ANTHROPOLOGICAL REVIEW • Vol. 74, 3–12 (2011)
Available online at: https://doi.org/10.2478/v10044-010-0003-2

Pregnancy length: Secular trends and patterns of variation in Sweden, 1982–2005

Lucio Vinicius, Holly Tibbitts

Leverhulme Centre for Human Evolutionary Studies, University of Cambridge, Fitzwilliam Street, Cambridge CB2 1QH, United Kingdom; E-mail: LVC22@cam.ac.uk

ABSTRACT Anthropological and medical studies rarely investigate the existence of secular trends in the duration of human pregnancy, which is widely assumed to show less variation than traits such as body size, menarche or lifespan. Here we analyze pregnancy duration in the Swedish population between 1982 and 2005, and correlation patterns of four variables: pregnancy length, maternal height, newborn weight and newborn head circumference. Results reveal positive trends of very small magnitude in the four traits. Although bivariate correlations were all significant and positive, multiple linear regression shows a positive independent contribution of newborn size (both weight and head circumference) and a negative independent contribution of maternal height to pregnancy length. We propose that the very weak and negative independent contribution of maternal height to pregnancy duration, in contrast to the stronger and positive contribution of newborn size, explain the absence of significant secular trends in pregnancy duration in Sweden. The results confirm some of the predictions of the maternal investment hypothesis, the 'obstetrical dilemma', and Ellison's metabolic crossover hypothesis. Due to the weak association between pregnancy length and maternal height, we hypothesize that pregnancy length is expected to show limited secular change even in a population undergoing strong secular trends in maternal height.

KEY WORDS: newborn size; maternal height; obstetrical dilemma; metabolic crossover hypothesis

Secular trends denote changes in biometric and developmental variables in human populations due to changes in living conditions, and are well illustrated by increases in average body size in affluent societies over the 150 years [Eveleth & Tanner 1990]. Average body height in Dutch males has increased from 165 cm in 1860 to 184 cm in 1997 [Van Wieringen 1986, Cole 2003]. Developmental variables have also presented trends, with menarche decreasing from an average of 15-16 years in the 1850s to a current value of

Received 16 August 2011; accepted 16 September 2011
DOI: 10.2478/v10044-010-0003-2

12-13 years in industrialized countries [Stinson 2000]. Lifespan has also been extended, with female life expectancy at birth in the United States increasing from 48.7 years in 1900 to 81 years at the turn of the century [Harper & Crews 2000]. Secular trends are attributed to improvements in nutrition and medical care and have generally slowed down in developed countries possibly due to the relatively lower rate of progress in living conditions in recent times [Cole 2003]. However, not all anthropometric and developmental variables have exhibited clear secular trends. For example, although both average adult size and child growth rates have increased in industrialized countries, there is no convincing evidence for secular changes in average birth weight [Cole 2000].

Surprisingly, secular trends in gestation length have rarely been addressed in anthropological and medical research. An increase in the incidence of preterm births (pregnancies shorter than 37 weeks) has been reported [Demissie *et al*. 2001, Kramer *et al.* 2006], but this has been attributed to higher rates of caesarean births and labor induction [Maslow & Sweeny 2000] rather than shorter pregnancies. Thus, either pregnancy length has not undergone any significant secular trends, or secular trends are of small magnitude and have been ignored. The apparent absence of secular trends seems to contradict some current theories in biological anthropology. For example, the 'obstetrical dilemma' hypothesis [Rosenberg & Trevathan 1995] suggests that pregnancy length and newborn head size are limited by the size of the female birth canal. Increase in maternal body size should therefore allow mothers to afford larger newborns and therefore longer pregnancies. The maternal investment hypothesis [Martin & McLarnon 1985] suggests that larger mothers can invest more energy in the fetus and deliver larger newborns, but it is not clear whether this would be achieved through longer pregnancies or faster fetal growth rates. Not all theories imply a link between maternal size and pregnancy length. The metabolic crossover hypothesis [Ellison 2001], in contrast, does not imply a link between larger maternal body size and changes in pregnancy duration. Although larger mothers can invest more energy in offspring, their fetuses are also larger and demand more energy per unit time. According to the metabolic crossover hypothesis, the two factors would counterbalance each other, and as a result pregnancy duration would not vary between small and large mothers.

