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COMPARATIVE ANALYSIS OF POVERTY IN FAMILIES WITH A DISABLED CHILD AND FAMILIES WITH NON-DISABLED CHILDREN IN POLAND IN THE YEARS 2014 AND 2016

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ABSTRACT

The presence of a child with disabilities in a family presents more challenging conditions than the presence of a non-disabled child. One of the difficulties is of financial nature. One of the parents often has to give up their job to care for the child, which shrinks the household income. At the same time, the family has higher expenses resulting from, e.g. costs of treatment. All this increases the risk of falling into poverty. The goal of this paper is to analyse the financial situation of households with a disabled child, mainly in the context of poverty, and compare it to the financial situation of households with non-disabled children. The study is based on data from Polish Household Budget Survey, covering two years, 2014 and 2016. The study revealed that families with a disabled child are generally poorer than families with non-disabled children. The financial situation improved over the studied period in both types of families, but the improvement in the families with a disabled child was much greater. The main factor in reducing the risk of poverty in both types of families is the education attainment level of the reference person (the household head), which should be at least upper secondary.

Key words: households with a disabled child, factors related to poverty, Household Budget Survey, logistic regression.

1. Introduction

The issue of poverty is frequently addressed in economic, social and political discourses. In “Europe 2020: A strategy for smart, sustainable and inclusive growth”, one of the five headline targets determined for the European Union is combating poverty (European Commission, 2010, p. 3). Poverty is a dangerous phenomenon – both for the entire society, and for people categorised as the poor. Low-income households limit their consumption, both current and related to

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development and prevention. These limitations usually bring about changes in the behaviour and mentality, which may result in passivity, loss of self-esteem, alcohol abuse and other addictions, pathologies and aggression. All of this may, in turn, lead to reduced participation in various aspects of life, namely – to social exclusion.

A highly dangerous phenomenon is the intergenerational transmission of poverty (Bird, 2013; Harper, Marcus and Moore, 2003; Kruszyński and Warzywoda-Kruszyńska, 2011). From the perspective of the entire society poverty is associated with wastage of human capital, financial outlays for support and the growth of poverty enclaves (Golinowska, et al., 2008, pp. 60-61).

Poverty is related to failure to meet one's needs at the expected level due to too low an income (Panek, 2014, p. 196). This situation develops for a number of reasons. Among the predictors of poverty, the following are mentioned: the source of income of household head from unearned sources other than retirement; number of children in household; education attainment level of household head; voivodship; unemployed persons in household; persons with disabilities in household – especially when they are children with disabilities (Szarfenberg and Szewczyk, 2010, pp. 29-30; GUS, 2015a, pp. 10-11). The impact of some factors on emergence and persistence of poverty is ambiguous: at times it is hard to say whether a given factor is the cause or the effect of poverty (for example alcohol addiction – sometimes it can be the result of living below the poverty line, and sometimes it can be a reason for finding oneself in a group of the impoverished).

One of the factors increasing the risk of poverty is the presence of a disabled person in a household. In 2016, the incidence of extreme poverty (percentage of persons in households with expenditures below extreme poverty threshold set by the Institute of Labour and Social Studies) in households with at least one disabled person was 7.5%, whereas in a household without such members, the corresponding value was 4.2%. With regard to households where a child was the disabled person, the incidence of extreme poverty went further up, reaching 8.3% (GUS, 2017a, p. 4). Two years earlier, all three indicators were higher, amounting to 10.8%, 6.5%, and 14.6% respectively (GUS, 2015b, p. 4). A situation in which the incidence of extreme poverty is higher in households with at least one disabled child than in households with disabled adults had been the case in point for several years. But in 2017 the situation changed; the incidence of extreme poverty in households with at least one disabled person (regardless of age) was 6.7%, while in households with at least one disabled child (under 16) it was 4.9% (GUS, 2018, p. 4).

The analysis in this paper covers households where at least one person is 18 or under. The work aims to describe poverty from various perspectives since this issue is complex, ambiguous and diverse, both in the territorial and social sense. The analysis concerns the research conducted in 2016 and 2014. It is important to know that in 2016 the support programme "Family 500+" was introduced, which is likely to have reduced poverty in households with members under 18 years of age (see: GUS, 2017b, p. 12).

