would be equivocal, because, one of the features of this phase is that the general mortality is superior to natality, but, in Buey Arriba, natality are still significantly bigger than mortality (almost twice), that indicates than, in truth, the population decrease obeys to migration, which maintains negative balances from several decades behind (Oficina Nacional de Estadísticas e Información, 2017).

Such situation provokes, for Buey Arriba, a genetic exchange rate of its population, with another populations, lowermost than those municipalities eminently catchers of migrants, as the main urban centers of province and nation, therefore, is possible to hope a bigger homogeneity among its inhabitants, which increments the probability of appearing of stable, common and recurrent sequences on its population's attributes (phenotypic patterns).

Phenomenon of stagnation and posterior decrease of population, started in the years 70's of century XX, was generated, in turn, an aging progressive process of its population (see figure 2, note that the pyramid goes toward inversion), which lead to a decrease of potential sports

matriculation, matter that indicate the need of to increase the effectiveness of work with earlier ages.

Table 1. Evolution of Buey Arriba population into 39 years. 1977-2016

Year	1977[1]	2007[2]	2016[2]
Population	32290	32239	31652

Sources: [1]Comité Estatal de Estadísticas (1979). [2]Oficina Nacional de Estadísticas e Información (2017)
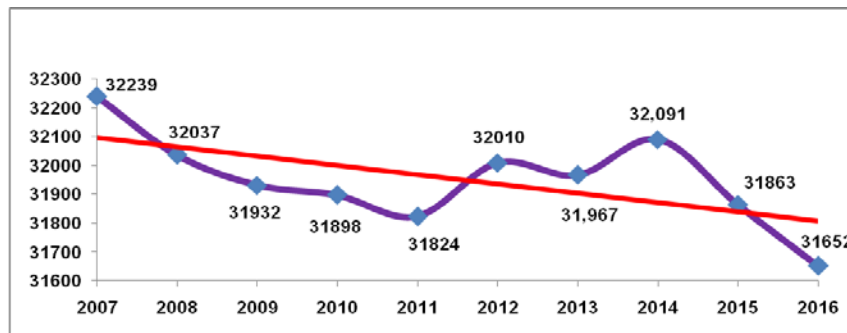

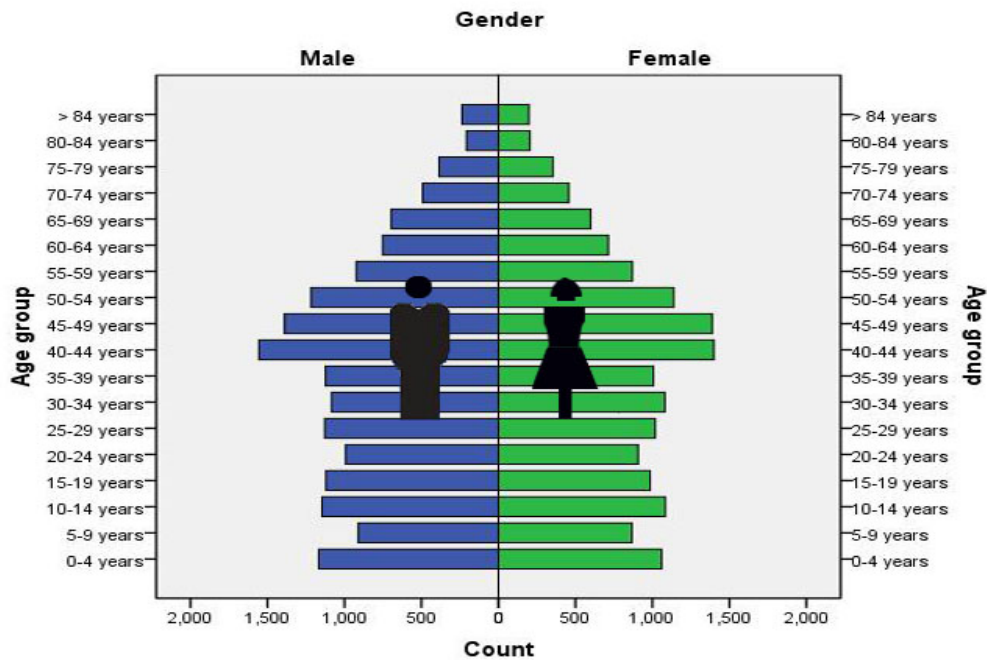**Figure 1**. **Evolution of Buey Arriba's population. 2007-2016**

Figure 2. **Population pyramid from Buey Arriba. 2016**

Source: Oficina Nacional de Estadísticas e Información (2017).