In this study, we used data from the Swedish Birth Register [Källén & Källén 2003] to investigate possible secular trends in pregnancy length in the last decades in Sweden. We also assess the relationship between pregnancy length and three variables: maternal height, newborn weight and newborn head size. As in other industrialized countries, strong secular trends in body size and menarche have been observed in Sweden in the past, but have generally slowed down in recent times [Hauspie *et al.* 1997]. Based on the Swedish data, we propose an explanation for why strong secular trends in pregnancy length seem to be absent in human populations.

Materials and methods

Data from the Swedish Medical Birth Register from 1982 to 2005 were obtained from the Center for Epidemiology at the Swedish National Board of Health and Welfare [Källén & Källén 2003]. The data comprise information on maternal characteristics and ante- and peri-natal traits of approximately 98.6% of all births occurring in Sweden from 1982 to 2005 (N=2,433,888).

Variables

We analyzed seven variables based on the relevance, quality and availability of data. Detailed descriptions of variables, collection methods and quality assessment methods can be found in Källén and Källén [2003] who originally described the database.

Gestational age at birth was measured in weeks by the Swedish Birth Record. Due to the difficulties in measuring pregnancy length (specially the problem of dating with precision the beginning of pregnancy), the Swedish Birth Register uses four different variables (data of last menstrual period; estimated day of delivery; corrected estimated day of delivery; and pregnancy duration as stated in the pediatric record; all measurements in weeks), from which a ranking of eleven different estimates of pregnancy length (from most reliable to least reliable) was derived. According to the Register, the most reliable estimate of pregnancy duration are the cases where corrected estimated day of delivery agrees with pregnancy duration as stated in the pediatric record; this covers 81.8% of all cases in the database; the second most reliable estimate was available in 8% of cases; and so on. The Register also defined procedures to deal with outliers and discordant estimates.

Birth weight in grams was missing from only 0.32% of all records, and quality analysis indicated that the majority of weights recorded were realistic.

Head circumference measured in centimeters was selected due to its strong correlation with brain size [Cabana *et al.* 1993]. Quality assessment of the data showed that the number of missing values increased in recent years but has not introduced biases in the sample.

Maternal height in centimeters was selected instead of maternal weight. Data on pre-pregnancy weight (measured at the first ante-natal visit) were only available for 70% of births, and maternal weight gain during pregnancy for about 60% of births. Virtually no data on maternal pre-pregnancy weight were available in 1990 and 1991, and information on weight gain between 1983 and 1990 is uncertain. Similar problems affected data on weight at delivery. In contrast, maternal height is known for 80% of births in the register, and quality analysis indicated that relatively few of the collected values are invalid [Källén & Källén 2003]. Finally, pelvic size correlates more strongly with maternal height than with maternal weight [Tsu 1992, Awonuga *et al.* 2007], and for this reason maternal height bears a closer relation to the obstetrical dilemma hypothesis.

Three different *types of delivery* are reported in the dataset: natural, caesarean and instrumental. Instrumental deliveries consisted of births assisted by forceps or vacuum extraction. Non-instrumental vaginal deliveries were classified as natural. No data were available to distinguish between emergency and elective caesareans. *Sex of the infant* and *year of birth* were also collected. Unfortunately we do not have information about maternal age and parity, and on multiple vs. single births, since disclosure of maternal and offspring identity would require special approval by ethical committees in Sweden.

Outliers and missing cases

Due to the large size of the dataset, we excluded all cases for which the value of at least one variable was missing. Exclusion of cases introduced no systematic bias into the sample, since analyses performed without exclusion of missing cases rendered very similar results (data not shown). Many values outside the realistic range for the variables (most likely due to mis-recording) were also excluded. Birth weights below 1000g and greater than 6000g, maternal heights lower than 140 cm and greater than 190 cm, and head circumferences below 20 cm and above 50 cm were also excluded due to the very small number of cases. Pregnancy length ranges from 22 to 45 weeks in the sample; those values were deemed as realistic, and using a narrower range could introduce biases in the analyses. Values outside the range 22-45 weeks were excluded: they were very few and may have mostly resulted from typographical errors in the electronic files from the Center for Epidemiology (probably occurring during the transcription of handwritten forms into the electronic datasheet). We only used data from male newborns in the analyses. Only births from natural deliveries were considered, since medical intervention (both as caesarean sections and instrumental deliveries) artificially shortens pregnancy length.