The statistical analysis was carried out using unit data from the Household Budget Survey (HBS) of 2014 and 2016. The sample covered in HBS in 2014 included 12,809 households with non-disabled children and 622 households with

at least one disabled child (in the vast majority of households it was only one such child). The sample used in HBS 2016 covered 12,172 and 635 households respectively. The households were studied as an entirety or taking into account their size and composition with the use of an equivalence scale. In the latter case, the so-called modified OECD equivalence scale was employed, as proposed by Haagenars, de Vos and Zaidi (1994, p. 18), which is currently used by Eurostat. See also Anyaegbu, (2010), and Łukasiewicz, Koszela and Orłowski (2006, pp. 207-217). The scale assigns the weight of 1 to the first person aged 14 or more, 0.5 to every subsequent person of the same age group, and 0.3 to children under 14.

The main contribution of this paper is the exploration of data from HBS, showing the potential of this survey, which allows the analysis of household finances broken down by the characteristics of individual members of the household such as age or having a disability. HBSs are conducted in all European Union Member States, and, although they are not harmonised, similar analyses can be performed in other countries and compared with the following results.

The second section of the article presents the general financial situation of the two groups of households under analysis. First of all, some objective metrics of the situation are considered, namely: source of income, levels of income and expenditure; then a subjective analysis of these households is performed, also in comparison with their actual financial situation. The following section includes typical elements of poverty analysis, namely the poverty thresholds, headcount rates, and depth of poverty, from the objective and subjective perspective. The final part addresses the differentiating factors for poor and non-poor households. In this analysis, classification trees and the logistic regression model were used.

2. General assessment of the income situation of households with children

The first aspect used in the comparison of the two groups of households is the main source of household income. Figure 1 presents frequency distributions in the form of a scatter plot. Thanks to this, any potential differences in distributions are more pronounced. The sources close to the diagonal of the square represent a similar share in both household groups under analysis. The sources above the diagonal are more frequent in households with disabled children, whereas the sources below the diagonal apply more frequently to households with non-disabled children.

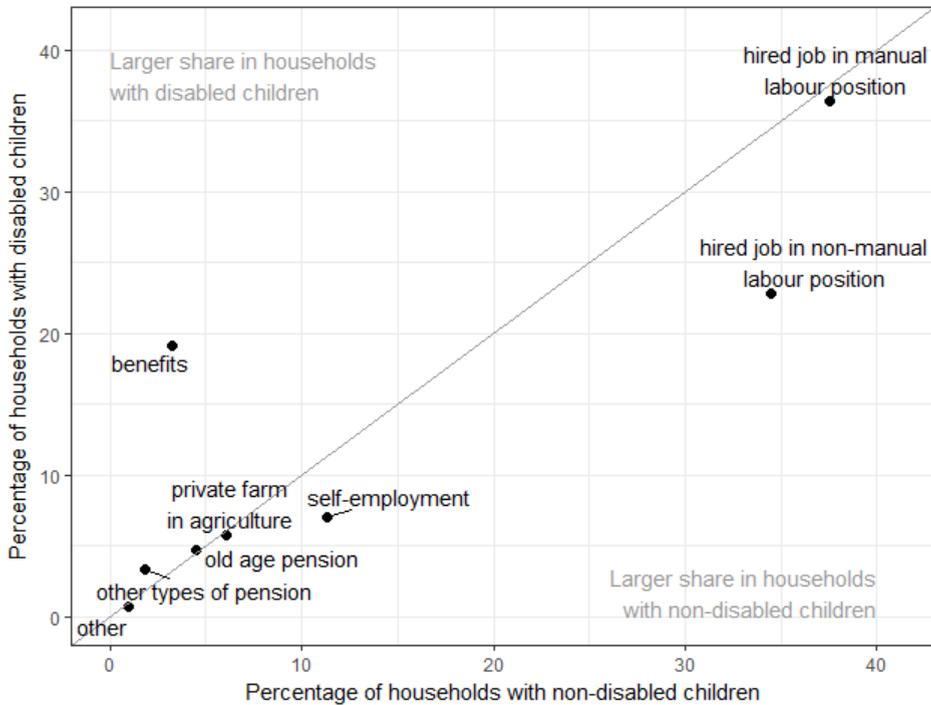


Figure 1. Distributions of main sources of income in 2016

Source: Own study based on unit data from HBS 2016.

