

Problems and opportunities of statistical analysis of the Chalcolithic house architecture in Northeastern Bulgaria

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ABSTRACT

The aim of this study is to demonstrate a small part of the opportunities of statistical methods and software for the Chalcolithic dwellings' architecture. It represents the problems which limit this kind of research. This study utilizes the statistical approach to analyze the Chalcolithic dwellings in Northeastern Bulgaria. The area provides great opportunities. It includes entirely excavated Chalcolithic settlements or ones with completely excavated building layers – Vinitsa, Golyamo Delchevo, Ovcharovo, Omurtag, Polyanitsa, Radingrad and Targovishte. A total of 628 Chalcolithic buildings have been analyzed. The information has been systemized and entered into an electronic table. It has been statistically processed via the statistical software. As a result, a number of conclusions have been drawn. They reflect the chronological dependencies, the exposure, the shape and the size of the dwellings, their inner plan and arrangement.

KEYWORDS

Chalcolithic, Northeastern Bulgaria, architecture, dwellings, statistical analysis, problems, opportunities

The current study presents a statistical approach to dwellings from a number of Chalcolithic settlement mounds, located in Northeastern Bulgaria. The aim is to reach a conclusion regarding their chronological distribution, as well as to differentiate the stages of their development. I would like to point out that my study is, to a great extent, theoretical. At this stage my aim is to represent the problems which I have faced in choosing statistical database as well as the opportunities which it provides. It is focused mainly on the methodological problems of the statistical analysis' application. A number of possibilities, which it provides, are also observed. The results are preliminary and some of the conclusions are likely to undergo corrections.

The statistical analysis of dwellings architecture requires a large database to be built up. The almost entire lack of completely excavated Chalcolithic settlements with thoroughly researched building layers presents a significant problem. It is common in archaeological excavations that a great part of dwellings remains unearthed or not entirely excavated. Published information is also often incomplete. Stratigraphic data, descriptions, photo and graphic information are missing. Overall this significantly impedes the creation of the necessary database and the statistical study of the Chalcolithic dwellings.

In this respect, Northeastern Bulgaria provides great opportunities. The area is one of the best studied the country. It includes a number of completely excavated settlements or ones with completely excavated building layers. They cover a significant chronological span (from Early to Late Chalcolithic period), as they provide the opportunity to gather the maximum amount of information about Chalcolithic architecture. For this reason, at this stage of my study, only dwellings from completely excavated settlements in the area have been statistically processed – Vinitsa (Радунчева 1976, 10-58), Golyamo Delchevo



Fig. 1. Map of Chalcolithic settlements used in research (by the author)

Обр. 1. Карта на халколитните селища, използвани в изследването (от автора)

(Тодорова и др. 1975 23-51; Todorova 1982, 90-106), Ovcharovo (Тодорова и др. 1983, 27-41; Todorova 1982, 119-143), Omurtag (Ангелова 1999, 66-67), Polyanitsa (Todorova 1982, 155-163), Radingrad (Иванов 1984а, 5-7; Иванов 1984b, 82-84; Todorova 1982, 166-168) and Targovishte (Ангелова 1986, 38-42; Todorova 1982, 176-180) (fig. 1.). A total of 628 Chalcolithic buildings have been analyzed. The information has been systemized and inserted into an electronic table. A lot of indicators reflecting the house architecture in detail have been set apart and used. They can be divided into 4 main groups. The first group includes indicators, reflecting the chronology, the cultural background and the characteristics of the settlements they belong to. It has been taken into account whether the settlement was burnt down or not, the presence and type of the enclosures, the total residential area (combined with that of the enclosures), the inner settlement area (without that of the enclosures), the built-up area and the open-air (street) area. The second group of indicators reflects the condition, layout and internal division of the dwellings. The state of preservation of the dwellings (preserved, partly destroyed, almost destroyed, destroyed), their exposure (north-south; east-west; northwest-southeast; northeast-southwest) and their shape (quadrangular, rectangular, square, trapezoidal, L-shaped (angular) and chain-plan ones) have been taken into consideration. The particularities of their plan and the internal layout have been pointed out. The presence of a shed and its position, with respect to the side of its construction, the number of floors, the number and layout of the internal premises (the rooms) and the number and layout of the entrances have been taken into account. Their metric indicators (the length of the walls, the length of the interior walls, the length and width of the sheds, the area of the respective dwelling and that of the separate rooms inside the house) have been also taken into consideration. The third group reflects the building materials and the construction technique used for the Chalcolithic dwellings in Northeastern Bulgaria.

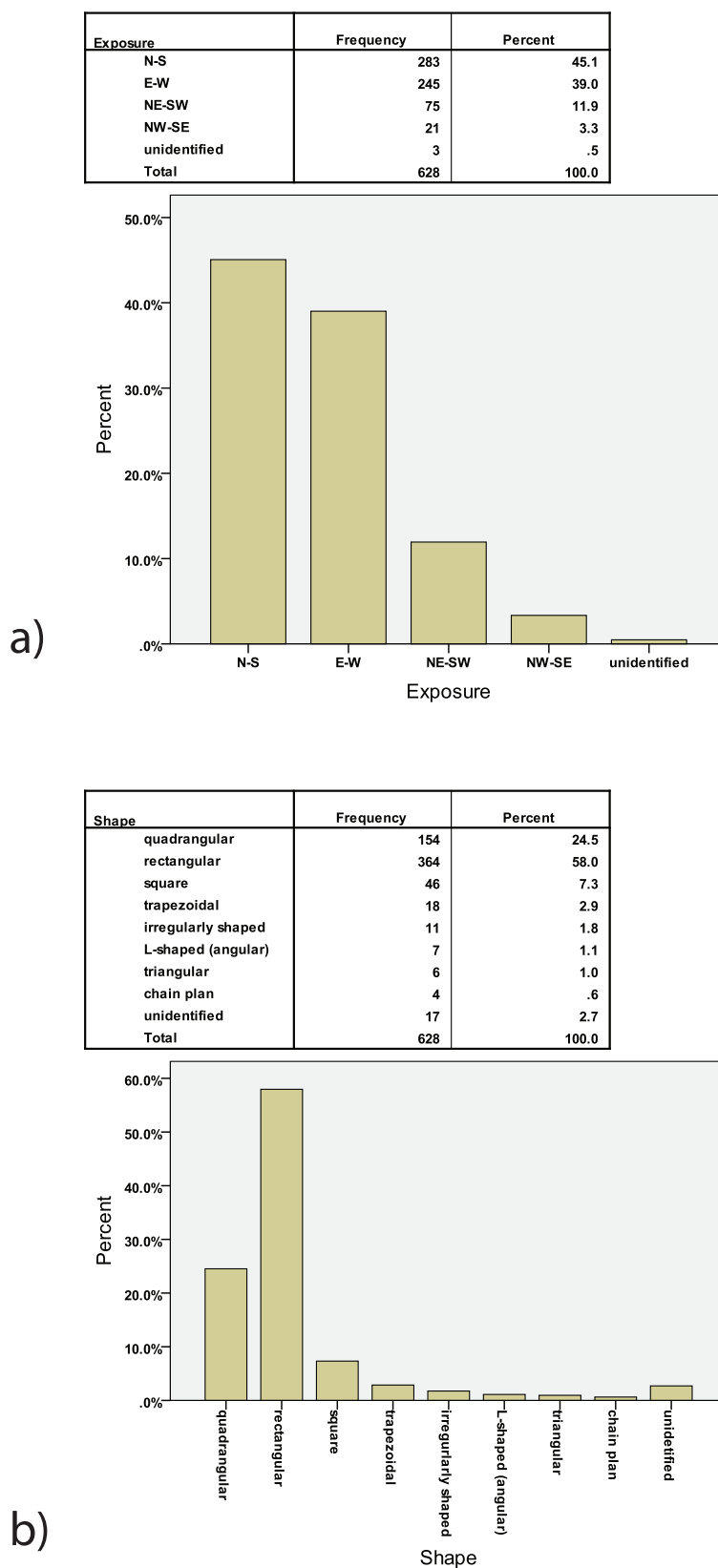
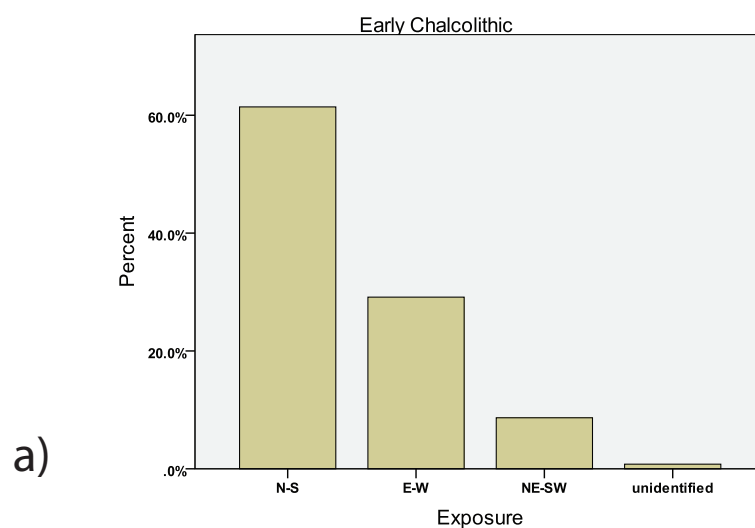


Fig. 2. a) Exposure of Chalcolithic dwellings in Northeastern Bulgaria (by the author); b) Shape of Chalcolithic dwellings in Northeastern Bulgaria (by the author)

