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Waist-to-Hip Ratio and Woman's Education Level as Predictors of Breastfeeding Duration

Boguslaw Pawlowski[1] and Stanley J. Ulijaszek[2]

[1] University of Wroclaw, Department of Anthropology, Wroclaw, Poland
[2] University of Oxford, Institute of Social and Cultural Anthropology, UK

A B S T R A C T

The possible existence of a relationship between breastfeeding duration, educational status and waist-hip ratio (WHR) as a measure of fertility and biological fitness in a sample of the Polish population is examined in this article. Data on age, height, weight, waist and hip circumferences, educational level (as a proxy for socio-economic status), and duration of breast feeding were collected for women using questionnaires in 11 outpatients' surgeries for healthy children, and in 5 general practices in three districts of Wroclaw, Poland. An ordinal multinominal linear model with logit link was used to determine the extent to which duration of lactation was influenced by maternal WHR and level of education. The best single predictor for the duration of lactation was WHR. While WHR decreases according to increasing duration of lactation for mothers with university or high school education, no such differences were observed among women at the lowest level of education. This study confirms the greater biological fitness of women with low WHR in the Polish population, and shows that this is mediated by level of educational attainment of the women.

Key words: *lactation, WHR, BMI, education, socioeconomic status, attractiveness, body shape, weight*

Introduction

Sexually reproducing organisms generally choose mates displaying traits indicative of high genetic quality[1,2]. Following this, phenotypic characters perceived as attractive should reflect the reproductive potential of any potential mate. Extending this to humans, the attractiveness of a female to males should be a reliable cue of her reproductive potential[1,2]. Two traits associated with female attractiveness are waist-to-hip ratio (WHR) and body mass index (BMI)[3,4,5]. The latter morphological index is a proxy for total body fatness, while the former reflects the distribution of body fat; a more gynoid shape, with more fat deposited on the hips and buttocks, is related to a lower WHR. While Tovee et al.[5] presented evidence that BMI is the primary determinant of sexual attractiveness, in a subsequent report, Tovee and Cornelissen[6] determined that BMI is a more important marker of female attractiveness in front view, with WHR being more important in profile. Women with WHR lower than the population average have been shown to be attractive to both males and females[3,4,7–9].

Body fat distribution in the female has been shown to be related to health[10–13], as well as endocrinological and reproductive status[14]; for example, girls with fat localized on the hips, therefore having lower than average WHR, have higher levels of sex steroids (estradiol and testosterone) and gonadotropins[15]. Health and endocrinological status are signs of female reproductive potential, albeit indirect ones. More direct measures of the biological fitness value of WHR have been demonstrated by Zaadstra et al.[16] who showed that women with higher than average WHR have a lower chance of becoming pregnant and have, as a consequence, on average fewer children than women with lower than average WHR. In addition, higher than average WHR and lower than average BMI have been found to be related to later onset of reproduction[17]. Furthermore, women with lower than average WHR have on average earlier first live birth than women with greater than average WHR, therefore having the potential for a larger number of children during their lifetime. Maternal WHR is also negatively re-

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lated to birth weight of the first child[18]. Since birth weight is the most important predictor of both infant mortality[19,20] and morbidity[21,22,23], WHR, as a predictor of birth weight, can be considered a proxy for a female reproductive fitness.