The greatest difference in the distribution of income sources can be seen under the position *benefits*, which comprise *unemployment benefit* and *other social benefits*. The share of this source of income is 15.8 percentage point higher in households with disabled children. An even greater disproportion occurs when the main and additional sources of income are taken into account: 67.4% of households with disabled children indicated benefits as the main or additional source of income, with 25.0% of the same households with non-disabled children. In 2014, these percentages were 61.3% and 9.8%, respectively. Next, a smaller share of households with disabled children – as compared to households with non-disabled children – is supported by performing *hired job in non-manual labour position* (difference: 11.6 percentage points) and *self-employment* (difference: 4.3 percentage points).

Figure 2 presents the empirical distribution functions of disposable income and total expenditure calculated per equivalent unit. Only in the case of low levels of income (up to about PLN 1,800) the difference in distribution functions is not big, within the range of 1-2 percentage points. For the remaining values of income and for virtually the entire scope of expenditure variability, the values of distribution functions for households with disabled children are higher. This suggests a worse financial status of such households when compared to

households with non-disabled children. However, it is a noteworthy fact that two years earlier, in 2014, the distribution functions were even more divergent.

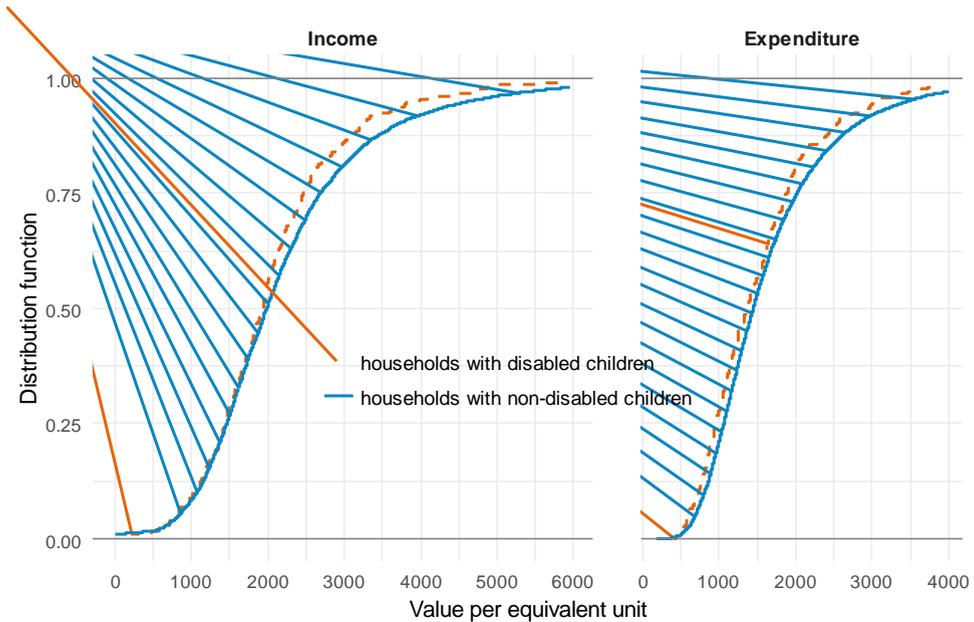


Figure 2. Empirical distribution functions of income and expenditure per equivalent unit in households in 2016

Source: Own study based on unit data from HBS 2016

An interesting question in HBS related to a subjective perception of financial status is the question about the income level in a household that the respondents would consider *very bad*, *unsatisfactory*, *barely satisfactory*, *good*, *very good*. Figure 3 illustrates the distribution of answers to this question using boxplots. An important point is that on the Y-axis a logarithmic scale is used due to the strong right-skewed distributions. On average, households with a disabled child had lower income expectations in all categories than households with non-disabled children. All three quartiles are lower in every income category. As compared to 2014, the values of income indicating a specific standard of living were higher in the case of both household groups. As an example, in 2016, the median of income indicated as *very bad* was PLN 750 in households with non-disabled children and PLN 667 in households with disabled children (as per equivalent unit). In 2014, however, the median was PLN 667 and PLN 588 respectively. The median of income indicated as *good* in 2016 in the first group of households was PLN 2174, and in the other group – PLN 2000. The 2014 results were PLN 1957 and PLN 1786 respectively.