Обр. 2. а) Ориентация на халколитните жилища в Североизточна България (от автора);
 б) форма на халколитните жилища в Североизточна България (от автора)

Exposure - Early Chalcolithic	Frequency	Percent
N-S	78	61.4
E-W	37	29.1
NE-SW	11	8.7
unidentified	1	.8
Total	127	100.0



Exposure - Middle Chalcolithic	Frequency	Percent
N-S	100	43.9
E-W	92	40.4
NE-SW	28	12.3
NW-SE	8	3.5
Total	228	100.0

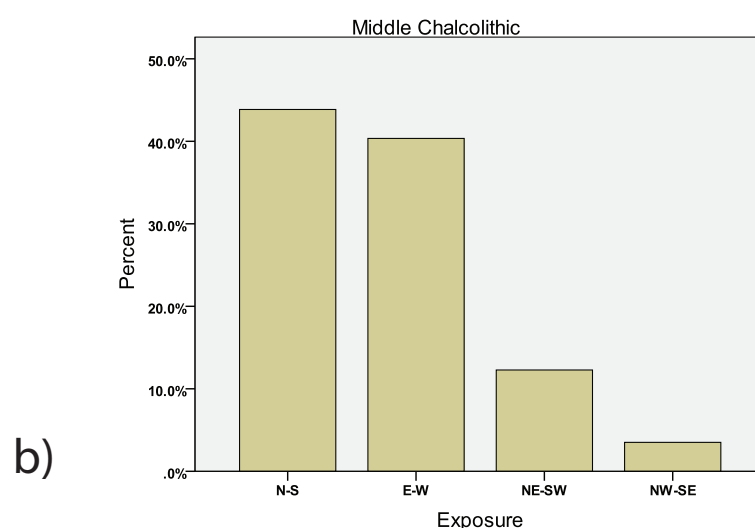
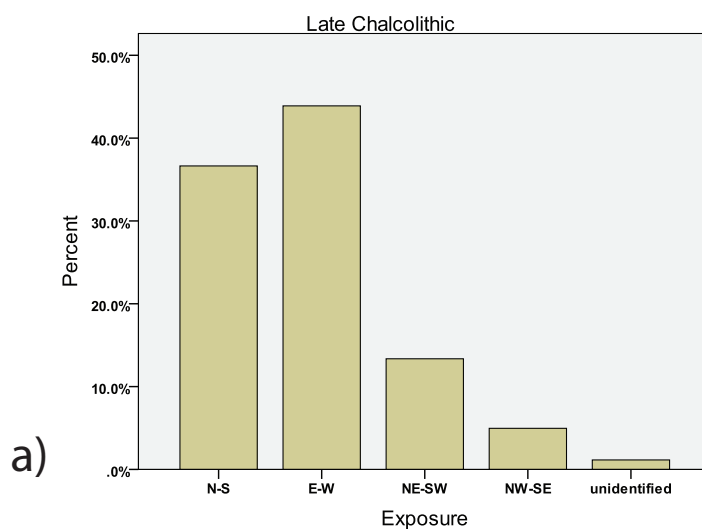


Fig. 3. a) Exposure of Early Chalcolithic dwellings in Northeastern Bulgaria (by the author); b) Exposure of Middle Chalcolithic dwellings in Northeastern Bulgaria (by the author)

Обр. 3. а) Ориентация на раннохалколитните жилища в Североизточна България (от автора); б) ориентация на среднохалколитните жилища в Североизточна България (от автора)

Exposure - Late Chalcolithic	Frequency	Percent
N-S	96	36.6
E-W	115	43.9
NE-SW	35	13.4
NW-SE	13	5.0
unidentified	3	1.1
Total	262	100.0



Shape - Early Chalcolithic	Frequency	Percent
quadrangular	18	14.2
rectangular	90	70.9
square	11	8.7
trapezoidal	2	1.6
chain plan	3	2.4
irregularly shaped	2	1.6
unidentified	1	.8
Total	127	100.0

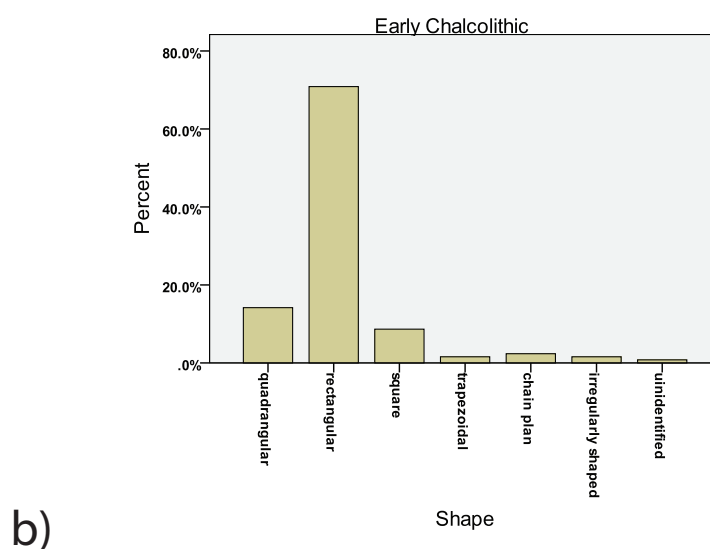
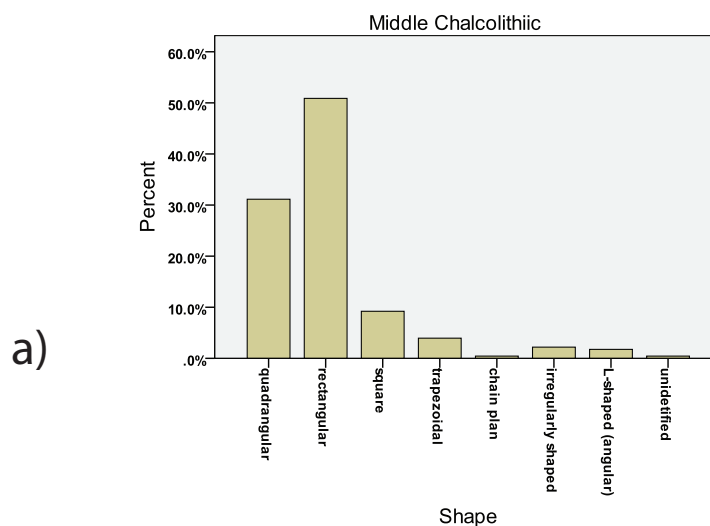


Fig. 4. a) Exposure of Late Chalcolithic dwellings in Northeastern Bulgaria (by the author); b) Shape of Early Chalcolithic dwellings in Northeastern Bulgaria (by the author)

Обр. 4. a) Ориентация на къснохалколитните жилища в Североизточна България (от автора); b) форма на раннохалколитните жилища в Североизточна България (от автора)

Shape - Middle Chalcolithic	Frequency	Percent
quadrangular	71	31.1
rectangular	116	50.9
square	21	9.2
trapezoidal	9	3.9
chain plan	1	.4
irregularly shaped	5	2.2
L-shaped (angular)	4	1.8
unidentified	1	.4
Total	228	100.0



Shape - Late Chalcolithic	Frequency	Percent
quadrangular	63	24.0
rectangular	152	58.0
square	13	5.0
trapezoidal	7	2.7
triangular	5	1.9
irregularly shaped	3	1.1
L-shaped (angular)	3	1.1
unidentified	16	6.1
Total	262	100.0

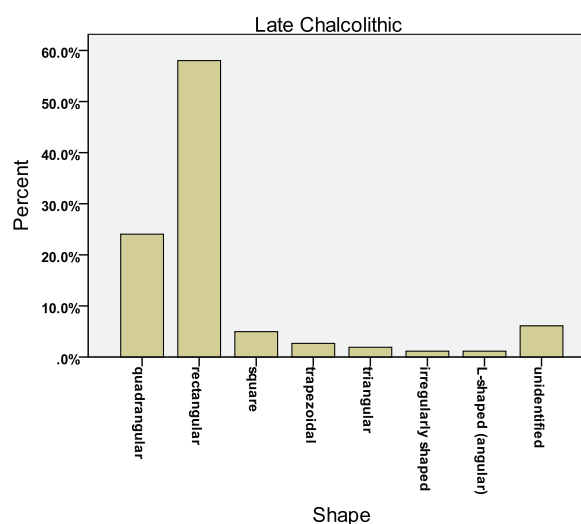


Fig. 5. a) Shape of Middle Chalcolithic dwellings in Northeastern Bulgaria (by the author); b) Shape of Late Chalcolithic dwellings in Northeastern Bulgaria (by the author)
 Обр. 5. a) Форма на среднохалколитните жилища в Североизточна България (от автора);
 b) форма на къснохалколитните жилища в Североизточна България (от автора)