Another possible measure of WHR as a marker of female reproductive condition is duration of breastfeeding. A proximate mechanism linking WHR and breastfeeding potential is that women with high WHR have high testosterone levels[24]; since testosterone is a negative modulator of prolactin[25], this may suppress lactation[26]. Greater duration of breastfeeding has many advantages over a shorter period of breastfeeding, even if the food (artificial or otherwise) displacing breastmilk is isoenergetic with it. Breastfeeding assures adequate passive immunity, an important factor for infant health, especially in high pathogen environments; infants that receive sustained passive immunity through breast-feeding have lower morbidity and mortality rates than infants that are not breast fed[27]. Worldwide, breast fed infants have lower infant mortality and morbidity than non-breastfed infants[28]. Breastfeeding is also associated with lower rates of sudden infant death syndrome[29], faster rates of physical growth and development in early infancy[30], and higher scores on intelligence tests[31]. In pre-industrial societies, adequate breastfeeding is associated with good health of infants below the age of 4 months, at least prior to dietary supplementation. Prolonged breastfeeding has also been associated with long interbirth intervals, which assures better parental investment in the infant currently breastfed. If the duration of breastfeeding can be shown to be inversely related to pre-pregnancy WHR, then this would present another line of evidence in support of the view that lower than average WHR is a biological fitness-enhancing trait among females. In contemporary society, these relationships are likely to be mediated by socio-economic factors such as level of education, income, and occupation, in that low WHR may also be a measure of status, and breastfeeding duration might be either economically constrained or enabled. In particular, level of education attained has been shown to be associated with WHR in Swedish[32], Finnish[33] and Polish women[34]. In this article, we examine relationships between WHR, breastfeeding duration and level of education attained in a sample of Polish women.

Methods

Data on children's birth weight and sex as well as on mother's age, height, weight, economic and health status, duration of breast feeding were collected by self-administered questionnaire by mothers in 11 outpatients' surgeries for healthy children, and in 5 general practices in three districts of Wroclaw, Poland. Only mothers with their last-born child between the ages of 9 and 16 months of age were approached for inclusion in this study. This was so as to include only women with the possibility of feeding their last born infant for at least 9 months, but who were reasonably able to recall their duration of lactation, pre-pregnant weight, hip and waist circumferences. Recall bias of breastfeeding duration is low, because the women of this study had stopped breastfeeding only recently prior to the survey. A retrospective design was employed in the present study because collection of female WHR prior to conception is a very expensive and time-consuming process. This is because not all women measured prospectively in this way are likely to conceive, and it is not possible to determine in any precise way which women would and would not conceive. In this study, the correlation between pre-pregnant WHR and WHR at the time of data collection was strong, at 0.84. Women with poor recollection of the information sought were excluded from the study. The duration of lactation was usually reported in months, and only in some cases of very short breast feeding duration was given in weeks. The data were collected between the Spring of 1998 and the Spring of 1999.

Of 795 women initially interviewed, those who gave birth to twins, did not specify or could not recall their height, duration of lactation, pre-pregnant weight, and/or waist and hip circumferences were excluded from the analysis. This left a sample of 644 women. Since premature infants are more likely to be formula-fed soon after birth, a factor which can influence the success of subsequent breastfeeding, the sample was further restricted to newborns of at least 38 weeks of gestation. Of the remaining sample, 82 women either gave birth to their infant before the 38th week of gestation (N=58) or did not reveal the length of gestation (N=24); these were excluded from the analysis. Thus the final sample size used in analysis was 562.

Three categories of duration of lactation were distinguished: non-breastfeeding (N=56; »non-feeders«), breast feeding up to 6 months (mean lactation time 3.2 months, sd=1.74, N=287; »short-feeders«) and breast feeding for 6 months or longer (mean lactation time 10.3 months, sd=2.03, N=219; »long-feeders«). This division was established after examining other possible ways of disaggregating the data. Since there were no significant differences in any characteristics between women who breastfed for up to 3 months and those who breastfed for between 3 and 6 months, they were aggregated in one category. The same was the case for those who breastfed for more than 6 months and less than 9 months, and for those who breastfed for 9 months or longer. Aggregation into three categories also reduced the extent to which recall bias could have influenced the results.

Education, as a proxy of socioeconomic status, can also influence the duration of lactation. Three categories of education level were distinguished: university (N=145, 26%), high school (N=277, 49%), and vocational combined with primary (N=140, 25%). The reason for combining vocational and primary levels of education is because there were only 30 women with primary education in the sample.