After the exclusion of missing cases, outliers, female newborns and non-natural deliveries, the dataset was reduced to 781,339 male births between 1982 and 2005. Mean values (and standard deviations in brackets) were: pregnancy length, 39.50 weeks (1.60); maternal size, 166.5 cm (6.03); newborn weight, 3621.7g (525); newborn head circumference, 35.04 cm (1.55).

Statistical analysis

Data were checked for skew, autocorrelation and collinearity. Skew statistics did indicate a small deviation from normal distribution, and the sample was treated as normally distributed. Calculation of the Durbin-Watson statistic (d= 1.949) indicated virtually no autocorrelation in the sample rendering the use of time series analysis for the investigation of secular trends unnecessary. Analyses also indicated little collinearity in the data; for example, in the multiple regression of pregnancy length on maternal height, newborn head circumference and newborn body size, the variance inflation index (VIF, the main collinearity measure) is respectively 1.604; 1.626; and 1.041, well below the commonly used threshold (VIF<4). Cook's distances for all variables were less than one, indicating that the presence of values more than three standard deviations above or below the mean did not have a substantial effect on linear regressions between the variables.

To safeguard against multiple significance tests we used the Bonferroni correction, i.e. the chosen significance level ($P<0.05$) divided by the number of tests ($n=20$). All relationships described below were significant after Bonferroni correction ($P<0.0025$); they were also significant at the more stringent level of $P<0.001$.

Results

Secular trends

A very small secular trend in pregnancy duration was identified in Sweden between 1982 and 2005 (Fig. 1). The correlation between pregnancy length and year of birth is weak although statistically significant ($r=0.024$, $t=20.8$, $P<0.001$), with year of birth explaining less than 0.1% of variation in pregnancy length ($R^2=0.0006$). Linear regression of pregnancy duration on year of birth generated an unstandardized coefficient value of $b=0.006$, which predicts an increase in pregnancy duration of only 0.006 week (or about 1 hour) per year, and a predicted total increase in pregnancy length of only 0.14 week (or about one day) from 1982 to 2005.

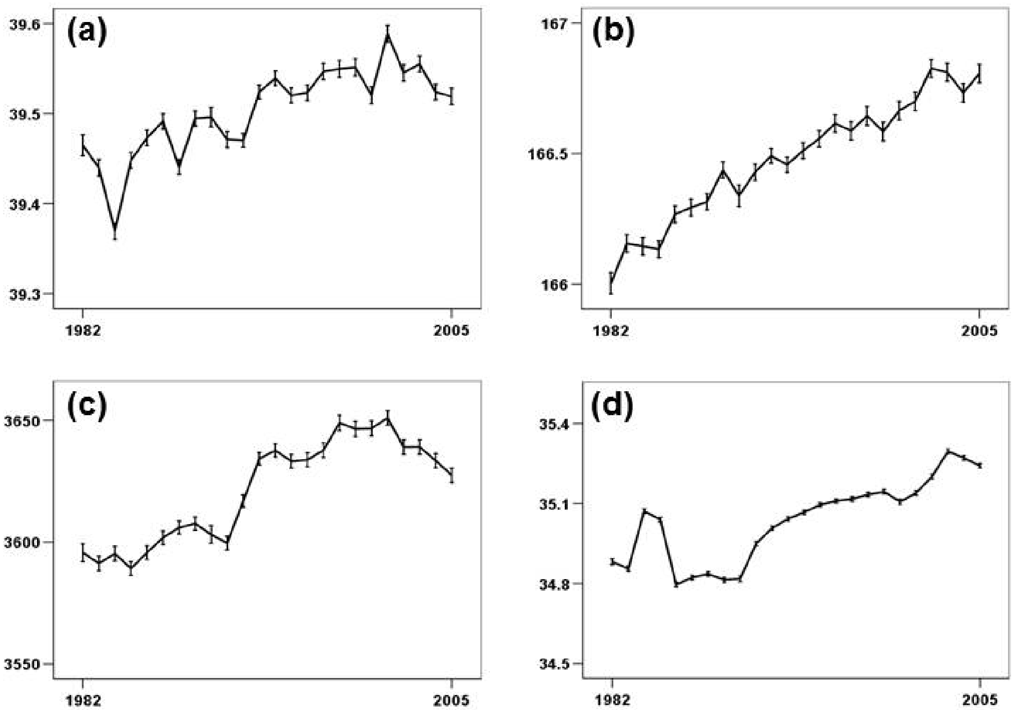

Fig. 1. Secular trends in Sweden, 1982-2005. The X-axis represents year, while the Y-axis displays (a) average pregnancy in weeks, (b) average maternal height in centimetres, (c) newborn size in grams, and (d) newborn head circumference in centimetres. Only natural deliveries and male births are included. Error bars represent ±1 standard error of the mean.

