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Original article

CHANGES IN BIOLOGICAL DEVELOPMENT OF NEWBORNS IN THE LIGHT OF SELECTED CONDITIONS – FROM AN AUXOLOGICAL PERSPECTIVE

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Abstract

Objective. The long-term consequences of the acceleration phenomenon should stimulate an increase of actions towards improving care over mother and child, which is the main task for realisation indicated in the 'European Strategy for Child and Adolescent Health and Development'

The aim of the hereby presented research was to state the changes in height and body mass, depending on the influence of selected paragenetic factors.

Methods. A total of 3911 neonates were examined, including 1869 (47.8%) born in 1970 and 2042 (52.2%) born in 2010. It encompasses newborns from the Świętokrzyskie Region. Body length and weight-at-birth, relevant to the subject of the research, were taken into consideration. Since records contain a number of social and demographical data, comparisons include the age and social background of mothers, the week of pregnancy as well as the order of pregnancy and order of labour. Newborns' mothers were divided into two groups: of urban and of rural origin.

Results. Since great importance is attached to social and demographical factors in research into acceleration, these traits were compared in the groups from 1970 and 2010. As a result, in comparison to data from 1970, the following conclusions have been drawn:

-the age of mothers increased.

-there was a significant decrease in the number of newborns of both sexes from first pregnancy and first parturition in favour of those from second pregnancy and second parturition.

-the length of pregnancy shortened, especially in the case of female newborns.

Conclusions. The connection between the biological condition of neonates and those changes can only be hypothesised and should become the subject of further research.

Key words: acceleration, biological, newborns.

Introduction

Presently the scope of auxology scientific knowledge encompasses not only issues concerning genetic conditions, paragenetic conditions and environmental processes of personal development but also health promotion and methods of controlling changes taking place in ontogenesis (Kopczyńska-Sikorska, 2004; Kornafel, 1978; Barański, Bogdanowicz, Łomnicki, 1938). These methods are still indispensable in ontogenetic development prognosis and diagnosing, but also in controlling the effectiveness of therapeutic, correctional or rehabilitative actions. This is especially significant in face of the presently shaping demographical situation. The Świętokrzyskie Region, previously named Kielecczyzna, is, in this respect, an extraordinarily interesting research area. Research was conducted in 1882 by Suligowski and was continued for years by many researchers (Kołodziej, Kołodziej, 1970; Nowak-Starz 2002; Nowak-Starz, Dutkiewicz, Cieśla, 2004). In literature devoted to changes in secular and accelerative growth in the Świętokrzyskie Region, there is a complete lack of research into changes in the biological development of newborns. Only recently, attempts have been undertaken to fill this gap.

Unfortunately, it is impossible to reach back to an earlier period, as in the case of other analyses, since documentation was destroyed in fifteen-year intervals.

The aim of the hereby presented research was to state the changes in height and body mass, depending on the influence of selected paragenetic factors.

Method and materials

The presented research was based on materials from the years 1970 and 2010. It encompasses newborns from the Świętokrzyskie Region. The analyses embrace only those features which are documented in neonates' records. Body length and weight-at-birth, relevant to the subject of the research, were taken into consideration. Since records contain a number of social and demographical data, comparisons include the age and social background of mothers, the week of pregnancy as well as the order of pregnancy and order of labour.

Analyses were also carried out in relation to mothers' place of residence. The author's own research included the comparisons of physical development of newborns in Kielce from the years 1970 and 2010. A total of 3911 neonates were examined, including 1869 (47.8%) born in 1970 and 2042 (52.2%) born in 2010.

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Data describing the origin of newborns' mothers was divided into two groups: mothers from urban areas and mothers from rural areas.

The research material was verified and grouped according to selected variables. The Statistica Polonia package was used for statistical analysis. Acquired data was verified and analysed. Arithmetical mean (\bar{x}), standard deviation (s), standard deviation of arithmetical mean ($E\bar{x}$), and coefficient of variation (V) were calculated and significance of differences between the arithmetical means of investigated features was described through statistical test /t^o/. The issue is only a part of extensive research into the discussed subject.

3. Results

In the span of 40 years, an increase in body length of newborns was observed. In 2010, mothers originating from cities gave birth to children longer by 0.5cm and mothers in the rural areas – by 0.2cm. In 1970, no difference in body length related to the place of residence was observed. In the researched material, only the difference indicating an increase in body length of newborns in cities is statistically significant (p<.001). Considering the fact that in all studied groups an increase in body length is observed, it can be concluded that acceleration exists. (Table 1).