External ethnic features and migratory flows

The crossbreeding process that Cuban nation even experiments it is also showed in the studied population, being observed such traits of external manner in a 75,97 % of individuals; purely

white or black population does not surpass the population's fifth (table 2a), data that follows a similar trend to Granma province, which, according to Centro de Estudios de Población y Desarrollo (2016), it is between the two provinces with minor proportion of inhabitants with white skin, among the three with less individuals of black skin and, in turn, among the three with bigger proportion of crossbred color.

Table 2a. Distribution of population according to external ethnic features

Classification	N	%
Mestizos	1067	75,7
Blancos	279	19,8
Negros	63	4,5
Overall	**1409**	**100**

Noticeable difference between whites and blacks it is accord with migratory flows that has been experimented by the municipality: into Buey Arriba there was a low slave presence from African origin and, the Haitian immigration of century XX, re-emigrated toward Camagüey and Ciego de Ávila, leaving a few descendent into localities where their bateyes was placed (Oliva, 1991).

Once crossbreds was distributed between Afro-American and Amerindian categories, it was knew that the population's heft (53,52 %) shows trend toward Amerindian traits, the which it coincide with fact that, into Granma province, has been verified the highest proportions of Native American genes into Cuba (Marcheco, Fuentes, Marín, & Gómez, 2015).

Table 2b. Distribution of population according to external ethnic features

Classification	N	%
Afroamericanos	376	26,7
Amerindios	754	53,5
Euroasiáticos	279	19,8
Overall	**1409**	**100**

As way as approach to genetic pile of local population, research proposes to study of individual external ethnic features to, starting from the conjoint of this, to interpret the patterns to population level, considering skin phototype and hair type; idea that it is supported over fact that skin color depend from melanin amount present in this, which, even though can look itself influenced by effect of exposition to solar radiation, only, vary for such cause (environmental) within determined limits essentially imposed, by genetics (Marcheco, 2013).

Reaserchs from authors as Szabo et al. (1969), Toda et al. (1972), Konrad and Wolff (1973), cited by Barsh (2003), have revealed than the organelles that it contains pigments, so-called melanosomes, are bigger, more numerous, and more pigmented in dark skin compared with intermediate skin, and in this, compared with clear skin, corresponding to individuals whose ancestors came from Africa, Asia or Europe, respectively.

Marcheco et al. (2015) in their study about genetic characterization of current Cuban (first at country in examining genes for skin color in Cuba), consider than, to individual level, skin color, by oneself, is not an indicator to estimate the origin of ancestral lineage, as yes it is a genetic test, they definitely recognize than, at Cuban case, exists a significant correlation among the percentage of ancestral genes in a given genotype and melanin index, and consequently, skin pigmentation.

The *rs1426654* and *rs16891982* markers placed at *SLC24A5* y *SLC45A2* genes respectively, shown a significant association with skin pigmentation, of such manner than, by each copy of A allele from rs1426654 marker that possess an individual, melanin index will decrease in 5,04 units and his skin will be less dark, while, by each copy of G allele from rs16891982 marker, melanin index will decrease in 3,04 units (Marcheco et al., 2015).

Equally, it is knows that hair type are determined by genetics; it is inherited from parents, it is determined by world region where they originated. All depends from ethnic group or mixture of groups of ancestors (UCI, 2015a).

Then, when skin phototype and hair type are studied of conjoint manner, it is increased the information amount correlated with ancestral ethnic origin. Therefore, when data are processed to population level, it is possible to identify patterns capable of to express the more frequent external ethnic features and, consequently, to point toward most common origins of population under study.

Nowadays it is known that Native American population who inhabited Cuba at Colón's arrival was not extinguished by colonizers; native population, firstly, it went into various places of difficult access and next it mixed up with European conquerors. According to genetic studies developed by Moreno-Estrada et al. (2013), this crossbreeding, into Caribbean area, is considered that began precisely by this island, does ones 17 generations behind (considering 30 years per generation), while, for Puerto Rico, Dominican Republic and Haiti, is estimated in 16. However, most recent and extensive study made on inhabitants of Cuba, with help of ADMIXMAP v3.8 software, which bases its analyses over an algorithm that models the ethnic

mixture starting from bayesian methods combined with logistic regression models, it estimated the time of Cuban crossbreeding in only seven generations, that is to say, ones 200 years (Marcheco, 2013), that accords much more with various reports that bail to Cuba as country of Caribbean area where, for more time, was observed natives without crossbreeding, extending their presence in such status until XIX century (Pichardo, 1945; Guitar, 1998; Molina et al., 2007; Tamames, 2009, cited by Valcárcel, Samson, & Hoogland, 2013).