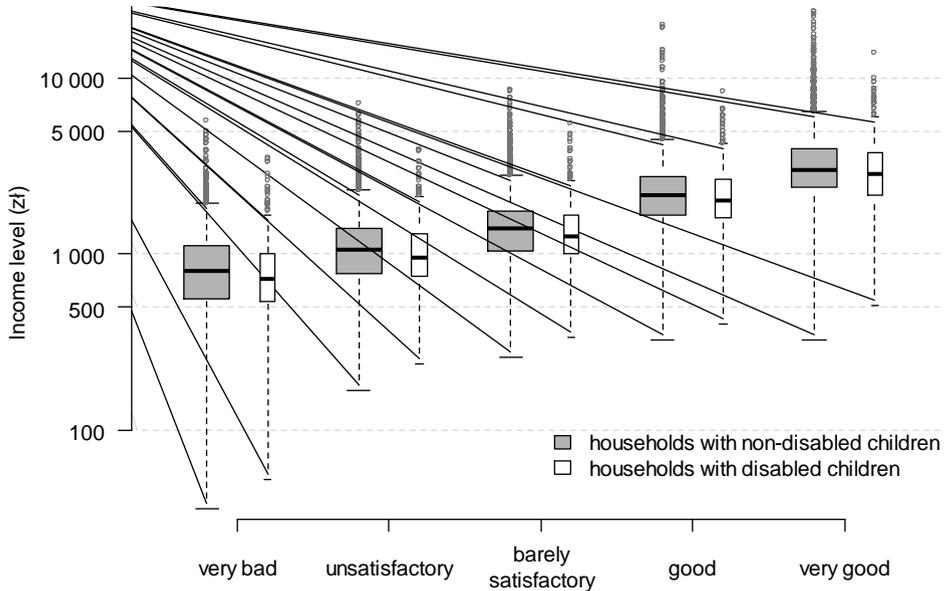


Figure 3. Distributions of answers to the questions about the income level that would mean a specific standard of living for a household

Source: Own study based on unit data from HBS 2016

The comparison above could suggest that respondents in households with a disabled child have on average lower expectations regarding the level of income. It is, however, a superficial pattern, since – as indicated above – households with disabled children are, generally speaking, poorer, whereas their expectations regarding the income level that would mean a specific standard of living are positively correlated with the actual financial status of a given household. To demonstrate this dependency, scatterplots are presented in Figure 4 for income levels indicating various standards of living and actual household expenditure, along with regression lines against the logarithms of both variables, separately for both types of households. The scatterplots and the slopes of the regression line confirm the positive correlation between the variables. Moreover, the regression line for households with disabled children virtually overlaps with the regression line of households with non-disabled children. (The differences in estimated regression coefficients and intercepts are not statistically significant. To show that this is the case, for each j -th standard of living, separate regression models were estimated: $\ln y_i^{(j)} = \beta_0 + \beta_1 \ln x_i + \beta_2 \text{gosp}_i + \beta_3 \ln x_i \cdot \text{gosp}_i + \varepsilon_i$, where $y_i^{(j)}$ is the value of income denoting the j -th standard of living, x_i is the actual household expenditure, gosp_i is the household type (0 – with non-disabled children, 1 – with disabled children). These models were estimated for both groups of households together, but thanks to the variable gosp_i and the interaction $\ln x_i \cdot \text{gosp}_i$, they can

be used to test the significance of differences in intercepts and regression coefficients between the models of the form: $\ln y_i^{(j)} = \alpha_0 + \alpha_1 \ln x_i + \varepsilon_i$, estimated separately for household groups, which are presented in Figure 4. The test for the significance of the difference in intercepts α_0 is the same as the significance test for coefficient β_2 , while the test for the significance of difference in the regression coefficients α_1 is the same as the significance test of the β_3 coefficient. The p-values for β_2 and β_3 coefficients, for each j level, are as follows: “very bad” (0.363, 0.365), “unsatisfactory” (0.197, 0.193), “barely satisfactory” (0.098, 0.091), “good” (0.357; 0.338), “very good” (0.372, 0.338). All p-values are greater than 0.05, so the regression line pairs in Figure 4 do not differ significantly from each other). It can be stated that if households with disabled children had higher income levels, their expectations regarding financial resources would also be higher.