Table 1. Body length of neonates In 1970 and 2010

| Mothers' residence | Neonates born in | | | | Difference 2010-1970 (d.) |
|-----------------------------------|------------------|------------------|-----------|------------------|----------------------------|
| | 1970 | | 2010 | | |
| | \bar{x} | s | \bar{x} | s | Significance of difference |
| Cities and rural areas (combined) | 52,78 | 3,57 | 54,17 | 3,37 | +0,393 p<0,101 |
| in cities (c) | 53,70 | 3,63 | 54,26 | 3,25 | +0,562 p<0,001 |
| in rural areas (r) | 53,86 | 3,43 | 54,08 | 3,43 | +0,225 p<0,139 |
| Differences d=(c-r) | | 0,155 p<0,628 | | 0,181 p<0,729 | |

However, the research results of Nowak-Starz, Dutkiewicz and Ciesla (2004); and research on the development of six-year-old children realised country-wide for the Ministry of National Education in the years 2005-2007 as part of the "Dziecko sześciolatek u progu nauki szkolnej" (Six-year-old child at the doorstep of school education) research project, indicate a linear build in further ontogenetic development of urban children and a thickset build of rural children, additionally strengthened by early-undertaken physical work [14]

The average birth weight of newborns examined in 1970 was 3323.76g with standard deviation s=547.26, while in 2010 it was 3271.01g with standard deviation s=553.82. In the period of 40 years, a decrease in body weight was observed in the two groups of newborns, both in cities and rural areas – by 37.13g (p>0.05) in cities and by 68.36g (p>0.05) in rural areas. The direction of changes, both in cities and in rural areas, characterised by an increase in body length and a decrease in weight-at-birth, resulted in a more asthenic constitution of neonates in 2010. (Table 2).

Table 2. Weight At birth of neonates In 1970 and 2010

| Mothers' residence | Neonates born in | | | | Difference 2010-1970 (d.) |
|-----------------------------------|------------------|------------------|-----------|------------------|----------------------------|
| | 1970 | | 2010 | | |
| | \bar{x} | s | \bar{x} | s | Significance of difference |
| Cities and rural areas (combined) | 3323,76 | 547,26 | 3271,01 | 553,82 | -52,75 p<0,003 |
| in cities (c) | 3329,01 | 593,21 | 3291,88 | 554,69 | -37,13 p<0,185 |
| in rural areas (r) | 3318,51 | 554,12 | 3250,14 | 553,75 | -68,37 p<0,004 |
| Differences d=(c-r) | | 10,50 p<0,825 | | 41,74 p<0,273 | |

Many authors indicate that there is a considerable relationship between the age of parents and the development of their offspring (Ciešlik, 1999; Garns, Petzold, 1983; Haiek, Lederman, 1988). An apparent increase in the age of newborns' mothers in 2010, as compared to 1970, was discovered; which means that, on average, mothers giving birth in 2010 were older. In that forty-years period, the age of mothers of boys increased, on average, by 1.217 years and of girls – by 1.509 years. Mothers aged 19-27 gave birth to the largest number of children in 1970 (66.21% of the total). In 2010, 61.51% of newborns were born

to mothers aged 22-30. In 1970, there were more mothers in the 19-24 age group (18.64%) giving birth to children than in 2010. An analogous preponderance of mothers in the 25-36 age group (22.12%) giving birth to children in 2010, in comparison with 1970, can be observed. The most significant decrease in the number of newborns of both sexes can be observed in the 19-21 age group. (Figure1). It was also noticed that in 2010 (a difference of 19.74% in relation to 1970) the number of older women (31-36 years old) giving birth to children increased almost twofold.