In kind, according to the testimony of the boyarriban mambi Manuel Tellez Oliva, at his trajectory through Buey Arriba's mountainous areas, as part of his missions of searching of salt to coast of current Guama municipality, at year 1895, he caught sight of several settlements purely aborigines (Oliva, 1991). Another investigators, based in numerous bibliographic proofs, insure that sightings of non crossbred indians (although yes transcultured) continued being reported until the first half of XX century in several of more intricate zones of Sierra Maestra (Yaremko, 2009).

Archaeological and bibliographical reports that give testimonies about crossbreeding, and not extinction, of Amerindian in Cuba, are nowadays enriched by the most recent national genetic studies, which show widely such fact.

According to the study for characterization of genomic variation patterns of Cuban population, published at 2013 by a collective of researchers from Stanford University School of Medicine, McGill University, University of Miami Miller School of Medicine, Ancestry.com DNA, University of California, University of Puerto Rico and the Center of Experimental Medicine Miguel Layrisse of Caracas, as part of a bigger research about genetic history of Caribbean population, at Cuba it is verified the more extreme range of inter-individual genomic variation, which varies, as example, for ancestors from Western Africa, from 2 % to 78 % (Moreno-Estrada et al., 2013). This it is meaning that another ancestors' lineages, as tainos, has equally a variable presence into genome of current Cuban, being bigger toward eastern mountainous zones where them survived for more time in front of crossbreeding, and, where migratory flow even shows a negative balances.

The most recent research developed at Cuba using a panel of 128 genetic markers, informative for ancestral origin, performed on 1.020 individuals from 137 municipalities of all country provinces, allowed to determinate the ethnic mixture proportions and its pattern of geographical distribution. In such study, the Granma province (where Buey Arriba municipality is placed),

showed the higher proportions of genes of Native American origin (15 %), followed by Holguín (12 %) and Las Tunas (12 %) (Marcheco et al., 2015).

At Buey Arriba case, archeological studies date the Amerind presence of arawak (tainos) origin into its current territory, since several centuries before of the Cristobal Colon arrival to Cuban coasts, being at least ten, the Amerindian deposits convincingly documented by local researchers (Dirección Municipal de Planificación Física, 2015; Garcés, 2015; Oliva, 1991).

Buey Arriba territory was colonized starting from year 1514, by the knight commander Manuel de Rojas, who it was established at aboriginal site of Egüarrobo, placed to several kilometers from mountain range Sierra Maestra, what supposed a displacement of local Native American population toward near mountains. However, De Rojas departed soon toward Peru, being left abandoned his lands until Diego de Soto claimed them, at year 1569 (Dirección Municipal de Planificación Física, 2015; Oliva, 1991).

Non Amerindian presence in Buey Arriba it continued without being significant until century XIX (Dirección Municipal de Planificación Física, 2015; Oliva, 1991). Such presence began to became significant only starting from year 1848, when successive migratory waves it was produced toward the Bueycito corral, site intermediate between the San Salvador de Bayamo village and the Manzanillo town, which it was consolidating with establishment of Spanish traders and creole landowners who, as Carlos Manuel de Cespedes, José Antonio Saco and Francisco Vicente Aguilera, were acquiring properties and were interning into Buey river's high part (Oliva, 1991).

Then, if we regard this year as date of real beginning of crossbreeding between the local Amerindian lineage and the Spanish, is feasible to infer than, since this process began, only have passed 5,6 generations and, therefore, is possible to hope that the local population, in a general way, preserve still Amerindian phenotypic traits, conditioned by their genetic pile.

Anthropometrical features of the studied population

Trunk: Short (Cormic index with arithmetic mean inferior to 51 at all ages in male gender, and inferior to 52 at all ages in female gender).

Limbs: Long (Manouvrier index with arithmetic mean superior to 89,9 at all ages, in both gender).

From comparison of BMI of Buey Arriba's boys and girls with Havanan children, it is possible to note that average values are statistically similar at all analyzed ages and genders (p> 0,05), from what it is inferable that the nutritional state is equally similar (table 3).