Exposure + Shape - Early Chalcolithic										
			Shape							Total
			quadrangular	rectangular	square	trapezoidal	chain plan	irregularly shaped	unidentified	
Exposure	N-S	Count	11	55	9	0	3	0	0	78
		% within Exposure	14.1%	70.5%	11.5%	0.0%	3.8%	0.0%	0.0%	100.0%
		% within Shape	61.1%	61.1%	81.8%	0.0%	100.0%	0.0%	0.0%	61.4%
		% of Total	8.7%	43.3%	7.1%	0.0%	2.4%	0.0%	0.0%	61.4%
	E-W	Count	6	27	2	1	0	1	0	37
		% within Exposure	16.2%	73.0%	5.4%	2.7%	0.0%	2.7%	0.0%	100.0%
		% within Shape	33.3%	30.0%	18.2%	50.0%	0.0%	50.0%	0.0%	29.1%
		% of Total	4.7%	21.3%	1.6%	0.8%	0.0%	0.8%	0.0%	29.1%
	NE-SW	Count	1	8	0	1	0	1	0	11
		% within Exposure	9.1%	72.7%	0.0%	9.1%	0.0%	9.1%	0.0%	100.0%
		% within Shape	5.6%	8.9%	0.0%	50.0%	0.0%	50.0%	0.0%	8.7%
		% of Total	0.8%	6.3%	0.0%	0.8%	0.0%	0.8%	0.0%	8.7%
	unidentified	Count	0	0	0	0	0	0	1	1
		% within Exposure	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%
		% within Shape	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.8%
		% of Total	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.8%	0.8%
Total	Count		18	90	11	2	3	2	1	127
	% within Exposure		14.2%	70.9%	8.7%	1.6%	2.4%	1.6%	0.8%	100.0%
	% within Shape		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total		14.2%	70.9%	8.7%	1.6%	2.4%	1.6%	0.8%	100.0%

Fig. 6. Exposure and shape of Early Chalcolithic dwellings in Northeastern Bulgaria (by the author)

Обр. 6. Ориентация и форма на раннохалколитните жилища в Североизточна България (от автора)

Exposure + Shape - Middle Chalcolithic											
			Shape							Total	
			quadrangular	rectangular	square	trapezoidal	chain plan	irregularly shaped	L-shaped (angular)		unidentified
Exposure	N-S	Count	38	36	18	3	1	3	1	0	100
		% within Exposure	38.0%	36.0%	18.0%	3.0%	1.0%	3.0%	1.0%	0.0%	100.0%
		% within Shape	53.5%	31.0%	85.7%	33.3%	100.0%	60.0%	25.0%	0.0%	43.9%
		% of Total	16.7%	15.8%	7.9%	1.3%	0.4%	1.3%	0.4%	0.0%	43.9%
	E-W	Count	25	56	1	4	0	2	3	1	92
		% within Exposure	27.2%	60.9%	1.1%	4.3%	0.0%	2.2%	3.3%	1.1%	100.0%
		% within Shape	35.2%	48.3%	4.8%	44.4%	0.0%	40.0%	75.0%	100.0%	40.4%
		% of Total	11.0%	24.6%	0.4%	1.8%	0.0%	0.9%	1.3%	0.4%	40.4%
	NE-SW	Count	7	18	2	1	0	0	0	0	28
		% within Exposure	25.0%	64.3%	7.1%	3.6%	0.0%	0.0%	0.0%	0.0%	100.0%
		% within Shape	9.9%	15.5%	9.5%	11.1%	0.0%	0.0%	0.0%	0.0%	12.3%
		% of Total	3.1%	7.9%	0.9%	0.4%	0.0%	0.0%	0.0%	0.0%	12.3%
	NW-SE	Count	1	6	0	1	0	0	0	0	8
		% within Exposure	12.5%	75.0%	0.0%	12.5%	0.0%	0.0%	0.0%	0.0%	100.0%
		% within Shape	1.4%	5.2%	0.0%	11.1%	0.0%	0.0%	0.0%	0.0%	3.5%
		% of Total	0.4%	2.6%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	3.5%
Total	Count	71	116	21	9	1	5	4	1	228	
	% within Exposure	31.1%	50.9%	9.2%	3.9%	0.4%	2.2%	1.8%	0.4%	100.0%	
	% within Shape	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	
	% of Total	31.1%	50.9%	9.2%	3.9%	0.4%	2.2%	1.8%	0.4%	100.0%	

Fig. 7. Exposure and shape of Middle Chalcolithic dwellings in Northeastern Bulgaria (by the author)

Обр. 7. Ориентация и форма на среднохалколитните жилища в Североизточна България (от автора)

Exposure + Shape - Late Chalcolithic										
			Shape							Total
			quadrangular	rectangular	square	trapezoidal	triangular	irregularly shaped	L-shaped (angular)	
Exposure	N-S	Count	24	49	6	4	3	2	1	7
		% within Exposure	25.0%	51.0%	6.3%	4.2%	3.1%	2.1%	1.0%	7.3%
		% within Shape	38.1%	32.2%	46.2%	57.1%	60.0%	66.7%	33.3%	43.8%
		% of Total	9.2%	18.7%	2.3%	1.5%	1.1%	0.8%	0.4%	2.7%
	E-W	Count	30	72	6	1	2	1	1	2
		% within Exposure	26.1%	62.6%	5.2%	0.9%	1.7%	0.9%	0.9%	1.7%
		% within Shape	47.6%	47.4%	46.2%	14.3%	40.0%	33.3%	33.3%	12.5%
		% of Total	11.5%	27.5%	2.3%	0.4%	0.8%	0.4%	0.4%	0.8%
	NE-SW	Count	5	25	1	2	0	0	1	1
		% within Exposure	14.3%	71.4%	2.9%	5.7%	0.0%	0.0%	2.9%	2.9%
		% within Shape	7.9%	16.4%	7.7%	28.6%	0.0%	0.0%	33.3%	6.3%
		% of Total	1.9%	9.5%	0.4%	0.8%	0.0%	0.0%	0.4%	0.4%
	NW-SE	Count	4	5	0	0	0	0	0	4
		% within Exposure	30.8%	38.5%	0.0%	0.0%	0.0%	0.0%	0.0%	30.8%
		% within Shape	6.3%	3.3%	0.0%	0.0%	0.0%	0.0%	0.0%	25.0%
		% of Total	1.5%	1.9%	0.0%	0.0%	0.0%	0.0%	0.0%	1.5%
	unidentified	Count	0	1	0	0	0	0	0	2
		% within Exposure	0.0%	33.3%	0.0%	0.0%	0.0%	0.0%	0.0%	66.7%
		% within Shape	0.0%	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%	12.5%
		% of Total	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.8%
Total		Count	63	152	13	7	5	3	3	16
		% within Exposure	24.0%	58.0%	5.0%	2.7%	1.9%	1.1%	1.1%	6.1%
		% within Shape	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	24.0%	58.0%	5.0%	2.7%	1.9%	1.1%	1.1%	6.1%

Fig. 8. Exposure and shape of Late Chalcolithic dwellings in Northeastern Bulgaria (by the author)
 Обр. 8. Ориентация и форма на къснохалколитните жилища в Североизточна България (от автора)

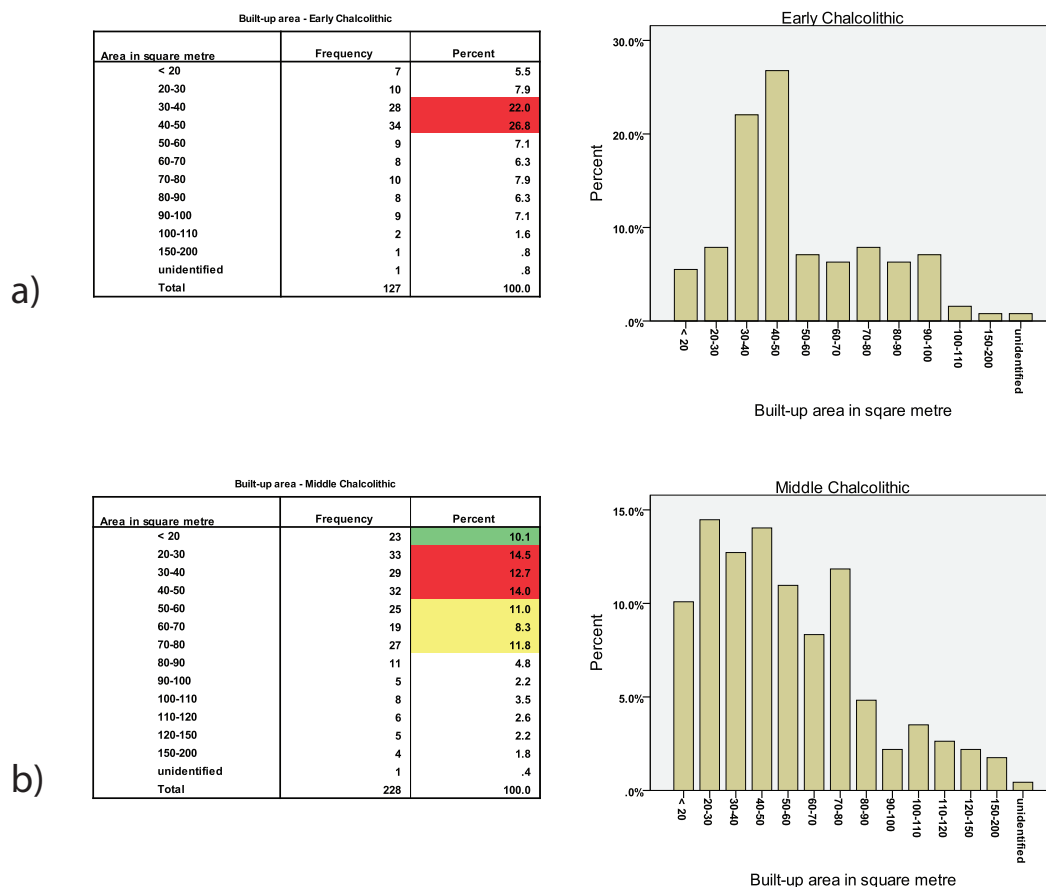


Fig. 9. a) Built-up area of Early Chalcolithic dwellings in Northeastern Bulgaria, in m² (by the author); b) Built-up area of Middle Chalcolithic dwellings in Northeastern Bulgaria, in m² (by the author)