A secular trend in maternal height was also identified but was of similarly small magnitude. There is a weak but statistically significant correlation between maternal height and year of birth (r=0.035, t=31.1, P<0.001), with linear regression predicting an increase of 0.032 cm in maternal height per year, or a total increase of 0.74 cm between 1982 and 2005.

Newborn body weight also exhibits a statistically significant correlation with year of birth (r=0.033, t=29.3, P<0.001), with linear regression predicting an increase of only 2.7 grams per year and a total of 62 grams between 1982 and 2005. Newborn head circumference has also presented a significant but small positive secular trend (r=0.08, t=72.2, P<0.001). Linear regression predicts an increase of 0.02 cm per year, or about 0.5 cm between 1982 and 2005.

Bivariate correlations

Bivariate correlations among the four variables (pregnancy length, maternal height, newborn weight and newborn head circumference) were all positive and statistically significant at the P<0.001 level (Table 1). There was a very weak but significant correlation between pregnancy length and maternal height (r=0.076), in contrast with the stronger correlations between pregnancy length and both newborn weight

Table 1. Bivariate correlations (with partial correlations in italics) among pregnancy length, maternal height, newborn weight and newborn head circumference for newborn boys.

	Boys (*N*=781,339)		
	Maternal height	Newborn weight	Newborn head circum.
Pregnancy length	0.076 (*–0.049*)	0.539 (*0.359*)	0.456 (*0.161*)
Maternal height		0.206 (*0.138*)	0.167 (*0.050*)
Newborn weight			0.660 (*0.539*)

All correlations are significant at the *P*<0.001 level (2-tailed).

Table 2. Bivariate correlations (with partial correlations in italics) among pregnancy length, maternal height, newborn weight and newborn head circumference for newborn girls.

	Girls (*N*=764,505)		
	Maternal height	Newborn weight	Newborn head circum.
Pregnancy length	0.075 (*–0.037*)	0.498 (*0.356*)	0.392 (*0.131*)
Maternal height		0.203 (*0.137*)	0.163 (*0.056*)
Newborn weight			0.610 (*0.506*)

All correlations are significant at the *P*<0.001 level (2-tailed).

(*r*=0.54) and newborn head circumference (*r*=0.46). The higher correlation between pregnancy length and the two newborn size measures is not surprising, since newborn weight and head circumference are strongly correlated with each other (*r*=0.66). In contrast, maternal height correlates less strongly with both newborn weight (*r*=0.21) and newborn head circumference (*r*=0.17).

Analyses of correlation patterns (Table 2) and secular trends (not shown) for female newborns revealed very similar results.

Partial correlations and multiple regression

We also calculated partial correlations between pairs of variables by controlling simultaneously for the effect of the other two. All the resulting partial correlations were significant at the *P*<0.001 level (Table 1). While the bivariate correlation between pregnancy length and maternal height is positive, their partial correlation is negative (partial *r*= -0.049) when both newborn weight and head circumference are simultaneously controlled for. The sign inversion is mostly an effect of body weight, which produces a partial correlation of *r*= -0.042 when used as the single control. However, the negative partial correlation is very low, meaning that maternal height has only a small independent effect on pregnancy length.

In contrast, pregnancy length retained a positive relationship with newborn weight (partial *r*=0.36). Finally, the relation between pregnancy and head circumference was much weaker when controlling for both newborn weight and maternal size (partial *r*=0.16) or only newborn weight (partial *r*=0.161). Partial correlations among maternal height, newborn weight and head circumference remained nearly as strong as the respective bivariate correlations.