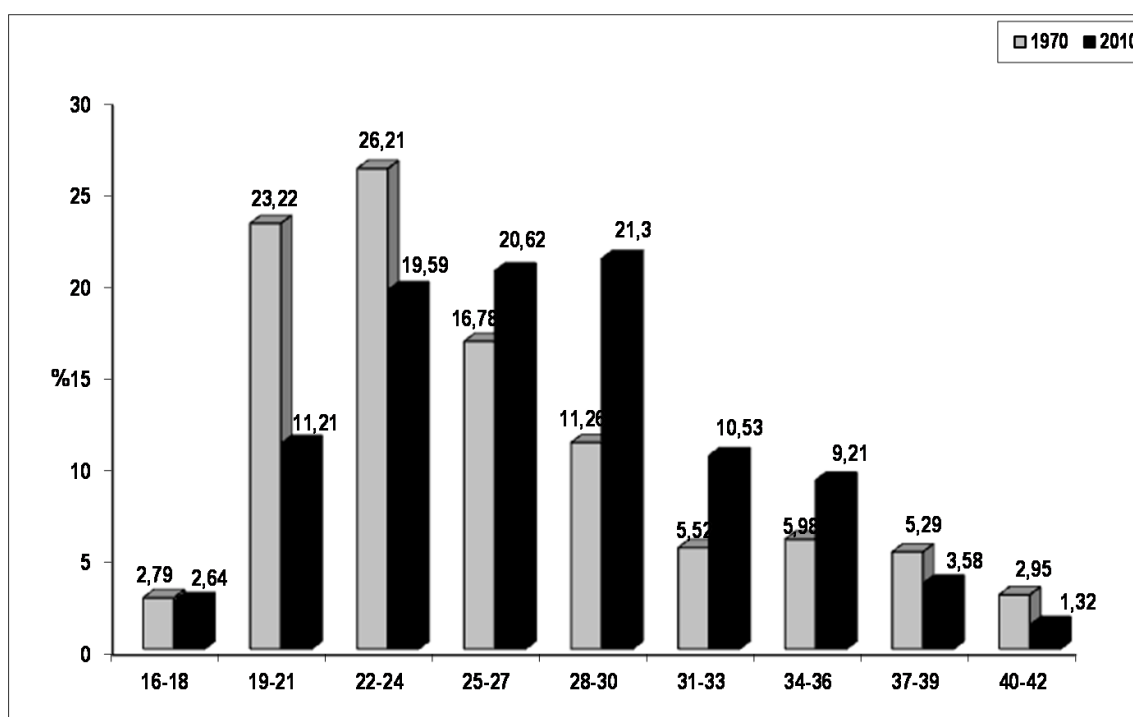


Figure 1. Comparison of distribution of data concerning the age of mothers of neonates in 1970 and 2010.

A preponderance of male newborns in 1970, in comparison to 2010, is observed in the 19-24 and 37-42 age groups of mothers and amounts to 23.18%. Similarly, a preponderance of female newborns in 1970, in comparison to 2010, is observed in the 19-24 and 37-42 age groups of mothers and amounts to 27.79%. In the examined period, there was a significant decrease in the number of births of female neonates born to mothers aged 22-24, in comparison with

mothers of male newborns. At the same time, there was a significant rise in the number of births of female neonates born to mothers aged 28-33.

The analysis of acceleration in development of newborns with an additional division into mothers' place of residence (Figure 2) is justified by claims resulting from supplementary studies, which indicate that the development of newborns is conditioned, to a large degree, by environmental factors.

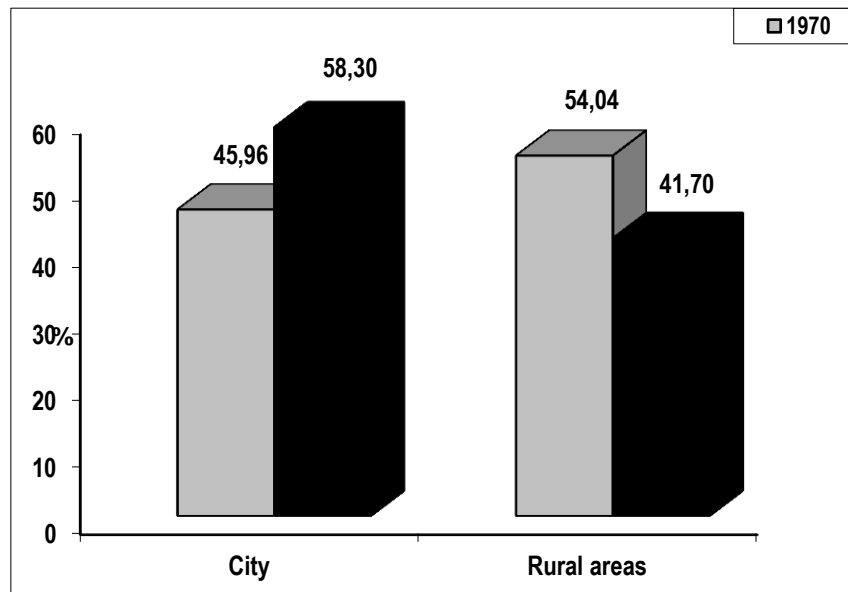


Figure 2. Comparison of distribution of data with reference to the place of residence of mothers of neonates from 1970 and 2010.