Обр. 9. а) Площ на раннохалколитните жилища в Североизточна България (от автора);
 б) площ на среднохалколитните жилища в Североизточна България (от автора)

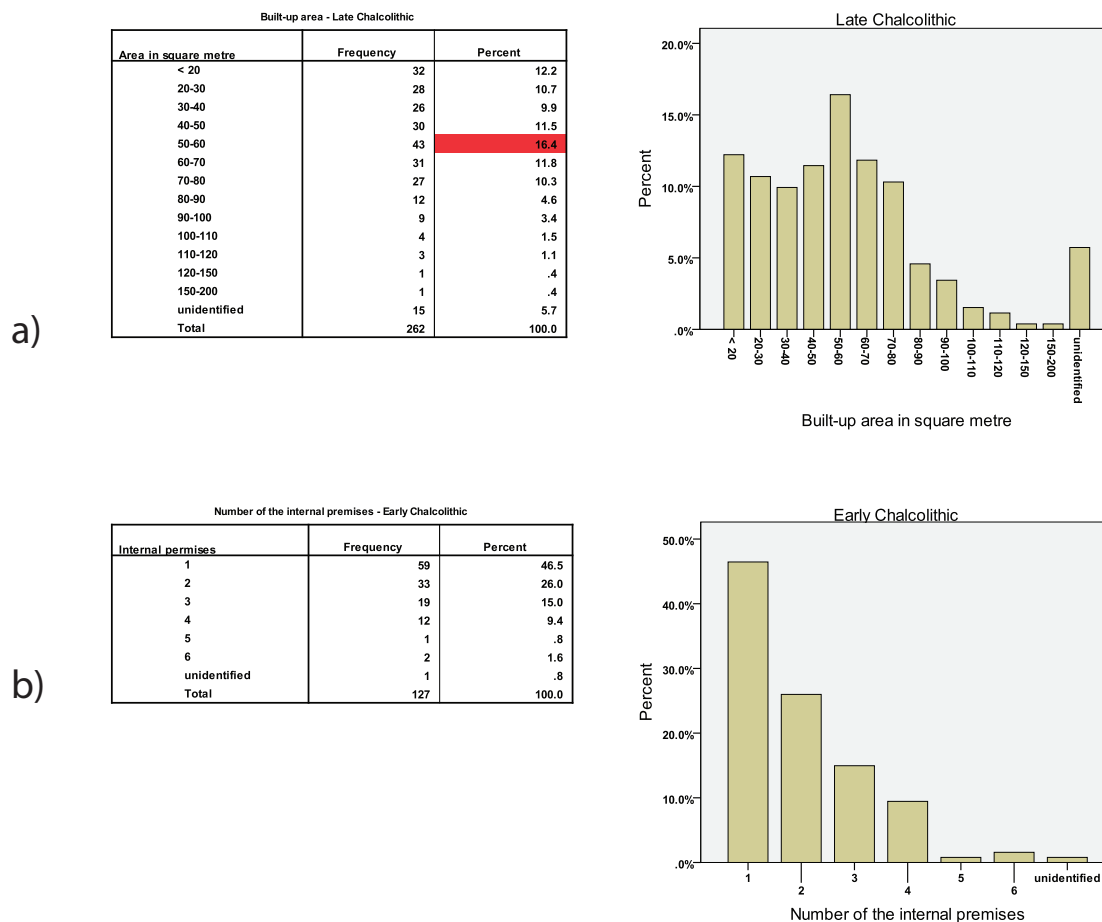


Fig. 10. a) Built-up area of Late Chalcolithic dwellings in Northeastern Bulgaria, in m² (by the author); b) Number of the internal premises of Early Chalcolithic dwellings in Northeastern Bulgaria (by the author)

Обр. 10. а) Площ на къснохалколитните жилища в Североизточна България (от автора);
 б) брой на помещенията на раннохалколитните жилища в Североизточна България (от автора)

The width and depth of the trenches, the number and diameter of the poles constructing the outer walls, the number and diameter of the pillars carrying the roof, the thickness of the floor, the number of plastered floors and walls and the data on ceiling and roof construction have been taken into consideration. Unfortunately, in many cases the degree of study and the state of the publications do not permit thorough insertion of these indicators in the developed database. The last group of indicators reflects the internal arrangement (the interior) and the inventory discovered in the dwellings. The availability and the type of heating and clay facilities have been pointed out. Their position (in relation to the walls, rooms and entrances of the dwellings), orientation and dimensions have been entered. The number and layout of ceramic vessels, flint, stone, bone and antler tools, loom weights, millstones, etc. have been taken into consideration. All that can be applied to the interpretation of the function of separate buildings or premises. Again, in a number of cases, the archaeological studies and the incomplete publications impede and limit the conclusions we can draw.

For the purposes of this study, the information, systemized in the database has been statistically processed via the statistical software. As a result, a number of conclusions have been drawn with regard to the construction technique and the chronological distribution of

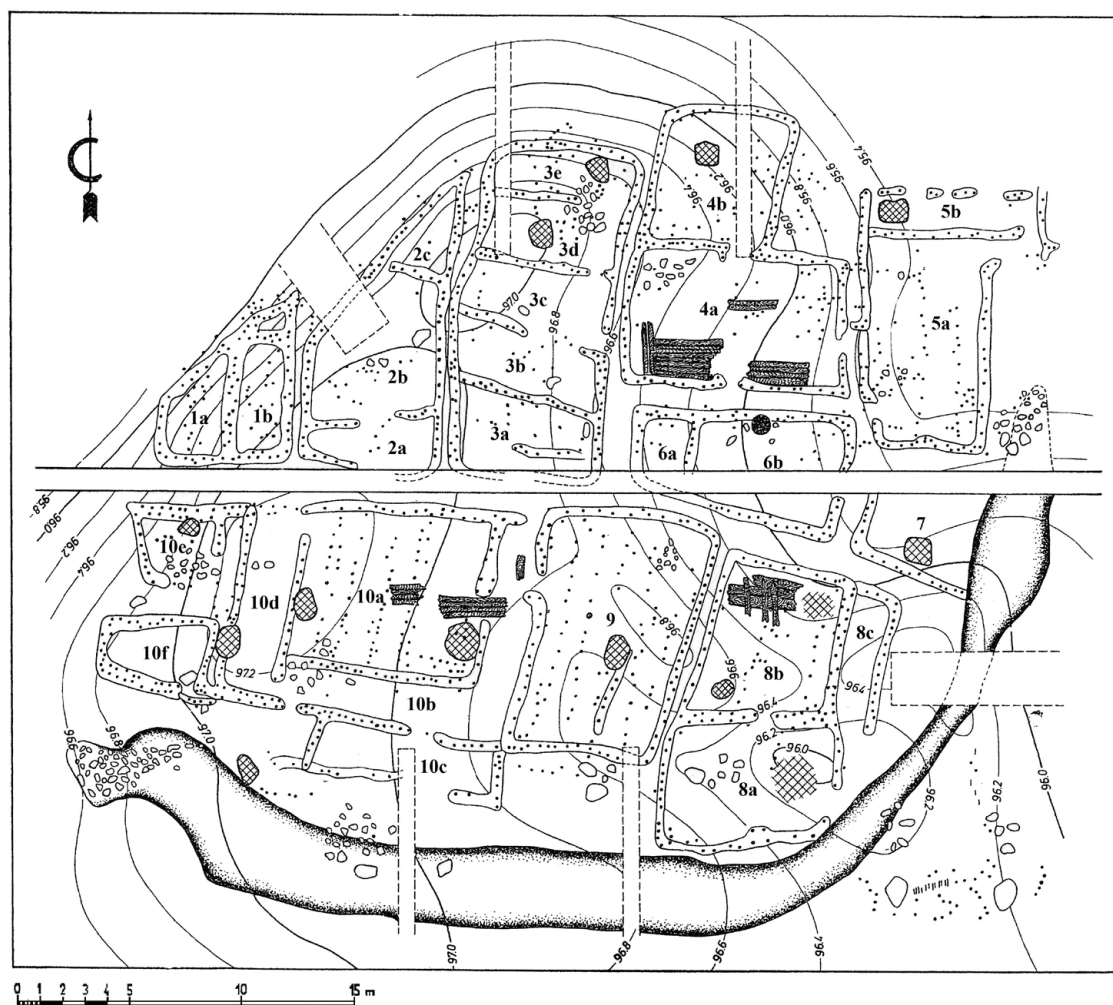


Fig. 11. Plan of Middle Chalcolithic settlement Ovcharovo VI (after Тодорова и др. 1983, Табло 21)
 Обр. 11. . План на среднохалколитното селище Овчарово VI (по Тодорова и др. 1983, Табло 21)

the Chalcolithic dwellings in Northeastern Bulgaria. At this stage, my attempt is to present only general conclusions. The study aims to indicate the possibilities of statistical methods by giving a few examples for their application.