The data set included ordinal dependent variables with 3 categories of duration of lactation (non-feeders, short-feeders and long-feeders), the categorical variables 'sex of the newborn' and 'parity' (null -vs- multiparity), and the continuously distributed predictors 'maternal age', 'maternal pre-pregnant weight', WHR, body mass index (BMI) and neonatal weight. Given this array of variable types, an ordinal multinominal linear model with logit link was chosen as the most appropriate for the discrimination of duration of lactation according to WHR and level of education. Statistical analysis was carried out using the statistical package »Statistica«[35].

Results

Of the women for whom all variables were obtained, 56 of them did not breastfed their babies (10%). This proportion does not differ from that of the women who gave information about duration of lactation but did not reveal some of the other information requested. Thus, there was no selection for or against breastfeeding women, by excluding women from analysis on the basis of missing data. Table 1 gives a comparison of the age and physical characteristics of mothers and their infants, disaggregated according to whether women were part of the sample, or were excluded from it. There are no differences in age or anthropometric traits between women included in the analysis, and those left out.

There is no relationship between prepregnant weight and duration of lactation (one-way analysis of variance: F(df:2,559)=0.75, p=0.47), or between BMI and duration of lactation (F(df:2,559)=0.09, p=0.92). When analysed independently, neither hip girth nor waist girth were significant predictors of lactation duration. However, there was a significant negative relationship between WHR and the duration of lactation (F(df:2,559)= 5.01, p=0.007). Similar analyses were carried out with primiparous and multiparous mothers disaggregated into two groups, which showed that although this relationship is only highly significant for primiparous women, a similar, but statistically significant tendency also existed for multiparous women (Figure 1). In this relationship, there was no interdependence between lactation categories and parity. Since there was no significant difference in the mean WHR between primiparous (WHR=0.75, s.d.=0.06, N=368) and multiparous (WHR=0.75, s.d.=0.05, N=194) women (t-student test: t=–0.63, df=560, p=0.52), further analysis with WHR as a predictor of duration of lactation was carried out for the combined sample.

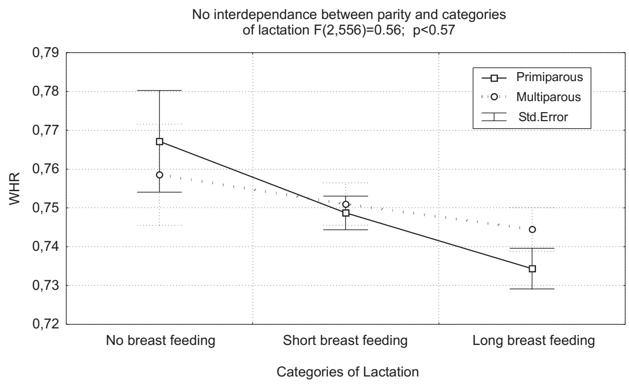

Fig. 1. Relationships between WHR and categories of lactation for primiparous and multiparous women (no interdependence).

One factor known to associate negatively with duration of breast-feeding is maternal age[36,37]. A relationship between mother's age and WHR was sought but not found for any linear or non-linear function of mother's age. Thus the negative correlation between WHR and lactation cannot be attributed to maternal age.

The ordinal Multinominal Linear Model with Logit Link analysis revealed that the best single predictor for the duration of lactation (in three categories) was WHR (df=1, Likelihood Score (L.s.)=9.4, p=0.002). The best model with two effects was WHR and parity (df=2, L.s.=12.5, p=0.002), while the best model with three effects was WHR, parity and sex of the newborn (df=3, L.s.=13.6, p=0.004). The best model with four effects was WHR, parity, sex of the newborn and neonatal weight (df=4, L.s.=14.6, p=0.006). Other additional predictors increased the likelihood score only very slightly (for example, in the model with 5 effects, which is the best model with four effects with the additional variable »body mass index«, the likelihood score was 14.9 (df=5)). Using only the four best predictors, estimates of duration of lactation with all effects was calculated (Table 2). The goodness of fit was very high (Stat/df ranging between 0.93 and 1.01).