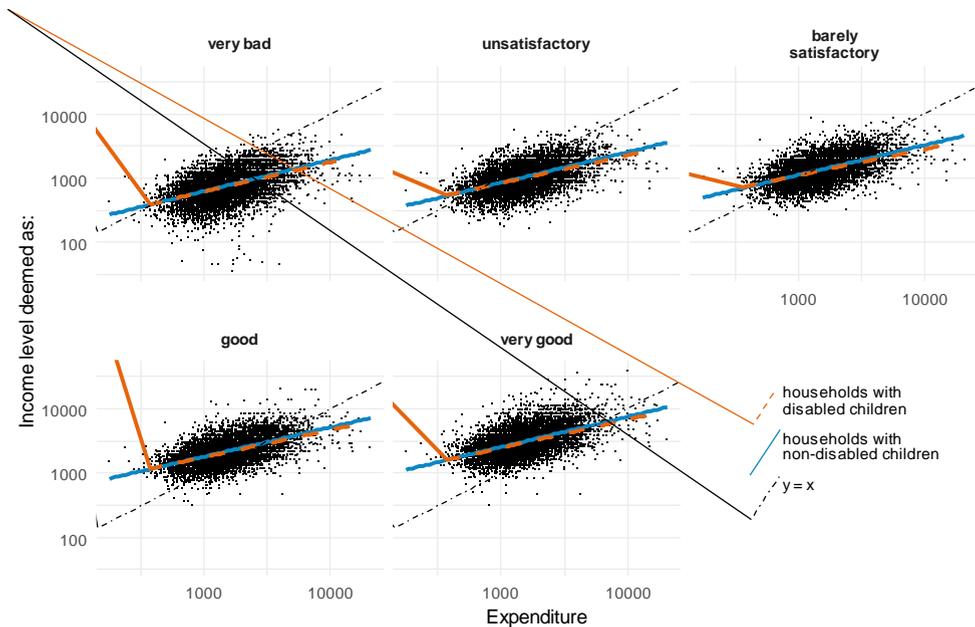


Figure 4. The relationships between income levels that would mean a specific standard of living for households and the actual financial situation of households measured with expenditure in 2016

Source: Own study based on unit data from HBS 2016

Another statement, validating the aforementioned conclusion, is the comparison of income levels indicating a certain standard of living for a household with an actual disposable income. Figure 5 shows the percentage of households the actual income of which was classified between the one considered by the respondents as indicating a certain standard of living in 2016 and 2014. For

example, in 2016 the percentage of households whose actual disposable income was between the level described as *good* and *very good* (by each household individually) was 28.5% for households with non-disabled children and 31.8% for households with disabled children. The highest percentage of households in the two groups and in the two periods had the disposable income which, according to their subjective criteria, was between the level of income described as *barely sufficient* and *good*.

On the basis of this figure, improvement in the subjectively viewed financial situation can be observed in both examined groups of households in 2016 as compared to 2014. Proportions of households with actual income higher than the income subjectively viewed as *good* and *very good* increased, while portions of households with income lower than *good* decreased (an exception to this rule is the group of households with disabled children with the income lower than the income subjectively described as *very bad*, but the difference is small). It must be emphasised that such subjective improvement was greater among households with disabled children.

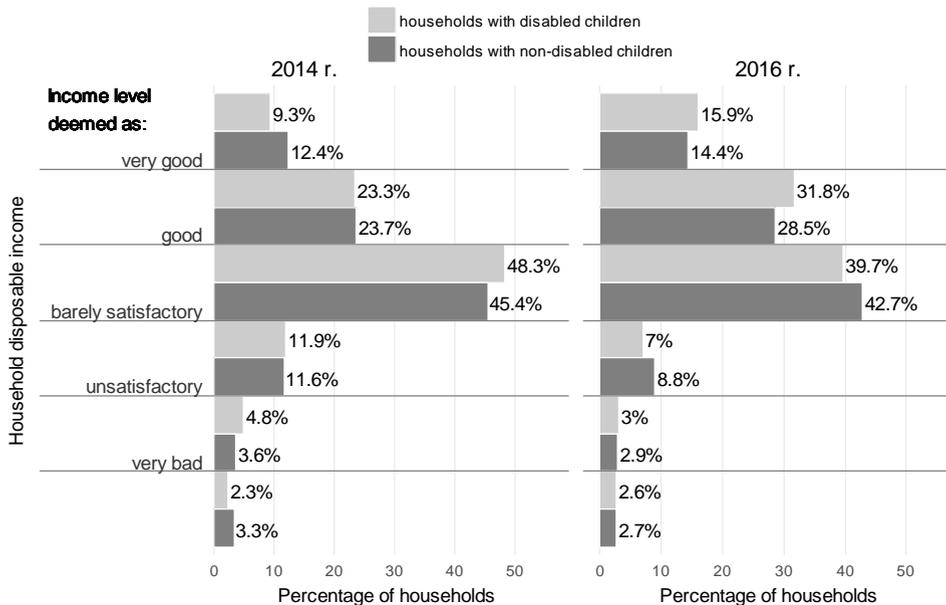


Figure 5. Distribution of disposable income classified by subjective income level for different standards of living in 2014 and 2016

Source: Own study based on unit data from HBS 2014 and 2016.