As far as the information provided is concerned, the statistical analysis demonstrates considerable advantages. It is fast and easy to notice significant changes in the studied indicators characterizing the house architecture. This is possible thanks to the attempts to illustrate the test results conducted using statistical software. They have been represented via tables and graphics. This is informative enough and aids the smooth drawing and visualization of conclusions. This can be easily demonstrated by the following examples. It was established that the Chalcolithic dwellings in Northeastern Bulgaria have 4 main exposures in relation to the four cardinal directions – N-S (45,1 %), E-W (39 %), NE-SW (11,9 %) and NW-SE (3,3 %). Only in 0,5 % of all cases the exposure of the buildings was not determined (fig. 2a). In relation to the plan and, to a great extent, the outer shape, the Chalcolithic buildings from Northeastern Bulgaria can be divided into several groups. The rectangular constructions have the largest share (58%). They are followed by quadrangular and square buildings, taking up 24,5 % and 7,3% respectively. The distribution of the remaining groups

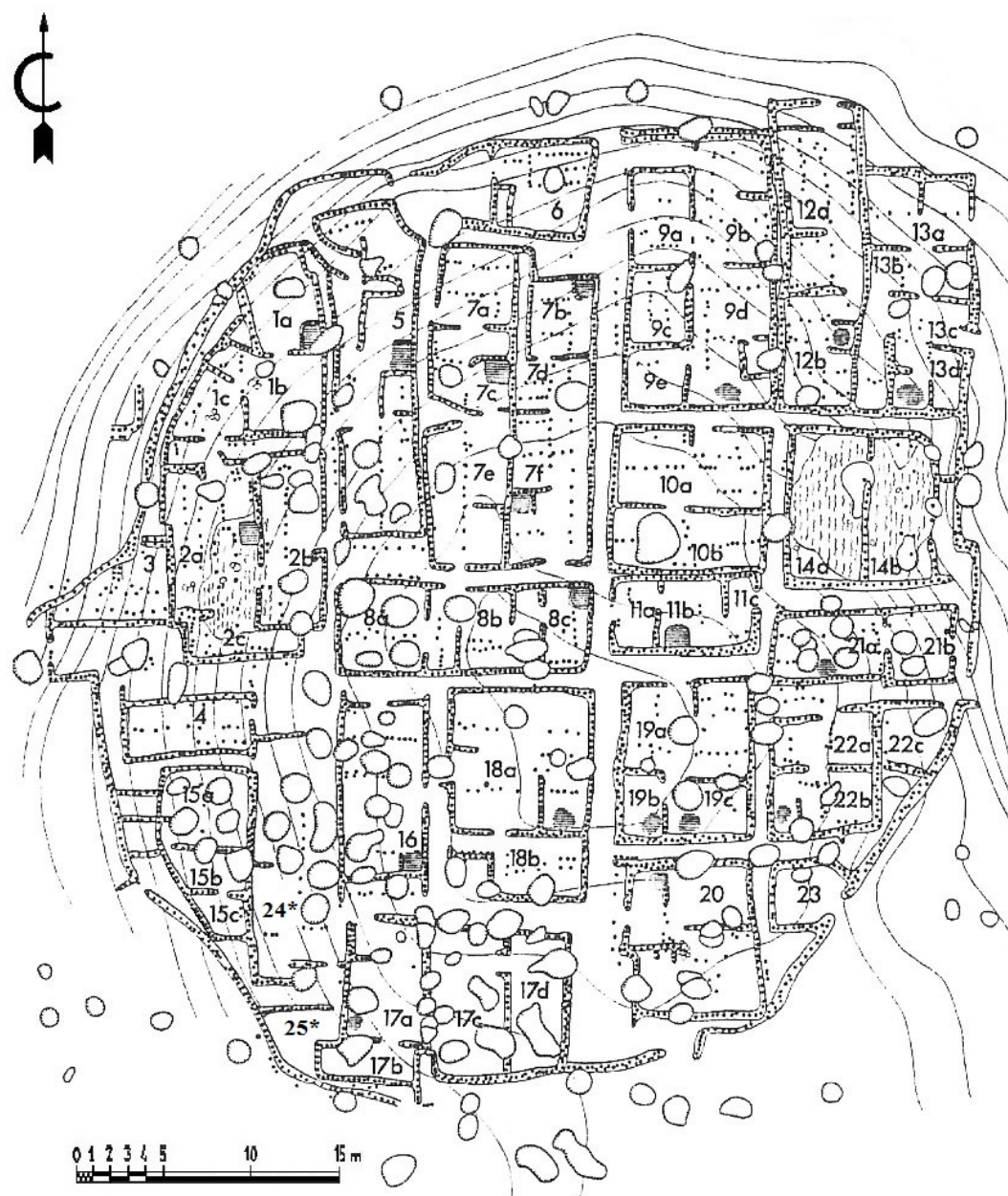


Fig. 12. Plan of Late Chalcolithic settlement Polyanitsa VIII (after Todorova 1982, 220, Abb. 173.)

Обр. 12. План на къснохаалколитното селище Поляница VIII

(no Todorova 1982, 220, Abb. 173.)

is insignificant – trapezoidal (2,9 %), irregularly shaped (1,8 %), L-shaped (angular) (1,1 %), triangular (1 %) and chain plan ones (0,6 %). The plan of 2,7 % from the studied buildings remains unidentified (fig. 2b). It is well-known that rectangular buildings with N-S exposure prevail in the Chalcolithic period. However, no one is able to say exactly how much more they are than the others. In this respect, statistical software remains unmatched, as it is designed to show the exact quantitative values of the ratios – in numbers and in percentages. Thanks to that we are able to make much more precise analysis and visualize results.

Another advantage of the statistical software appears to be the fast and easy separation of the information into periods, phases, layers, settlements, etc. This also contributes to precise synthesis of the conclusions. For example, if we distribute the differently oriented

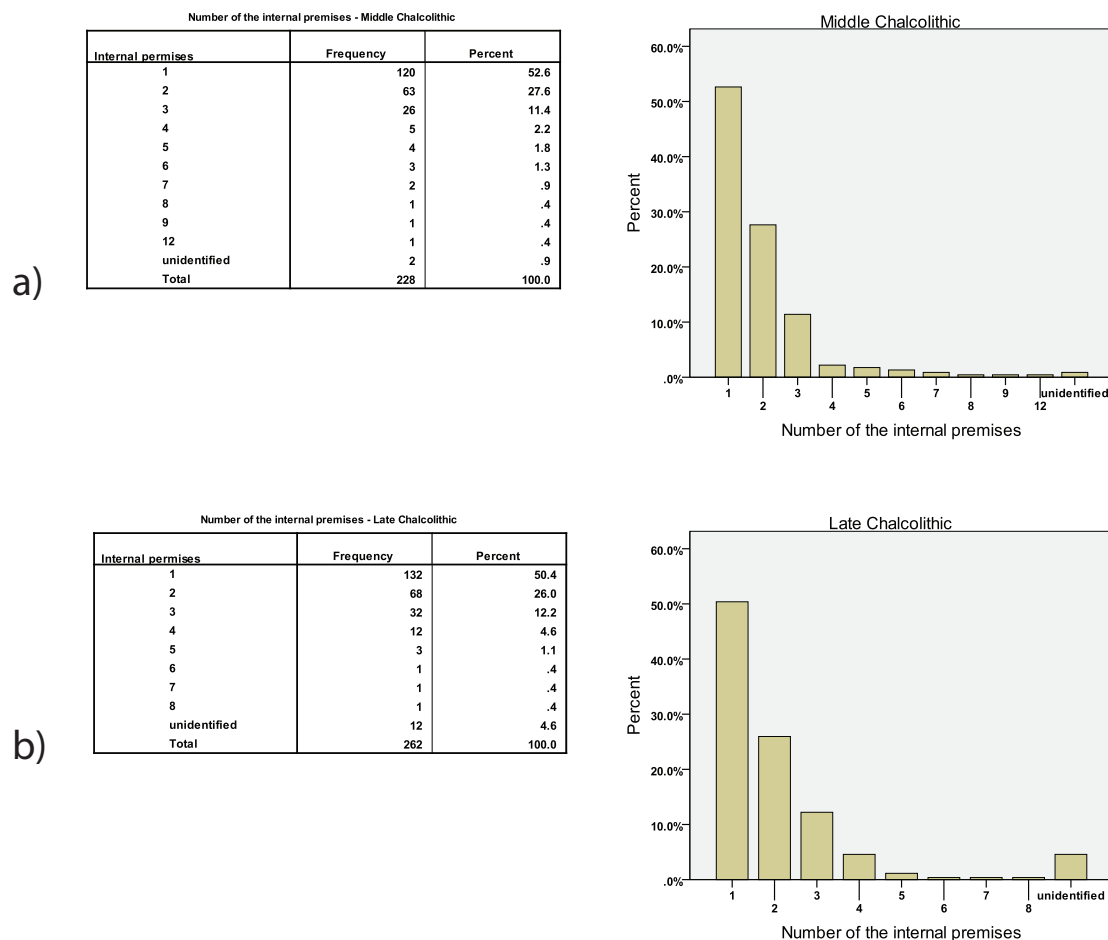


Fig. 13. a) Number of the internal premises of Middle Chalcolithic dwellings in Northeastern Bulgaria (by the author); b) Number of the internal premises of Late Chalcolithic dwellings in Northeastern Bulgaria (by the author)

Обр. 13. а) Брой на помещенията на среднохалколитните жилища в Североизточна България (от автора); б) брой на помещенията на къснохалколитните жилища в Североизточна България (от автора)

buildings into periods, the following can be observed: during the Early Chalcolithic period, more than half of the buildings have N-S exposure (61,4 %); far less are those with E-W position (29,1 %); buildings with NE-SW exposure (8,7 %) take up an insignificant share while the ones with NW-SE exposure are completely missing (fig. 3a). Certain changes took in place during the Middle Chalcolithic period. The share of buildings with E-W exposure nears that of the buildings with N-S exposure, as both groups take up 40,4 % and 43,9 % respectively. The share of buildings with N-S exposure probably decreased due to the emergence of new variation of this position – NW-SE. They take up only 3,5 %. Furthermore, the share of buildings with NE-SW exposure increases (12,3 %) (fig. 3b). The buildings with E-W exposure (43,9 %) dominate in the Late Chalcolithic period. The share of buildings with N-S exposure decreases at the expense of the ever-distributioning buildings with NE-SW exposure (13,4 %) and NW-SE (5 %) (fig. 4a). Similar examples are also noticed in dividing buildings with different plan into periods. During the Early Chalcolithic age greater part of dwellings in Northeastern Bulgaria are rectangular in plan (70,9 %). In terms of distribution, they are followed by those of quadrangular and square shape, taking up 14,2