Most probably, migration from rural areas to cities resulted in the fact that in 1970 54.02% of mothers originated from rural areas, while in 2010 58.30% of the examined were mothers originating from cities. The differences in the origin of mothers are most clearly noticeable in female newborns. In 2010, 64.26% of all female neonates were born to mothers who came from cities. This is 28.52% more than in the case of mothers who came from rural areas in the same period and 18.82% more than in the case of mothers who came from cities in 1970.

On the basis of the definition of prematurity, formulated by the WHO Commission of Experts in 1951, which describes premature infants as neonates born after a period of pregnancy lasting 37 weeks or less, the data was divided into three groups, according to the length of pregnancy:

1. neonates delivered prematurely – up to 37 weeks,
 2. neonates delivered in full term – between 37 and 41 weeks,
 3. neonates delivered post-maturely – after 41 weeks
- (Figure 3)

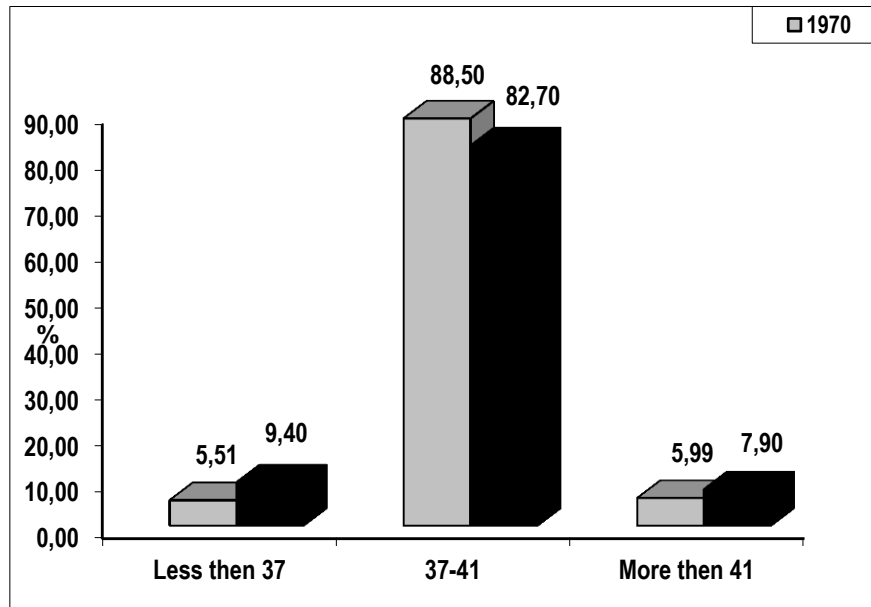


Figure 3. Comparison of the distribution of data with reference to the week of pregnancy in which neonates were delivered in 1970 and 2010

In the examined period, no significant changes between the three groups of newborns were observed. The number of male newborns delivered in full term decreased by 9.90% in comparison with 1970; at the same time, there was an increase in the number of males delivered prematurely (by 3.55%) and post-maturely (by 5.35%). Similarly, in the case of female newborns, there was a decrease in the number of females born in full term, although – in contrast to boys – by only 1.87%; the number of girls born prematurely increased by 4.21% and the number of girls born post-maturely dropped by 2.34%.

Analysing the orders of pregnancy and parturition in 1970 and 2010, the number and proportions of sexes were taken under consideration. In the examined period, there was a decrease by 12.79% in the number of first-born neonates and an increase in the number of newborns from the second pregnancy by 13.75%. (Figure 4).

Differences in the numbers of neonates born in subsequent pregnancies and deliveries were small. (Figure 5).