In summary, pregnancy length shows a positive partial correlation with newborn weight, a weaker positive correlation with head circumference, and a negative but much smaller independent contribution from maternal size. The independent contribution from the three variables to pregnancy duration can also be shown through multiple linear regression. The model with newborn weight, newborn head circumference and maternal height as independent variables produced a correlation of r=0.557 (F=117,276; P<0.001) and is:

$$\textit{pregnancy length} = 0.001\ (\textit{newborn weight}) + 0.187\ (\textit{newborn head circumference}) - 0.011\ (\textit{maternal height}) + 30.06$$

Discussion

Our results show that secular trends in pregnancy duration, maternal height, newborn weight and head circumference can be identified but were of very small intensity in the Swedish population between 1982 and 2005. These findings are consistent with proposals of a plateau in the trend for larger body size in Scandinavian countries [Hauspie *et al.* 1997], probably due to the fact that improvements in living standards have occurred more slowly in recent decades. However, we acknowledge that the interval of 23 years may simply not be long enough to reflect more significant changes occurring in pregnancy length. Further studies based on data to be collected by the Swedish Birth Register in the next decades may be necessary to clarify the issue.

There may, however, be another explanation for the apparent lack of secular trends in pregnancy duration. Despite considerable variation among individuals in the four variables assessed, correlations (both bivariate and partial) between pregnancy length and maternal height are very weak and close to zero. This suggests that the very strong positive trend in adult and maternal height observed in Sweden and other industrialized countries in the past may have occurred without any effects on pregnancy length. This possibility is consistent with the predictions of the metabolic crossover hypothesis. In contrast, pregnancy length correlated more strongly with neonate size, which has remained almost constant over the last decades even in countries such as Sweden where adult size has significantly increased. Multiple regression confirms this conclusion, revealing that maternal height has a very weak negative independent effect of pregnancy duration, opposed by the stronger positive effect of both newborn size and newborn head size. The positive correlations (both bivariate and partial) between pregnancy length and newborn head size are in agreement with the obstetrical dilemma hypothesis, whereas the positive correlations between maternal size and neonate size are consistent with the maternal investment hypothesis.

Due to the weak independent effect of maternal height on pregnancy length, we can predict weak (or absent) secular changes in pregnancy length even in populations characterized by strong secular trends in maternal height. Based on the Swedish data, the linear regression of pregnancy length on maternal height (F=4591; P<0.001) is given by:

$$\textit{pregnancy length} = 0.02\ (\textit{maternal height}) + 36.124$$

We can hypothetically extrapolate this regression to estimate the intensity of secular change in pregnancy length in a given population. The regression shows that an increase in female height from 150 cm to 170 cm predicts an increase in pregnancy length from 39.1 weeks to 39.5 weeks, or only 2.8 days. We hypothesize that a secular trend in maternal height of that same magnitude (i.e. a change in average female height from 150 cm to 170 cm) would cause an equally small increase in average pregnancy duration. The extrapolation from linear regression based on within-population variation to secular trend can be partially justified by the fact that both biometric variation in human populations and secular trends are mostly attributed to environmental rather than genetic factors [Eveleth & Tanner 1990: 191]. It would be relevant to test our prediction of weak secular trends in pregnancy length in a developing country currently undergoing rapid secular changes in adult female height.

We would urge caution about some of the conclusions of this study. Our explanation for the absence of trend in pregnancy length is based on the relatively strong positive correlation between pregnancy length and newborn size, compared to a weaker correlation between pregnancy length and with maternal size. However, we do not argue that newborn size 'causes' or 'determines' pregnancy length, or vice-versa; such statement is beyond the scope of our data and analyses, which can only identify correlations.

Another limitation is that the Swedish sample does not take into account the effect of ethnic factors on gestation length, which seems to vary across human populations even after controlling for environmental factors [Balchin & Steer 2007]. If this is true, immigration during the period 1982–2005 might have been an additional factor affecting gestation length in Sweden. However, less than 15% of the Swedish population consists nowadays of immigrants, most of which are of European origin (more than half are from other Scandinavian or Northern European countries) and therefore not ethnically very different to the Swedish population. The proportion of immigrants was even smaller in the years 1982–2005. We were unable to control for other possible confounders such as social status or diabetes.