Lay-out of the entrances - Early Chalcolithic		
Lay-out of the entrances	Frequency	Percent
E	23	18.1
W	14	11.0
N	35	27.6
S	53	41.7
unidentified	2	1.6
Total	127	100.0

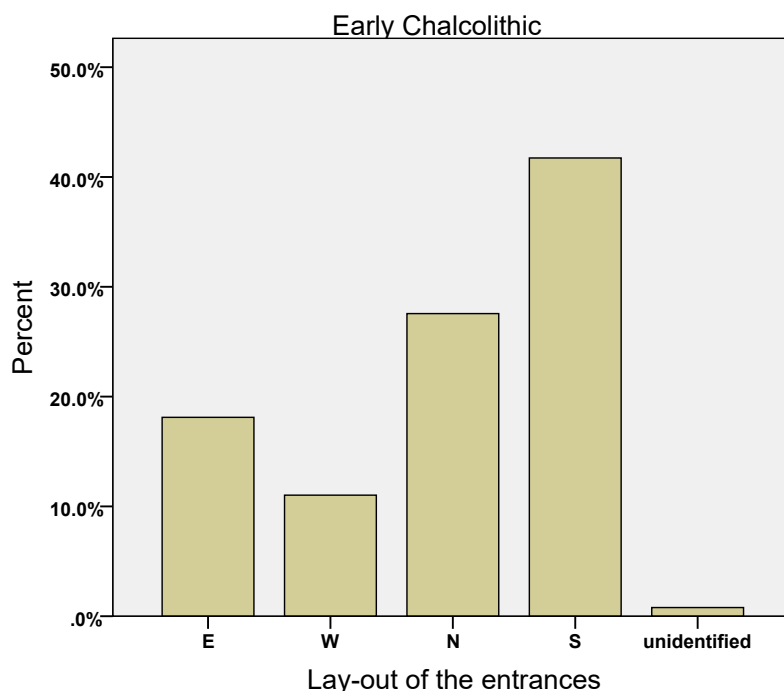


Fig. 14. Lay-out of the entrances of Early Chalcolithic dwellings in Northeastern Bulgaria (by the author)

Обр. 14. Разположение на входовете на раннохалколитните жилища в Североизточна България (от автора)

% and 8,7 % respectively. Constructions with chain-like plan (2,4 %) , as well as trapezoidal (1,6 %) and irregularly-shaped ones (1,6 %), sporadically occurred (fig. 4b). In the Middle Chalcolithic age the share of constructions with rectangular plan significantly decreases, as they take up a little over the half (50,9 %) in relation to the rest. Those with quadrangular shape are far more prevalent (31,1 %). The share of square buildings also slightly increases (9,2 %). The rest keep on occurring rarely – trapezoidal (3,9 %), irregularly-shaped (2,2 %), L-shaped (1,8 %) and chain-like (0,4 %) (fig. 5a). It can be concluded that the situation remains unchanged during the Late Chalcolithic age. The share of rectangular buildings slightly increases (58 %), while that of the quadrangular ones decreases (24 %). The rest keep on occurring seldom – square (5 %), trapezoidal (2,7 %), triangular (1,9 %), L-shaped (1,1 %) and irregularly-shaped (1,1 %). In 6,1 % of cases the shape has not been identified (fig. 5b).

A significant advantage of statistical methods is the ability to analyze (and to combine) simultaneously up to two or more indicators. By comparing the information provided from the database, we can draw a lot more substantial conclusions. For example, if we combine the above-mentioned presented indicators – exposure and plan of the Chalcolithic dwellings in Northeastern Bulgaria, we can observe the following results. In this case, we

Lay-out of the entrances - Middle Chalcolithic		
Lay-out of the entrances	Frequency	Percent
E	48	21.1
W	39	17.1
N	48	21.1
S	71	31.1
unidentified	22	9.6
Total	228	100.0

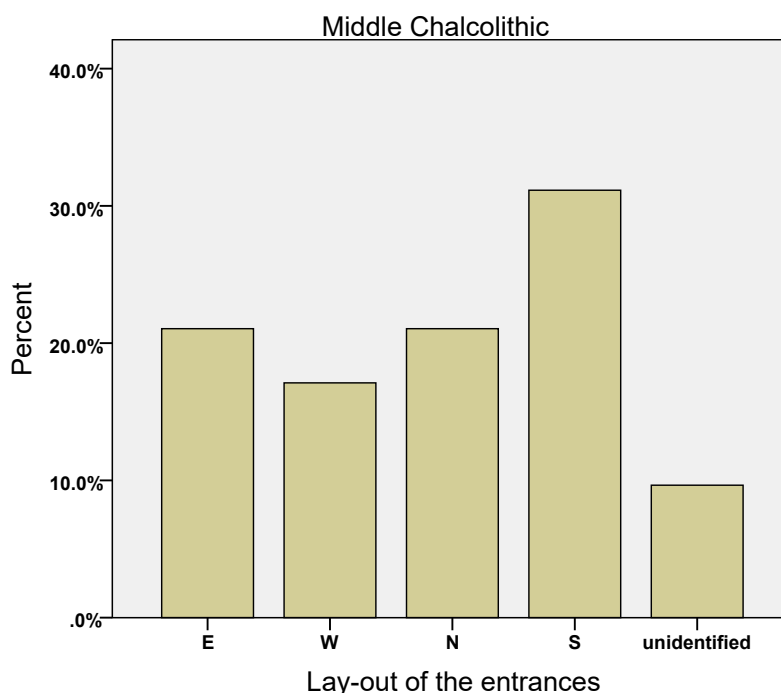


Fig. 15. Lay-out of the entrances of Middle Chalcolithic dwellings in Northeastern Bulgaria
(by the author)

Обр. 15. Разположение на входовете на среднохалколитните жилища в Североизточна България (от автора)

can follow closely the development in the exposure of rectangular constructions, which were most prevalent during the Copper age. In the Early Chalcolithic age the greater part of them have N-S exposure (61,1 %). Approximately 1/3 have E-W exposure (30 %). Only a few feature NE-SW exposure (8,9 %) (fig. 6). Significant changes are observed in the Middle Chalcolithic age. Nearly half of the rectangular constructions have E-W exposure (48,3 %). The share of those with N-S exposure significantly decreases – up to 31 %. Rectangular constructions with NW-SE exposure emerge (5,2 %) and those with NE-SW exposure increase their share (15,5 %) (fig. 7). It is obvious that during the Late Chalcolithic age the changes remain (fig. 8).

The use of statistical methods and software is especially adequate in analyzing the metric data of the dwellings. Unfortunately, the analysis of these indicators poses great difficulties, the information for some of them the information is missing. Again the reasons are the state of research and the published data. However, some substantial conclusions can be drawn and this is clearly evident by the tests made via the statistical software. For example, if we divide the Chalcolithic dwellings in Northeastern Bulgaria into groups according to

Lay-out of the entrances - Late Chalcolithic		
Lay-out of the entrances	Frequency	Percent
E	68	26.0
W	46	17.6
N	33	12.6
S	57	21.8
unidentified	58	22.1
Total	262	100.0

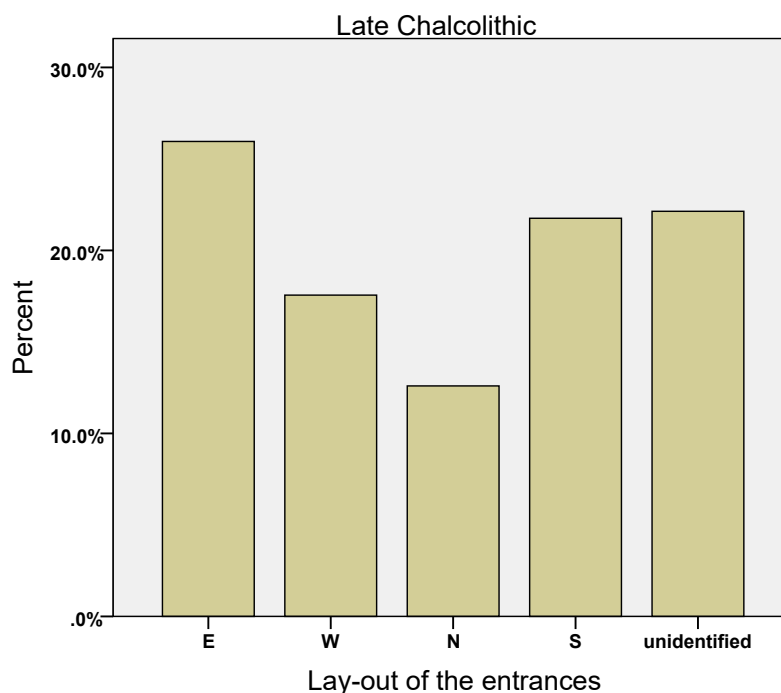


Fig. 16. Lay-out of the entrances of Early Chalcolithic dwellings in Northeastern Bulgaria
(by the author)

Обр. 16. Разположение на входовете на къснохалколитните жилища в Североизточна България (от автора)

their built-up area, in an interval of 10 m², we can observe the following dependencies in chronological terms. During the Early Chalcolithic age more than half of the studied constructions fall into two groups – with a built-up area from 30 to 40 m² and with built-up area from 40 to 50 m², taking up 22 % and 26,8 % respectively. The rest are far less prevalent. Dwellings with a built-up area over 100 m² are extremely rarely found (fig. 9a). In the Middle Chalcolithic age we observe relatively even distribution of dwellings which are different in size. Once again a great part (over 40 %) falls into the groups of built-up area from 20 to 50 m². Small constructions with a built-up area below 20 m² (10,1 %) occur more often. Constructions with a built-up area between 50 and 80 m² increases. The share of constructions with a built-up area over 100 m² also increases (fig. 9b). During the Late Chalcolithic age we observe a relatively even prevalence of constructions with a built-up area of up to 80 m². The most common dwellings cover built-up area between 50-60 m² (16,4 %). The share of constructions with a built-up area over 100 m² decreases (fig. 10a).