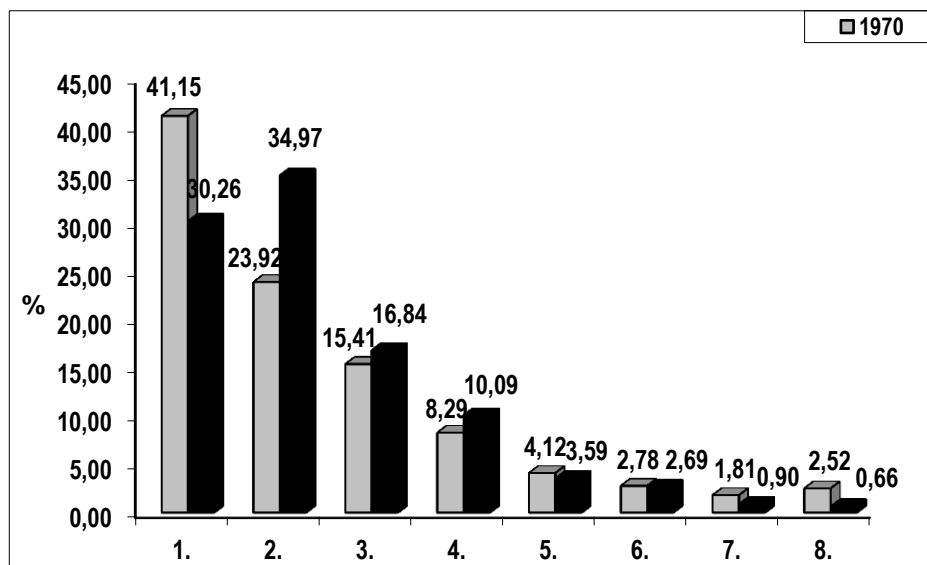


Figure 4. Comparison of the distribution of data with reference to the order of pregnancy of mothers of neonates born in 1970 and 2010

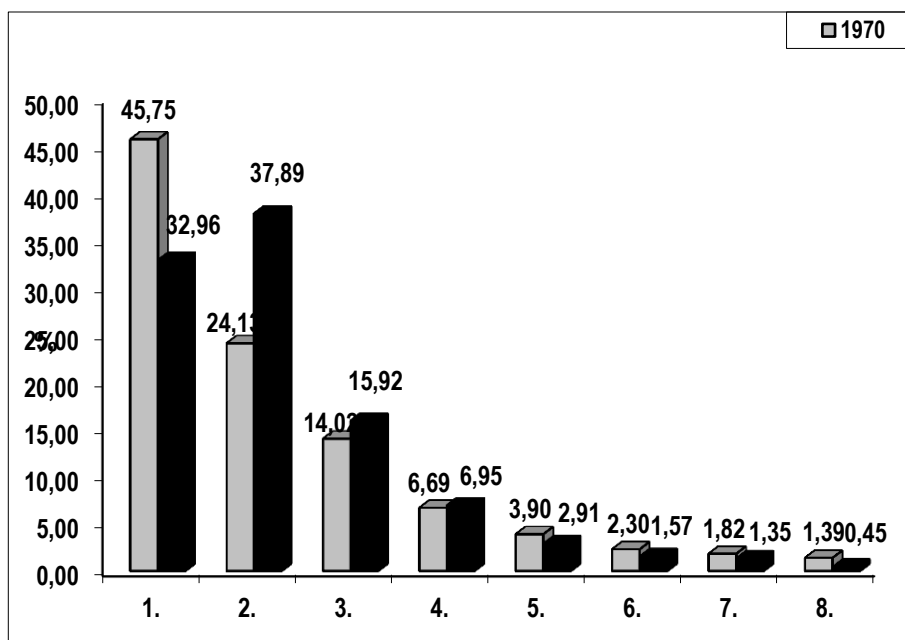
Figure 5. Comparison of the distribution of data with reference to the order of parturition of mothers of neonates born in 1970 and 2010

Discussion

As a result of the research, acceleration in the development of newborns with reference to body length and body weight was determined. On the whole, there is an increase in body length of newborns – although, the statistical difference is greater in the material from cities – and a decrease in body weight at birth – here the statistical difference is more significant in the case of newborns' mothers from rural areas. Such a direction of changes and relationship of body length to body weight detectable in the course of years results in an asthenic build of contemporary neonates in the Swietokrzyskie Region.

disorders in the state of health and development is increasing.