A further issue is the use of maternal height instead of maternal weight. Brooks *et al.* [1995] reported that both pre-pregnancy weight and weight gain during pregnancy were better predictors of neonatal size than maternal height, which may therefore be better predictors of gestation length than maternal height. As seen above, maternal height was selected for this study due to the quality of available data and its stronger correlation with pelvic dimensions in mothers, which made the variable more appropriate for appraisal of the 'obstetrical dilemma' hypothesis.

Finally, our analyses might have been influenced by the inability to control for pregnancy induction. For example, it is possible that mothers of infants with large birth weights and head circumferences may have been medically advised to have their pregnancies artificially foreshortened due to possible health risks. However, labor induction was very rarely used in Sweden in the 1980s (which partially explains why it only started being recorded in 1998), gradually increasing to the present rate of about 10% of births [Källén & Källén 2003, Cnattingius *et al.* 2005]. We tested whether a subsample covering only the years 1982–1989 (when induction was almost absent) and the whole sample covering the interval 1982–2005 would yield differences, and obtained essentially the same results. For example, the comparisons between variable averages in the intervals 1982–2005 and 1982–1989 (in brackets) are respectively: pregnancy length, 39.5 weeks (39.45); maternal height, 166.5 cm (166.24); newborn weight, 3621.7g (3598.3); and newborn head circumference, 35.04 cm (34.89). For this reason, we believe that labor induction had a negligible effect on our analyses.

An important long-term aim would be to gain a large data set equivalent to the Swedish Medical Birth Register for a population still experiencing significant improvements in living conditions and exhibiting lower levels of medical intervention (caesareans and labor induction). While this may prove a difficult task, it could substantially improve our knowledge of secular trends in human gestation.

Notes

Acknowledgements: We thank the Leverhulme Trust and the Leverhulme Centre for Human Evolutionary Studies (LCHES), Cambridge University, for funding this project. We thank Milla Bennis (Centre for Epidemiology, National Board of Health and Welfare in Sweden) for preparing the database. We are also grateful to an anonymous reviewer for the very useful comments on a previous version of this manuscript.

References

Awonuga A.O., Z. Merhi, M.T. Awonuga, T. Samuels, J. Waller, D. Pring, 2007, *Anthropometric measurements in the diagnosis of pelvic size: An analysis of maternal height and shoe size and computed tomography pelvimetric data*, Arch. Gynecol. Obstet., **276**, 523–28

Balchin I., P.J. Steer, 2007, *Race, prematurity and immaturity*, Early Hum. Dev., **83**, 749–54

Brooks A.A., M.R. Johnson, P.J. Steer, M.E. Pawson, H.I. Abdalla, 1995, *Birth weight: Nature or nurture?* Early Hum. Dev., **42**, 29–35

Cabana T., P. Jolicoeur, J. Michaud, 1993, *Prenatal and postnatal growth and allometry of stature, head circumference, and brain weight in Quebec children*, Am. J. Human Biol., **5**, 93–99

Cnattingius R., B. Hoglund, H. Kieler, 2005, *Emergency caesarean delivery in induction of labour: An evaluation of risk factors*, *Acta Obstet. Gynecol. Scand.*, **84**, 456–62

Cole T.J., 2000, *Secular trends in growth*, Proc. Nutr. Soc., **59**, 317–24

Cole T.J., 2003, *The secular trend in human physical growth: A biological view*, Econ. Hum. Biol., **1**, 161–68

Demissie K., G.G. Rhoads, C.V. Ananth, G.R. Alexander, M.S. Kramer, et al., 2001, *Trends in preterm and neonatal mortality among blacks and whites in the United States from 1989 to 1997*, Am. J. Epidemiol., **154**, 307–15

Ellison P.T., 2001, *On Fertile Ground*, CUP, Cambridge

Eveleth P.B., J.M. Tanner, 1990, *Worldwide variation in human growth*, CUP, Cambridge

Harper G.J., D.E. Crews, 2000, Ageing, senescence, and human variation, [in:] *Human Biology*, S. Stinson, B. Bogin, R. Huss-Ashmore, D. O'Rourke (eds), Wiley-Liss, New York, pp. 465–67

Hauspie R.C., M. Vercauteren, C. Susanne, 1997, *Secular changes in growth and maturation: An update*, Acta Paediatr. Supp., **423**, 20–27

Källén B., K. Källén, 2003, *The Swedish Medical Birth Register: A summary of content and quality*, Swedish Centre for Epidemiology, Sweden