The statistical analysis and the use of statistical software provide great advantages for drawing the conclusions and their vizualization with regard to the study of the interior

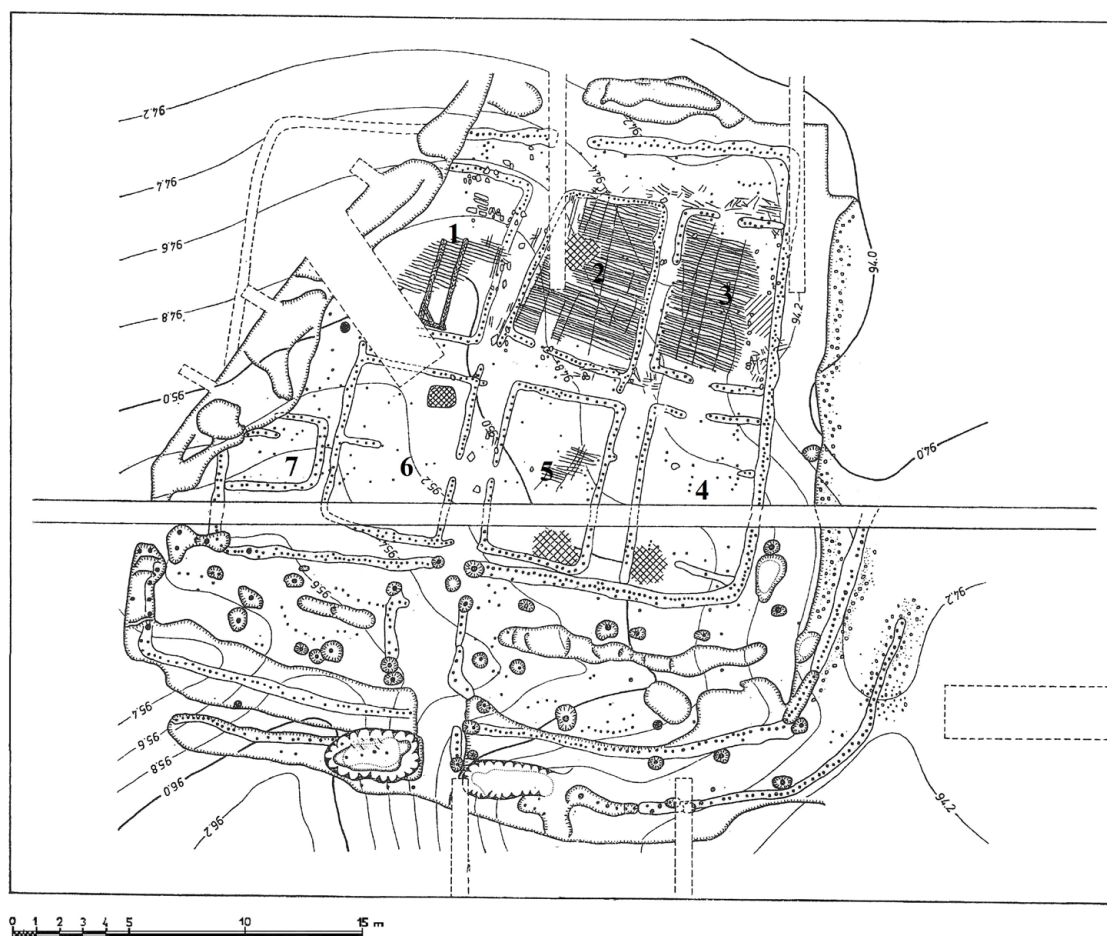


Fig. 17. Plan of Early Chalcolithic settlement *Ovcharovo I* (after Тодорова и др. 1983, Табло 13)
 Обр. 17. План на раннохалколитното селище *Овчарово I* (по Тодорова и др. 1983, Табло 13)

plan of the Chalcolithic dwellings. This can be demonstrated by the determination of the chronological dependencies in the number of rooms. For example, during the Early Chalcolithic age, constructions with more than 6 rooms do not occur. Nearly half of the dwellings from this period have one room (46,5 %). Approximately 1/4 have two rooms (26 %). Dwellings with 3 (15 %), 4 (9,4 %) or more rooms occur much more rarely (fig. 10b). Such buildings are House № 3 from *Ovcharovo VI* (fig. 11) and House № 9 from *Polyanitsa VIII* (fig. 12). It appears that, to a great extent, the situation remains the same in the following subperiods of the Copper age, except for the occurrence of the Middle and Late Chalcolithic constructions with more rooms (fig. 13). We can make interesting conclusions about the location of the entrances as well. During the Early Chalcolithic age greater part of dwellings have entrances facing South (41,7 %). This is logical and traditional taking into consideration that this position is sunlit the longest in the course of the day. Simultaneously, though, over 1/4 of the constructions' entrances face North (27,6 %), while those facing East (18,1 %) are less in number (fig. 14.). This changes during the Middle Chalcolithic age. The constructions with entrances facing South occur less frequently (31,1 %). Dwellings with entrances facing East equal those facing North. They take up 21,1 % as a whole (fig. 15). It is interesting that during the Late Chalcolithic age the preferred exposure of the entrances is East (26 %). Dwellings with entrances facing South decrease their share even more – up to 21,8 %.

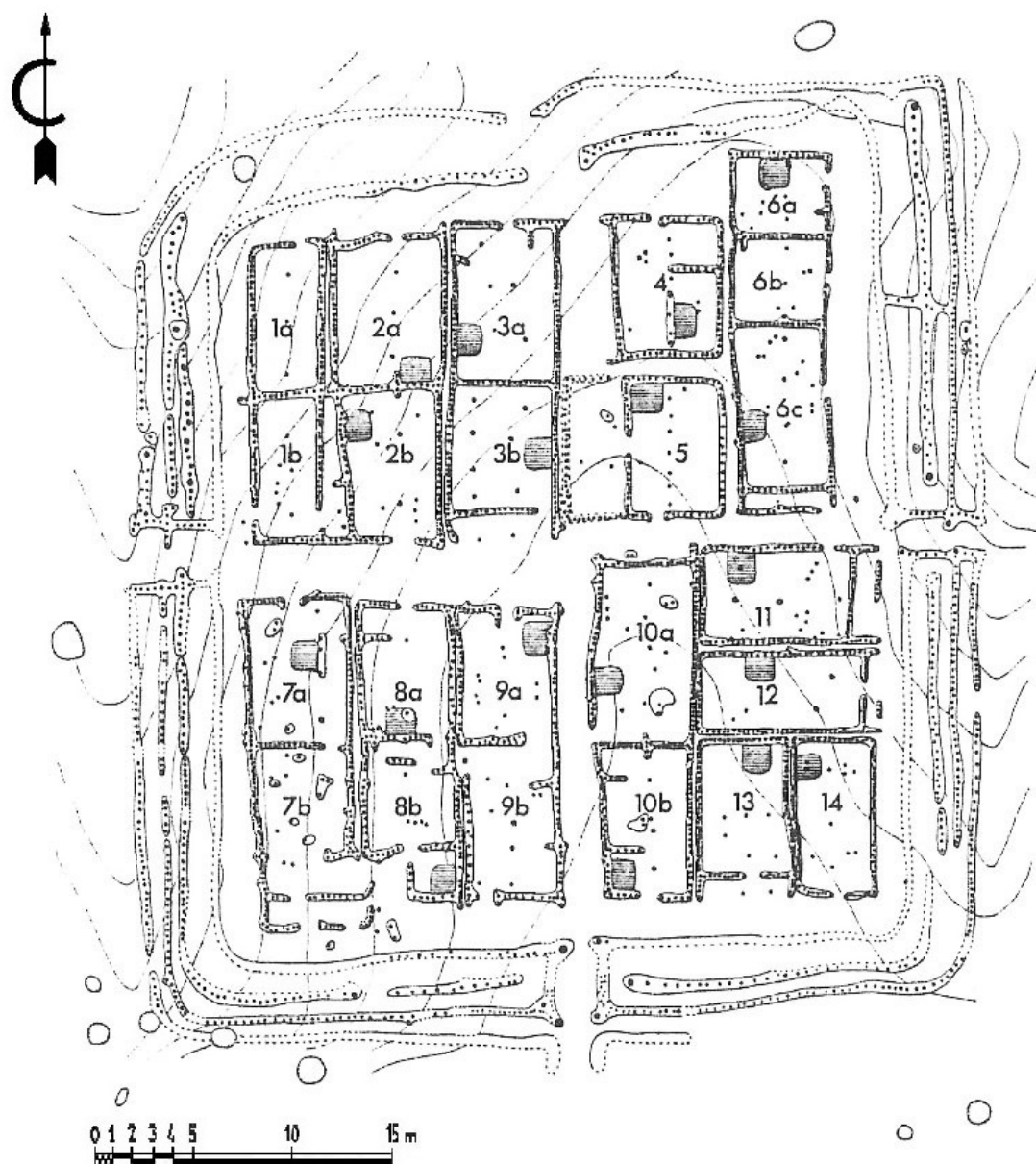


Fig. 18. Plan of Early Chalcolithic settlement Polyanitsa I (after Todorova 1982, 206, Abb. 159.)
Обр. 18. План на раннохалколитното селище Поляница I (по Todorova 1982, 206, Abb. 159.)