Table 3. Comparison of BMI of Buey Arriba's boys and girls with Havanan children, according to age and gender

Age	Gender	M	SD	Test value	t	Sig.
9	F	15,68	5,35	15,6	0,177	0,86
	M	16,40	5,18	15,6	1,818	0,80
10	F	16,08	4,74	15,9	0,410	0,17
	M	16,28	4,08	15,9	1,175	0,37
11	F	17,35	6,698	16,3	1,897	0,06
	M	16,51	6,037	16,1	0,753	0,45
12	F	17,94	5,08	17	1,203	0,24
	M	16,49	4,40	16,5	-0,011	0,99
13	F	18,04	3,997	18,1	-0,199	0,84
	M	16,91	3,349	17	-0,323	0,75
14	F	19,14	2,528	19,3	-0,714	0,48
	M	17,53	3,23	17,7	-0,491	0,62

This may work out showy, considering that the nutritional state is a variable with a great sensibility to environment (Facultad de Ciencias Médicas Julio Trigo López, 2015) and, therefore, the better results must expect for those country's zones where exists a bigger grade of socioeconomic development, like Cuban capital, however, such differences do not exist in relation to Buey Arriba, what explains itself by State efforts to reduce the economic and social breaches among the field and the city, for example, programs to eradicate the infantile malnutrition.

The stature comparison of local children with their similar of the rest of country (tabla 4), it returned significant differences, being smaller the children from Buey Arriba, at all ages and genders (p< 0,05).

Table 4. Stature comparison of Buey Arriba children with the rest of country, according to age and gender

Age	Gender	M	SD	Test value	t	Sig.
9	F	125,77	9,13	128,8	-3,866	0,000
	M	125,78	9,66	128,9	-3,775	0,000
10	F	132,13	7,35	134	-2,764	0,007
	M	131,13	6,07	133,5	-4,941	0,000
11	F	136,64	11,81	139,8	-3,231	0,002
	M	135,90	10,06	137,7	-1,995	0,048
12	F	141,70	9,89	145,6	-2,558	0,014
	M	140,56	6,81	142,5	-2,278	0,026
13	F	146,60	9,51	150,6	-5,535	0,000
	M	146,47	9,46	148,6	-2,725	0,007
14	F	152,29	7,13	154	-2,784	0,006
	M	153,28	7,44	155	-2,210	0,030

Examining figure 3, which shows the curves of stature, it is possible to note than initial crossing of the same shows heterochronicity in relation to national trend: at Buey Arriba occurs a little earlier, at nine years old, while at national level it is observed approximately at 9,2 years old. As to the final crossing, differences are still bigger: at Buey Arriba occurs at 13,2 years old; while nationally it is observed approximately at 13,7 years old.

On the other hand, if we compare Buey Arriba's curves crossing with the reported for current Havana province, where environmental conditions are better, it is possible to note that trends are similar, because differences in favor of the capital are minimal, and only are observed at the final crossing: into Havana, the first curves crossing occurs at nine years old and, the final crossing, at 13,1 years old (Facultad de Ciencias Médicas Julio Trigo López, 2015).

In addition, the gray shady area among curves represents the intensity of sexual dimorphism associated to height, such a lot at Buey Arriba as national level. From such figure it is inferred that this phenomenon are less pronounced at Buey Arriba municipality, that is to say, size differences among females and males during stretching of puberty are lesser here than nationally.
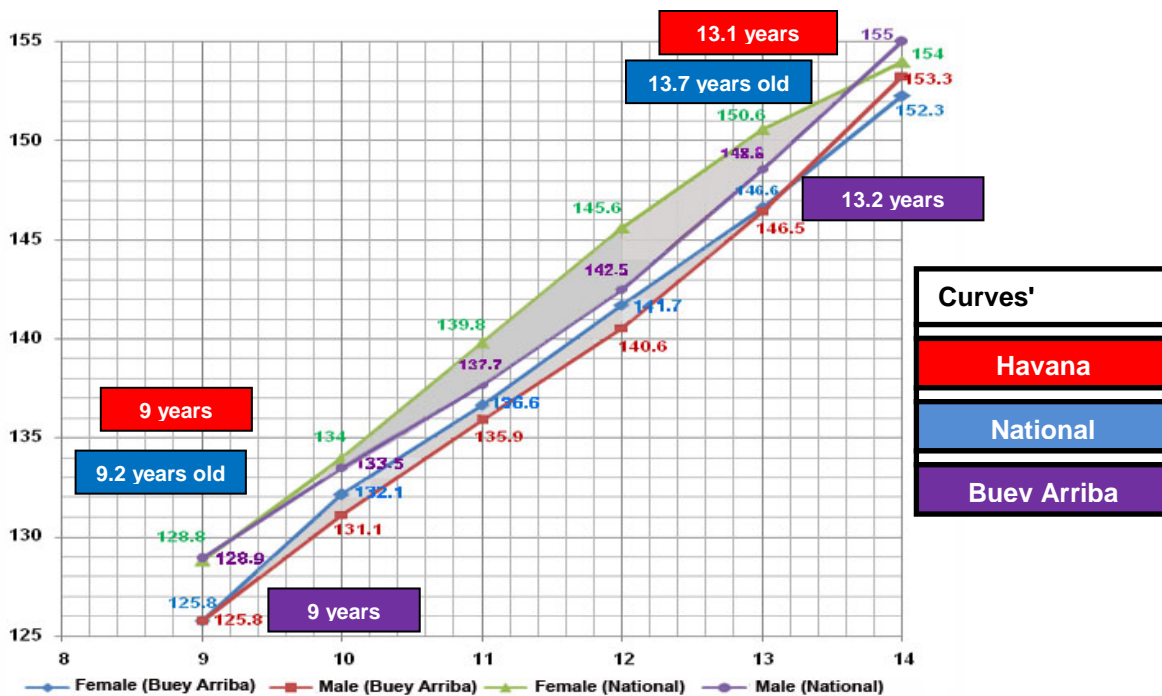
Figure 3. Stature evolution of children from Buey Arriba, from all country (national), and from Havana, according to age and gender