In the second step of analysis, the extent to which the relationship between pre-pregnant WHR and duration of lactation also depends on maternal education level was examined. Figure 2 shows mean WHR according to education level attained and lactation category. There were

TABLE 1
COMPARISON OF PHYSICAL CHARACTERISTICS OF MOTHERS WHO WERE INCLUDED IN ANALYSIS AND THOSE WHO WERE EXCLUDED

	Included (N=562)		Excluded (N=233)				
	Mean	SD	Mean	SD	N	t	p
Mother's age (years)	26.8	5.3	26.7	5.9	209	–0.32	.75
Mother's height (cm)	165.2	5.39	165.3	5.76	205	0.28	.77
Pre-pregnant weight (kg)	58.1	7.89	58.6	10.08	192	0.73	.47
Waist to hip ratio	75	.06	.75	.06	124	1.17	.24

TABLE 2
ESTIMATES OF DURATION OF LACTATION IN RELATION TO NEONATAL SEX, WEIGHT, MATERNAL WAIST-HIP RATIO (WHR) AND PARITY. GOODNESS OF FIT VARIES BETWEEN 0.93 AND 1.01

	Estimate	Standard Error	Wald Statistics	P
Intercept 1	2.21	1.24	3.20	.07
Intercept 2	4.91	1.26	15.33	.0001
WHR (per 0.1)	–0.44	0.14	9.90	.002**
Newborn sex (boy)	–.10	.08	1.51	.22
Parity (primiparous)	–.15	.09	3.14	.08
Neonatal weight	.18	.18	1.03	.30

* level of significance

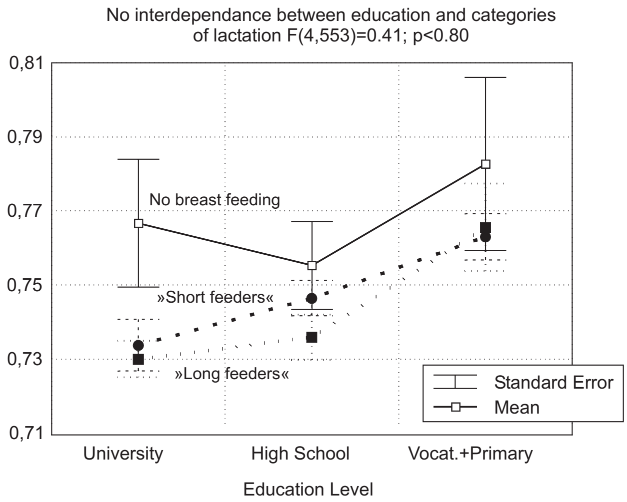

Fig. 2. Duration of lactation in relation to pre-pregnant mother's waist-hip ratio and level of education attained.

significant differences in mean WHR across the three classes of lactation. For mothers who graduated from university or from high school, the WHR decreases according to increasing duration of lactation ($F(2,419)=3.76$ $p=0.02$), with post-hoc significant differences only between non-feeders and long feeders. No such differences were observed among women at the lowest level of education ($F(2,137)=0.6$, $p=0.6$).

Discussion

Although the results presented here are not entirely clear-cut, they provide limited additional support to the position that women with low WHR have higher reproductive potential than women with high WHR. The finding that the duration of lactation is associated with WHR only for women attaining higher levels of education is initially surprising, although Kaye et al.[17] also found that women with higher educational attainment had lower WHR. This relationship cannot be attributed to the differences in the variances of WHR between educational categories. We postulate that the lack of difference in the means of pre-pregnant WHR in relation to the duration of lactation among women in the lowest category of education may be due to greater competition for mother's time between breast feeding and work activity than among women with greater levels of education[38].

In the present study, there is no difference in WHR between short and long feeders among the women attaining the lowest level of education; however non-feeders have a slightly higher, but non-significant WHR in comparison to breast feeders of all types. This effect is stronger among the primiparous women than the multiparous women. Multiparous women have significantly lower variance in WHR than primiparous women, suggesting either that women become more similar with respect to WHR after having their first baby, or that in terms of body shape (WHR) there is some preselection for women who tend to have more children.