Works on the role of non-genetic and paragenetic factors are also interesting. From amongst them, research on the relation between parents' age and morphological features of children in different periods of ontogenesis (Charzewska, Wolański, 1964), time of deciduous teeth eruption (Stołycho, 1964), and the age of menarche is worth mentioning (Kowalska, 1968). This provided the basis for measuring out the so called optimal parents' age. For the urban environment in Poland, this was enclosed in the 25-30 range for mothers and 30-35 for fathers, whereas the father



Since great importance is attached to social and demographical factors in research into acceleration, these traits were compared in the groups from 1970 and 2010. As a result, in comparison to data from 1970, the following conclusions have been drawn:

- the age of mothers increased; and so – mothers of female neonates were older by 0.285 of a year in comparison with mothers of male newborns. There was a significant decrease in the number of newborns born to mothers in the 19-21 age group in favour of newborns born to mothers in the 28-30 age group. Taking into consideration that, along with age, cytoplasm of the ovum ages and the number of errors in transferring genetic information increases, the phenomenon will have its consequences, both demographical as well as health-related – the number of children with

should be three-years-or-more older than the mother. In the rural environment, this age was 20-25 for mothers and over 40 for fathers. Such a phenomenon was confirmed in other Polish and foreign research (Cieślak, 1999; Dougherty, Jones, 1982).

A mother's advanced age is presently one of the basic indications for prenatal diagnostics. Most researchers find that the risk of foetus developmental disorders' occurrence increases along with the age of the mother giving birth. Moreover, newborns from such mothers are far weaker biologically, therefore they have greater adaptive inhibitions.

The research of D. Kornafel, B. Kwiatkowska, J. Kowal and E. Żemojtel (Kornafel, Kwiatkowska, Kowal, Żemojtel, 2002) shows that:



- newborns of mothers from extreme age groups have lower birth parameters than newborns born at an optimal age;
- newborns of adolescent mothers are born with a better clinical condition than newborns of mothers who are over 40;
- both mothers' age groups should be under medical care, and the development of their children should be monitored.
- there was a significant decrease in the number of newborns of both sexes from the first pregnancy and first parturition in favour of those from the second pregnancy and second parturition. In 1970, the greatest number of newborns were born from the first pregnancy, and in 2010 from the second pregnancy. These tendencies will have a long-term demographical, social and economical (pensions, financing and functioning of the health-care system) reach.

In older works, attention was also drawn to relations between weight-at-birth and order-of-labour. Most frequently, weight-at-birth increased with every subsequent birth given by a woman over 25. The differentiation of this relation between genders was also indicated: the heaviest male children were born from the second pregnancy; female children – from the third.

The presently existing tendency of the number of past pregnancies increasing along with a mother's age hinders precise determination of the influence of order-of-labour on many of the offspring's features. In recent years, owing to ever more common sexual education, the phenomenon of a stabilised child birth frequency amongst adolescent mothers – below the age of 19 – situation can be observed. On the other hand, the number of childbirths among older women – above 40 – is increasing. The social causes of this phenomenon are various, but one of them is undoubtedly the transfer of a western type of life with its established occupational-family priorities.

Presently, we can notice a clear tendency for societies to get older as a result of ever lower birth-rate and longer life expectancy. Between the years 2000 and 2020, the headcount of the 65-90 age group will increase from 16% to 21% of the whole EU population. This lack of numerical balance between younger and older people will bring about qualitative changes in intergeneration relations.

- the length of pregnancy shortened, especially in the case of female newborns. The above-mentioned long-term consequences of the acceleration phenomenon should stimulate an increase of actions towards improving care over mother and child, which is the main task for realisation indicated in the 'European Strategy for Child and Adolescent Health and Development', which was signed by Poland in 2005, and the document is given priority character by WHO.

A social and demographical analysis of the acceleration in development of newborns demonstrated numerous

changes in environmental factors influencing foetuses, in the course of 40 years (Malina, 2004; Król, Melke, Biskup, Wójcik, Makiela, Nowak-Starz, Zboina, 2011; Nowak-Starz, Kozak, Zdziebło, 2013).

Conclusions

Since great importance is attached to social and demographical factors in research into acceleration, these traits were compared in the groups from 1970 and 2010. As a result, in comparison to data from 1970, the following conclusions have been drawn:

1. The age of mothers increased.
2. There was a significant decrease in the number of newborns of both sexes from first pregnancy and first parturition in favour of those from second pregnancy and second parturition.
3. The length of pregnancy shortened, especially in the case of female newborns.
4. The connection between the biological condition of neonates and those changes can only be hypothesised and should become the subject of further research.

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