Figure 5 can also help determine the incidence of subjective poverty by showing a percentage of households with a disposable income below the individually set threshold. The threshold can be the *very bad*, *insufficient* or *barely sufficient* level. In the first case, it can be viewed as subjective extreme poverty.

For both household groups, this rate fluctuated between 2-3%. If the *barely sufficient* level is taken as the poverty threshold, then in 2014, 18.5% of households with non-disabled children and 19% of households with disabled children were subjectively impoverished, while in 2016 – it was 14.4% and 12.6% respectively (the incidence of poverty, i.e. headcount rates, is discussed in more detail in the next section).

Another element of the subjective evaluation of a household's income situation is requesting a respondent to provide an expression which best characterises the way of managing money in his/her household. Table 1 presents the distribution of answers to that question. In both groups, the income situation in 2016 was better when compared to 2014 – the percentage of answers *we have to live economically everyday* (which may be understood as living in privation) and *we have not enough even for basic needs* (which may be understood as living in poverty) decreased. It must be emphasised that similarly to the distributions shown in Figure 5 in the group of households with disabled children, the improvement was greater. The percentage of responses indicating poverty dropped by 3.9 percentage points (in the group with non-disabled children by 1.1 percentage points), while the percentage of responses indicating privation dropped by 15.7 percentage points (in the group with non-disabled children by 7.3 percentage points). In both years the disproportions between the groups were noticeable. More households with disabled children are in a worse financial situation. In 2016, 26.9% of households with disabled children (8.7 percentage points more than in the case of households with non-disabled children) had to live economically every day.

Table 1. Subjective evaluation of money management in households

Statement	Households with children			
	non-disabled		disabled	
	2014	2016	2014	2016
	<i>In %</i>			
<i>we can afford some luxury</i>	1.5	2.0	0.6	1.4
<i>we have enough without special saving</i>	11.7	15.2	5.0	9.1
<i>we have enough for everyday living, but we have to save for greater purchases</i>	59.1	63.7	45.2	59.9
<i>we have to live economically everyday</i>	25.5	18.2	42.6	26.9
<i>we have not enough even for basic needs</i>	2.1	1.0	6.6	2.7

Source: Own calculation based on unit data from HBS 2014 and 2016.

When analysing the phenomenon of poverty, it is worth to have a closer look at income inequality. In the case of households with disabled child and households with non-disabled children the Gini coefficient (based on income per person) was on a similar level, i.e. in 2016 it was 0.28 and 0.30 respectively

(the Gini coefficient based on income per equivalent unit was 0.27 and 0.30 respectively), which stands for a relatively low dispersion of income in the two types of households under study. It should be emphasised that in the case of the two types of households in question, income inequality decreased in 2016 in comparison with 2014 (when it was 0.34 and 0.33 respectively).

Another measure also related to poverty is the ratio of two extreme deciles (also quintiles). In 2016, the decile ratio for households with a disabled child was 3.31 (in 2014, 4.24). In the case of households with non-disabled children, the decile ratio was higher, namely 3.63 in 2016, and 4.38 in 2014. It is clear that income dispersion measured with a ratio of extreme deciles is significantly lower between the measured periods in the case of the two household groups.

3. Measures of poverty

In the research on poverty, no general definition of poverty has been established. Consequently, determining who is poor in the examined population is not that easy (Cowell, 2011; Thon, 1979). Therefore, the analysis of poverty must be multifaceted. Generally, a household can be classified as poor when its income or expenditure level is lower than the established threshold (Lisicka, 2013; Panek, 2014, p. 204; Szarfenberg and Szewczyk, 2010, pp. 29-30). In this study five different types of threshold were used, which could be divided into two groups, objective and subjective. In the objective approach, legal and two relative lines were used, while in the subjective approach – the Leyden method and the subjective poverty line were used (Panek, 2011, pp. 35-38).