Breast feeding behaviour among the better educated women is less likely to be influenced by adverse socio-economic conditions, the lower level of economic constraint possibly allowing easier detection of inherent maternal biological condition associated with the capability of sustained breast feeding. Alternatively, women with lower than average WHR may be perceived by males as being more attractive and this may therefore also lead to a higher probability of being chosen as a partner by prosperous males. As a consequence, only educated women with low WHR may have social and economic conditions that are advantageous for prolonged breast feeding.

One ambiguity of this study is that university-educated women that did not breastfeed had the same WHR as women attaining only vocational and primary school education, but who breastfed their children for either short or longer periods. It is possible that WHR represents different phenomena, or is attained differently, among women of different educational or social status. For example, it might be that university-educated women are more conscious of their figure and maintain a lifestyle that allows them to preserve their slimness and shapeliness. In this case, high WHR may be more directly a consequence of endocrine factors such as endogenous prolactin or testosterone[39] levels, which may influence their ability to breastfeed. In contrast, women with the lowest educational attainment may have a high WHR because they care less about their figure and diet. In this case, high WHR may be largely environmental in cause, and have little impact on the ability to breastfeed. If this is so, then this might explain why the WHR-breast-feeding relationship holds true for the university- and high school-educated women, but not for the women that attained lowest level of education.

One of the limitations of this study is that data on lactation duration are retrospective. For instance, studies of recall bias in reporting breastfeeding duration in a southern Brazilian population have shown that richer and better educated women are more likely to report longer breastfeeding duration, while poorer and less-educated women show no significant bias[40]. Han and Lean[41] have shown that British adults tend to underestimate their reported waist circumferences, while Klipstein-Grobusch et al.[42] have shown that self-reported past body weight has a high degree of reproducibility. In the present study, breastfeeding recall bias is likely to have been negligible, because the women in this study had stopped breastfeeding only recently.

The other possible limitation of our study is recall data on pre-pregnancy WHR. Self-report of anthropometry is quite commonly used in epidemiological studies and a large number of studies have been carried out to check the accuracy of such data. Comparison of self-report values for hip and waist circumferences with those obtained by trained anthropometric technicians typically yields significant correlations (0.70–0.99)[43–47]. However, even if some residual error remains, there is no reason to expect the magnitude of such errors to be correlated with breast feeding duration. It should be also underlined that participants were not aware of the aim of the study and so could not have introduced any covert biases into their responses.

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B. Pawlowski

University of Wroclaw, Department of Anthropology, ul. Kuznicza 35, 50-138, Wroclaw, Poland
e-mail: bogus@antropo.uni.wroc.pl

OMJER STRUKA I BOKOVA I STUPANJ OBRAZOVANOSTI KAO PREDIKTORI DUŽINE DOJENJA U ŽENA

SAŽETAK

U članku je istražena mogućnost postojanja veze između dužine dojenja, statusa obrazovanosti i omjera struk-kuk kao mjere plodnosti i biološkog fitnesa u uzorku poljske populacije. Podaci o dobi, visini, težini, opsegu struka i kuka, stupanj obrazovanosti i trajanje dojenja prikupljeni su od žena putem upitnika u 11 klinika za zdravlje djece i 5 općih praksi iz tri četvrti grada Wroclaw u Poljskoj. Ordinalni multinominalni linerani model sa logitom linkom korišten je da bi se dobila mjera utjecaja perioda laktacije na majčin omjer struk-kuk i stupanj obrazovanosti. Dok se omjer struk-kuk smanjuje s povećanjem dužine laktacije za majke s visokim stupnjem obrazovanosti, razlike kod majki s niskim stupnjem obrazovanosti nisu uočene. Ova studija potvrđuje veći biološki fitnes žena s manjim omjerom struk-kuk unutar poljske populacije, i pokazuje kako je to posredovano i sa stupnjem educiranosti žene.