It has been suggested, for example, than generational increment of stature (secular trend) observed at various countries, over all those with better life conditions, obeys to the progressive disappearance of groups genetically isolated, what, in turn, increments the number of heterozygote individuals, more susceptible to influences of environment that surrounds them (Facultad de Ciencias Médicas Julio Trigo López, 2015).

At Buey Arriba case, during more of half century, socioeconomic conditions of its population have been improved of significant manner (that favors a better expression of genetic potentialities of longitudinal growth), however, its population has received, in this time, a little genetic influence from another populations, expressed it in the migratory negative balance that it shows.

The finding about sexual dimorphism intensity would be able to be explained by the bigger male sensitiveness and environmental conditions of Buey Arriba; however, in the light of last result (stature curves crossing similar to Havana) it results contradictory.

In front of a similar beginning and final, of stature curves crossing, at Buey Arriba and Havana, we must to assume that, in this case, external circumstances have not been the main cause of the growth's trends at this municipality, being the genetic factors, therefore, the ones that may have performed the preponderant role.

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It is undeniable the difference of comfort and level and life quality, of the Cuban capital, respect to the rest of nation territories, however, the measures adopted by Cuban State regarding to rural zones (like Plan Turquino Manatí's creation), such differences have been shortened, over all those related with nutrition and medical attention. It is common knowledge than, in the interaction among genetic and environmental factors, the first will have bigger possibility to express itself in the measure that the environment conditions be more favorable (Facultad de Ciencias Médicas Julio Trigo López, 2015), therefore, in Buey Arriba, environmental conditions of socioeconomic kind, generated by state policies, may have favored a bigger expression of genetic factors.

Results described, perceived of similar manner in all studied ages, confirms the existence of growth and development patterns typical of Buey Arriba, little favorable for those sports whose performance structure demands very high statures, as basketball and volleyball, for example.

Such patterns may be associates not only to geographic conditions of this territory, but also, to its demographic dynamics (characterized to be a municipality with a negative migratory balance maintained during several decades -Oficina Nacional de Estadísticas e Información, 2017-, phenomenon that it propitiates a scarce introduction of new external genetic material into genetic pile of this population in particular), and the Arawak indigenous genetic component, even underlying in the crossbreeding of local inhabitant; nowadays it is common knowledge than, at the municipality, it existed at least ten indigenous settlements, whose residents had a propensity toward low stature: 158 cm on average, the men, and 148 cm, the women; similar to height of current natives of Venezuela, Guyana and north of Colombia, from where their ancestors proceeded (Garcés, 2015; UCI, 2015b). Let's remember than majority of morphologic characters linked to longitudinal skeletal development (among these, stature) are highly heritable, and practically it does not suffer modification as a consequence of environmental change, because its reaction norm to a given stimulus is null practically.

Conclusions

1. The population under consideration experiences a strong crossbreeding process, in the one that even predominate individuals whose external ethnic features show certain Amerind tendency.

2. The population under consideration possesses growth and development patterns that are different to the rest of the Cuban nation.

3. Due to their inferior stature regarding to the rest of country, the population under consideration possesses conditions little favorable for those sports whose structure of performance demands very high statures.

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