

# Correlation of heart external dimensions with body external dimensions of human fetuses

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*In an evaluation of foetal hearts in II and III pregnancy semester, correlation with exterior foetal dimensions should be taken into consideration. It is interesting also if all exterior heart dimensions are correlated at the same level with overall body dimensions.*

*The subject of examination was 204 fetuses of both sexes, including 106 males and 98 females, in 5th and 6th month of foetal life. Fetuses were fixed for minimum 3 months in 9% formalin solution. They were taken from natural abortions, without exterior features of developmental malformations. Examined material was evaluated in month groups of morphological age. The number of fetuses in different groups was various. Exterior heart dimensions were considered: height, width, heart depth, and also heart circumference in coronary sulcus (atrial-ventricular). Exterior dimensions of fetuses were: vertex-plantare, vertex-tubulare.*

*All exterior dimensions of heart are closely and strongly correlated with both exterior dimensions of fetuses.*

**key words:** heart development, external dimensions, human development

## INTRODUCTION

Biometrical research of internal organ development enables us to obtain data concerning basic biological issues: time of origin and differentiation of sexual diversities in dimensions of examined organs, rate of growing ones and also correlation of these organs' dimensions with body external dimensions.

Developmental changes of internal organs, including heart, during human development are described rather generally and published data are uncertain.

During an evaluation of fetuses' heart development, one should also take into account its correlation with external dimensions of fetuses. However it is interesting if all external dimensions of heart are correlated with general body dimensions to a similar extent.

## MATERIAL AND METHODS

Research was carried out on 204 fetuses of both sexes (106 male and 98 female) at the age of 5th and 6th month of foetal life. Fetuses were stained for a minimal period of 3 months in 9% formalin solution. Analysed fetuses were taken from natural abortions, without external properties of malformation. The studied material was evaluated in month classes of morphological age. Foetus numbers in following age classes are various. The examined material originated from the Department of Histology and Embryology of the Medical University of Bydgoszcz. All measurements were carried out by one scientific worker, measuring to 1/10 mm of certainty.

Measurements were taken twice and their average value was used for statistical analysis of the following dimensional properties:

**Table 1.** Matrix of correlations of chosen properties for 5th month according to morphological age

	Heart height	Heart width	Heart depth	Heart circuit	Age	V-pl	V-tub
Heart width	0.662**						
Heart depth	0.801**	0.676**					
Heart circuit	0.840**	0.797**	0.871**				
Morphological age	0.783**	0.658**	0.758**	0.800**			
V-pl	0.766**	0.688**	0.734**	0.818**	0.947**		
V-tub	0.785**	0.660**	0.756**	0.799**	1.000**	0.946**	
Body mass	0.764**	0.611**	0.689**	0.764**	0.910**	0.916**	0.910**

\*\*p ≤ 0.01

**Table 2.** Matrix of correlations of chosen properties for 5th month according to morphological age

	Heart height	Heart width	Heart depth	Heart circuit	Age	V-pl	V-tub
Heart width	0.650**						
Heart depth	0.756**	0.747**					
Heart circuit	0.780**	0.783**	0.929**				
Morphological age	0.562**	0.659**	0.681**	0.697**			
V-pl	0.545**	0.587**	0.667**	0.708**	0.900**		
V-tub	0.563**	0.657**	0.681**	0.695**	1.000**	0.900**	
Body mass	0.560**	0.512**	0.620**	0.666**	0.807**	0.820**	0.808**

\*\*p ≤ 0.01

**Table 3.** Matrix of partial correlation after morphological age rate obtained for 5th month

	Heart height	Heart width	Heart depth	Heart circuit	Age	V-pl	V-tub
Heart width	0.590**						
Heart depth	0.367**	0.314**					
Heart circuit	0.407**	0.511**	0.361**				
Morphological age	–	–	–	–			
V-pl	0.254*	0.123	0.266*	0.078	–		
V-tub	0.178	0.117	0.117	–0.097	–	–0.015	
Body mass	0.198"	0.201"	0.038	–0.005	–	0.404**	–0.030

\*p ≤ 0.005; \*\*p ≤ 0.01; "p ≤ 0.1

**Table 4.** Matrix of partial correlation after morphological age rate obtained for 6th month

	Heart height	Heart width	Heart depth	Heart circuit	Age	V-pl	V-tub
Heart width	0.662**						
Heart depth	0.448**	0.450**					
Heart circuit	0.651**	0.617**	0.542**				
Morphological age	–	–	–	–			
V-pl	0.181"	0.107	–0.019	0.168	–		
V-tub	0.127	0.038	–0.056	–0.001	–	0.031	
Body mass	0.289**	0.219*	–0.44	0.163	–	0.363**	0.098

\*p ≤ 0.005; \*\*p ≤ 0.01; "p ≤ 0.1

- heart height — the biggest longitudinal heart dimension, from horizontal plain adjacent to base of heart, to apex of heart;
- heart width — the biggest cross-sectional heart dimension;
- heart depth — the biggest sagittal heart dimension;
- heart circumference — circuit at the level of coronary groove;
- body mass — in grams;
- external foetal dimensions;
  - vertex-plantare — entire body length — line between vertex point on head top and point located on left plantar surface of foot, along anatomical axis of lower leg;
  - vertex-tubulare — parietal — bottom length of corpus is line between point situated on head top vertex and bottom point, at ischiadic tuber level.

Biometrical analyses of measured properties were taken on the basis of statistical methods from scientific papers by Bożyłow and Sawicki [1] and Malinowski and Bożyłow [3] (Tables 1–4).

## RESULTS

In evaluating the correlation of heart external dimensions in 5th together with 6th month one should point to a serious correlation of these with the external dimensions of foetuses. However excluding age influence in particular age classes concerning their range, these correlations are not so direct. There are correlations between heart external dimensions and body external dimensions according to evaluation of partial correlation after morphological age rate obtained in 5th month. Statistically crucial dependences are between heart height and vertex-plantare, together with heart depth and vertex-plantare. In 6th month there are statistically important correlations between height and depth and body mass. One should also consider serious correlations between following external dimensions of heart.

## DISCUSSION

Heart external dimensions are closely correlated with both external dimensions of foetuses and body mass to a similar extent. But excluding influence of group range in following age classes, the dependences visible in 5th and in 6th month are indirect. This could be influenced by: too big range of age classes (months, not weeks), changes of proportions of fol-

lowing heart dimensions — in its shape [6–8]. What is interesting is also the lack of correlation between both external dimensions of body, which is caused by body proportions change during human development and growth [8]. Research concerned 5th and 6th month because of current updates by Malinowski [2]. This is the period of the most intensive heart growth, evaluated on the basis of its mass. Marecki [4–6] indicates serious correlations between body external dimensions and heart mass during 6th month and these correlations are slightly visible in 5th month. This indirectly confirms my results. However there is a lack of direct evaluation of heart external dimensions with body external dimensions in literature. These papers are not available either according to sectional material or USG examination. This happens because different parameters and heart dimensions are defined differently during these studies. Sectional biometrical research includes one of the parameters of heart height or its mass and not other heart dimensions. This could be influenced mostly by heart shape diversity, which was pointed out earlier and occurred during its growth. Heart mass is rather not influenced by this factor. However shape variety has a slight influence on growth evaluation ability, because all heart external dimensions are seriously correlated together.

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