Kramer M.S., R.W. Platt, H. Yang, K.S. Joseph, S.W. Wen, et al., 2006, *Secular trends in preterm birth: A hospital-based cohort study*, J. Am. Med. Assoc., **280**, 1849–54

Martin R.D., A.M. MacLarnon, 1985, *Gestation period, neonatal size and maternal investment in placental mammals*, Nature, **313**, 220–23

Maslow A.S., A.L. Sweeny, 2000, *Elective induction of labour as a risk factor for caesarean delivery among low-risk women at term*, Obstet. Gynaecol., **95**, 917–22

Rosenberg K., W. Trevathan, 1995, *Bipedalism and human birth: The obstetrical dilemma revisited*, Evol. Anthropol., **4**, 161–68

Stinson S., 2000, Growth variation: biological and cultural factors, [in:] *Human Biology*, S. Stinson, B. Bogin, R. Huss-Ashmore, D. O'Rourke (eds), Wiley-Liss, New York, pp. 434–38

Tsu V.D., 1992, *Maternal height and age: Risk factors for cephalopelvic disproportion in Zimbabwe*, Int. J. Epidemiol., **21**, 941–46

Van Wieringen J.C., 1986, Secular growth changes, [in:] *Human Growth: A Comprehensive Treatise, vol. 3*, F. Falkner, J.M. Tanner (eds.), Plenum Press, New York, pp. 307–31

Streszczenie

Wyniki badań antropologicznych i medycznych zdają się potwierdzać przypuszczenie, że długość trwania ciąży nie wykazuje trendu sekularnego, albo że ten trend jest nieznaczny, w przeciwieństwie do wyraźnych i istotnych zmian, jakim w ostatnich dekadach podlegają wielkość ciała, wiek menarchy i długość życia. Koncepcje takie, jak „inwestycji macierzyńskiej" czy „dylematu położniczego" sugerują, że czas trwania ciąży powinien rosnąć wraz ze wzrostem wielkości ciała matek, natomiast hipoteza współzależności kosztów metabolicznych przewiduje nikły związek między wielkością matek i czasem trwania ciąży. Bardzo rzadkie są próby oceny związku międzypopulacyjnej zmienności rozmiarów ciała i sekularną zmiennością długości ciąży u współczesnych kobiet.

W przedstawianej pracy badaliśmy zmienność czasu trwania ciąży w szwedzkiej populacji w okresie od 1982 do 2005 r. Oceniliśmy także korelacje między czterema zmiennymi: czasem trwania ciąży, wysokością ciała matek, masą ciała noworodków i obwodem ich głowy. Dane pochodzące ze szwedzkiego medycznego rejestru urodzeń uzyskaliśmy z Centre for Epidemiology, Swedish National Board of Health and Welfare. Dane te zawierały informacje o cechach matek oraz o przed- i okołoporodowych charakterystykach około 98,6% wszystkich urodzeń w Szwecji we wspomnianym wyżej okresie (N=2.433.888).

Wyniki ujawniły słabe dodatnie trendy we wszystkich badanych zmiennych (ryc. 1). Jeśli idzie o układ zależności, to dwuwymiarowe korelacje wszystkich czterech zmiennych były pozytywne i istotne statystycznie (tab. 1). Interesujący jest fakt, że czas trwania ciąży znacznie silniej koreluje z masą urodzeniową niż z wielkością ciała matek. Ponieważ w ostatnich dekadach w zachodnich społeczeństwach nie stwierdzono istotnych zmian sekularnych masy urodzeniowej, nie dziwi więc fakt, że również długość trwania ciąży pozostaje stosunkowo stała. Powyższą konkluzję potwierdziliśmy analizą wielowymiarową. Regresja liniowa wielokrotna wykazała pozytywny niezależny udział wielkości urodzeniowej (masy i obwodu głowy), natomiast niezależny negatywny udział wysokości ciała matek w długości trwania ciąży. Uważamy, że mały wpływ wielkości matek na długość ciąży jest wyjaśnieniem braku trendu sekularnego czasu trwania ciąży w szwedzkiej populacji. Słaby, choć pozytywny związek między długością ciąży i wysokością matek, jak sądzimy, nie ujawnia się w postaci trendu długości ciąży nawet w populacjach podlegających wyraźnemu trendowi wysokości ciała.