In general, household expenditure is a better measure of wealth than income (Klugman, 2002, p. 30), therefore expenditure was used in the case of objective thresholds. But in the case of the subjective approach income was used since the question concerning the subjective evaluations refers directly to income.

The legal line is set in order to apply for a benefit from the social service system. It is determined separately for households with a different number of people (irrespective of their age). The relative line most often equals 60% of the median (used by Eurostat) or 50% of the mean (used by Central Statistical Office in Poland). It allows one to identify the poor who are far from the average level of expenditure realised in a given society.

The Leyden method uses answers to the question about the level of household income which the respondents would consider *very bad*, *unsatisfactory*, *barely satisfactory*, *good*, *very good* (see the previous section). The obtained answers are used to estimate the so-called individual income wealth (utility) functions, which have a form of a distribution function (here log-normal distribution). The poverty line (individual for each household) is set to such level of income for which the utility function takes a certain low, arbitrary chosen value δ (value of the distribution function). In the conducted analysis three values were adopted: 0.3, 0.4 and 0.5.

In order to determine the subjective poverty line, an answer to the question about the income essential to “make ends meet” is used. In the HBS there is no such question, but the same question as in Leyden method can be used, taking into account only the *barely satisfactory* variant, since it has the closest meaning to “making ends meet”.

Table 2. Poverty lines in 2016 (annual average values)

Type of poverty line	2-person household (1 adult + 1 child up to 14 years of age)	4-person household (2 adults + 2 children up to 14 years of age)
<i>In PLN</i>		
legal	1 028.00	2 056.00
<i>Based on expenditure</i>		
60% of median	1 157.86	1 870.39
50% of mean	1 131.82	1 828.33
<i>Based on income</i>		
Leyden ($\delta = 0.3$)	1 261.27	1 482.36
Leyden ($\delta = 0.4$)	1 640.96	1 928.61
Leyden ($\delta = 0.5$)	2 098.56	2 466.43
Subjective poverty line	1 755.76	2 082.19

Source: GUS, 2017, p. 11; Own calculation based on unit data from HBS 2016.

All the line values in Table 2, except for the legal line which remained the same throughout the year, are averaged for the whole year, while subjective limits are additionally averaged for all households. The lines were stated individually for households comprising one adult and one child (e.g. a single parent who raises the child on his or her own) and households comprising two adults and two children (e.g. a married couple with two children). The values were provided for information purposes only as they were not directly used, except for the legal limit, to calculate the headcount rates. The headcount rate (often referred to as “at risk of poverty rate”), i.e. the percentage of persons in households considered to be impoverished, for the relative values was calculated with respect to the lines calculated individually for each quarter (and in comparison with expenditure), while for subjective values – with respect to the lines set individually for each household (and in comparison with income). Naturally, objective lines are the same for households with the same composition, regardless of the presence of a child with a disability.

As for the legal and relative lines, the headcount rate in households with disabled children is much higher than in households with non-disabled children (Table 3). Bigger differences can be observed in 2014: for instance, the difference in the case of relative lines was approx. 10 pp., while in 2016 – 4.6 pp. for the 50%-mean line and 5.7 pp for the 60%-median line. As far as subjective lines are concerned, the situation is different. Here, the headcount index was nearly the same for the two groups of households under consideration. One exception is the values for 2016 calculated with the use of the Leyden line of $\delta = 0.5$, and the subjective poverty line where the percentage of poor households among households with disabled children is lower than the same percentage in the households with non-disabled children. One should emphasise that over the span of the two years in question, the range of poverty decreased, regardless of the definition of impoverished households.

Table 3. Headcount rates in households with disabled children and non-disabled children in 2014 and 2016 (in %)

Households with children	Type of poverty line						
	legal	50% of mean	60% of median	Leyden ($\delta = 0.3$)	Leyden ($\delta = 0.4$)	Leyden ($\delta = 0.5$)	subj. poverty line
<i>2014</i>							
non- disabled	17.5	16.5	17.3	8.3	14.5	24.2	18.5
disabled	30.0	26.5	27.3	8.1	14.8	23.5	19.0
<i>2016</i>							
non- disabled	17.4	12.8	14.0	6.4	10.9	18.3	14.4
disabled	25.7	17.4	19.7	6.2	10.3	16.3	12.6

Source: own calculation based on unit data from HBS 2014 and 2016.