Dwellings with entrances facing West (17,6 %) grows in numbers, while those facing North are less prevalent (12,6 %) (fig. 16).

The statistical analysis of the inventory of the dwellings would provide very interesting results. They could help to a certain degree for the determination of the function of the dwellings or that of separate rooms (residential, storage, religious ones as well as workshops). It is necessary to include the exact number, type and location of the artifacts in the dwellings and the rooms. This data is rarely published, which requires the processing of the terrain information (diaries, charts, inventory books).

In this study I managed to demonstrate a small part of the possibilities of statistical methods and software. I represented the problems, limiting this type of research. Un-

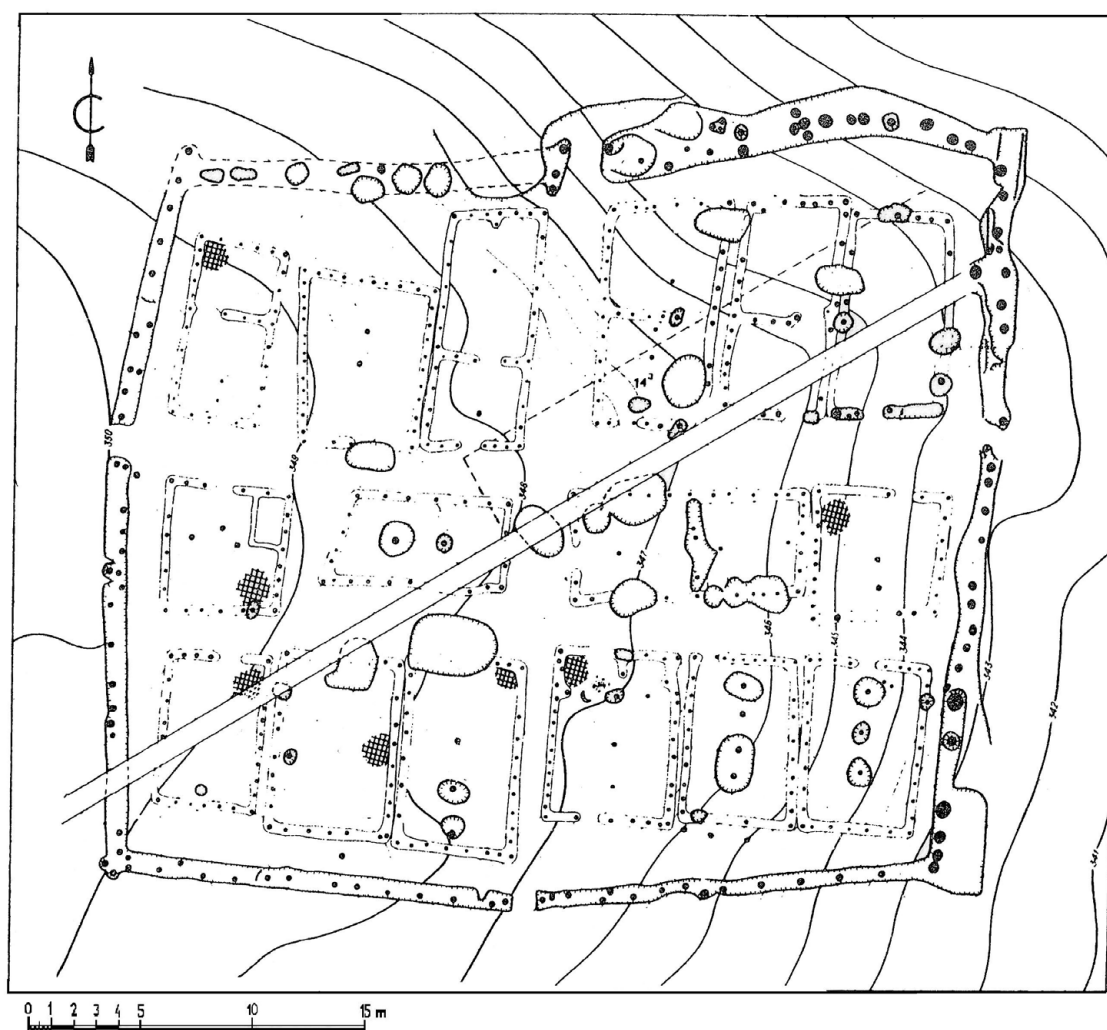


Fig. 19. Plan of Early Chalcolithic settlement Radingrad I (after Иванов 1984b, 83, Рис. 2)
 Обр. 19. План на раннохалколитното селище Радинград I (по Иванов 1984b, 83, Рис. 2)

doubtedly, statistical programs have a wide range of instruments. They contribute to draw maximum amount of information. This facilitates the making of substantial conclusions regarding the architecture of the dwellings. The possibilities for the visualization of the results make them especially useful for their presentation. The research is in its initial phase and significant historical conclusions are yet to be drawn. Nevertheless, at this point we can now draw the following conclusions. Obviously, the rectangular shape, the N-S exposure and the positioning of entrances facing south of the dwellings during the Early Chalcolithic age are largely due to the fact that they belong to the first horizons of a number of settlements (Ovcharovo I, Polyanitsa I, Radingrad I). Undoubtedly, the population enjoyed the benefits of being the first ones to inhabit this place. The area of the settlements is rationally used, as the dwellings, as well as the enclosures and streets are built according to a preconceived plan (figs. 17-19). The building up in later layers is not so strict. The dwellings do not have strictly regular shapes and their orientation is not so well observed. All of that is clearly evident from the settlement plans (figs. 12, 20). It is also visualized in quantitative terms by the graphs and tables, representing the statistical results.



Fig. 20. Plan of Late Chalcolithic settlement Polyanitsa VII (after Todorova 1982, 218, Abb. 171.)

Обр. 20. 20. План на къснохалколитното селище Поляница VII
(по Todorova 1982, 218, Abb. 171.)

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Проблеми и възможности на статистическия анализ в изследването на халколитната жилищна архитектура от Североизточна България

Антон Атанасов

(резюме)

Целта на настоящото проучване е да бъдат представени проблемите на статистическият анализ, както и възможностите които този метод предоставя за изследването на халколитната жилищна архитектура. Резултатите са предварителни и много вероятно е част от тях да претърпят корекции.

Статистическият анализ на жилищната архитектура изисква създаването на значителна по обем база данни, което пряко зависи от степента на проучване. Често при археологическите разкопки голяма част от жилищата остават непроучени или недопроучени. Публикуваната информация също е непълна, като липсват стратиграфски данни, описания, фото- и графична информация. В това отношение Североизточна България предоставя големи възможности. Районът е най-добре проученият за страната, като в него попадат редица изцяло разкопани селища и такива с изцяло проучени жилищни хоризонти (обр. 1.). За целта на изследването са анализирани общо 628 халколитни сгради, разкрити при разкопките им. Информацията е систематизирана в електронна база данни и е обработена чрез статистическа програма. Представени са само някои обобщени резултати. Маркирани са възможностите на статистическият метод и програми, като са дадени примери за приложението им.

Сред основните предимства на статистическият анализ са далеч по-лесното извличане на информацията. Бързо и лесно се забелязват съществени промени в изследваните показатели, характеризиращи халколитната жилищната архитектура в Североизточна България. Това е възможно благодарение на опциите за онагледяване на резултатите от тестовете, проведени със статистическата програма. Те са представени във вид на таблици и графики, което помага за лесното извличане и визуализиране на изводите. Това е видимо и лесно може да бъде демонстрирано чрез представянето на тестовите резултати, отнасящи се за ориентацията и външната форма на сградите (обр. 2). Предимство на статистическите програми се явява бързото и лесно сепариране (разграничаване) на информацията по периоди, фази, хоризонти, селища, площ и пр. Пример в това отношение са закономерностите, които наблюдаваме ако

разпределим различните по ориентация сгради по периоди (обр. 3, обр. 4 а), когато разделим сградите с различен план по периоди (обр. 4 б, обр. 5) или ако разграничим площта на сградите по периоди (обр. 9, обр. 10 а). Съществено предимство на статистическите методи е възможността да анализираме, а също и да комбинираме два или повече критерия едновременно. Например комбинирайки ориентацията и планът на халколитните жилища от Североизточна България, може да проследим развитието в позицията на най-широко разпространените през каменно-медната епоха правоъгълни постройки (обр. 6, обр. 7, обр. 8). Статистическият анализ и използването на статистически програми имат големи предимства и при изследването на вътрешния план и уредба на халколитните жилища. Това може да бъде демонстрирано чрез определянето на хронологическите зависимости в броя на помещенията през ранния (обр. 10 б), средния (обр. 13 а.) и късния халколит (обр. 13 б). По подобен начин може да проследим и разположението на входовете по периоди (обр. 14, обр. 15, обр. 16).

Изследването е в начална фаза като извличането на съществени исторически изводи предстои. На този етап е демонстрирана малка част от възможностите на статистическият анализ. Без съмнение статистическите програми притежават широка гама от инструменти. Те спомагат за извличането на максимална информация, позволяваща визуализирането на редица изводи относно халколитната жилищна архитектура.