Another measure of poverty is its depth, i.e. the poverty gap index. The depth calculated with respect to the relative poverty line (50% of mean expenditure) was at the similar level in the case of the two household groups in 2014 and amounted to 20.6 for households with non-disabled children, and 20.2 for households with disabled children. This means that the average expenditure of impoverished households was by approximately 20% lower than the poverty level calculated as 50% of mean expenditure for all households. In 2016, the depth of poverty in the case of households with a disabled child remained at the same level and amounted to 20.2, while in the case of households with non-disabled children it decreased to the level of 18.9.

4. Factors related to poverty

In the next step of the analysis, the aim was to check if and in what terms impoverished households differ from non-impoverished households and whether such differences are the same in households with non-disabled children and in households with disabled children. To this end, classification trees and the model of logistic regression were employed. The dependent variable in both cases was a dummy variable defined as follows:

$$Y = \begin{cases} 1 & \text{for poor households} \\ 0 & \text{for non - poor households} \end{cases}$$

A household was deemed impoverished if its expenditure per equivalent unit was lower than the relative poverty line understood as 50% of mean expenditure.

The following nine features of a household which were deemed most important in the context of the phenomenon under analysis and which could be obtained from HBS were selected as explanatory variables:

- number of children (18 or under),
- number of unemployed,
- number of adults,

- age of youngest child,
- education of household head (reference person),
- main source of household income,
- urbanisation degree (class of place of residence),
- voivodship,
- disabled parent (is one of the parents disabled?).

First, the exploratory technique of data analysis was used, i.e. classification trees. Binary trees were used; information gain was used as the criterion for split (see Gatnar, 2001, pp. 33-34); the division was stopped either at the maximum depth of the tree (which was set to 4) or the minimum leaf size (which was set to 1% of the number of units). The classification trees obtained in this way are presented in Figure 6 and Figure 7, separately for the set of households with non-disabled and disabled children. In the figures, the branch widths are proportional to the number of units in sub-sets. The nodes contain information about the variable used in the division and its variants, or a split point; below one can find information about the portion of impoverished households in a node (in the rectangle the shadowing intensity of which depends on the level of the fraction), while at the bottom, information about the number of units in a node (as a percentage of the whole set). Units which satisfy the condition of a node division are sent to the left side, the remaining ones – to the right side. The division is arranged in a way that a group with a smaller fraction of poor households goes to the left.

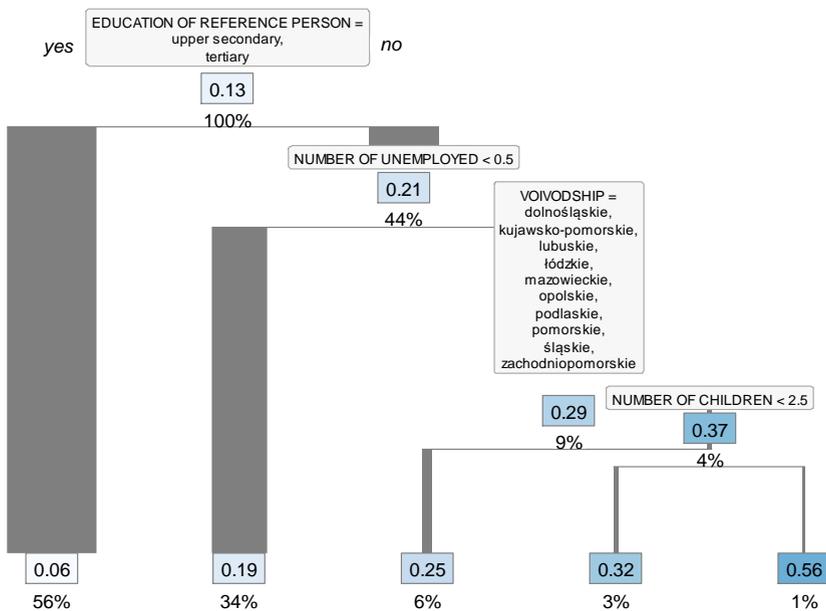


Figure 6. Classification tree of belonging to impoverished households, for households with non-disabled children in 2016

Source: Own study based on unit data from HBS 2016.

In the case of both trees, the first variable used for the division, i.e. the most discriminating variable, turned out to be the *reference person's education*. For households with non-disabled children, upper secondary or tertiary education determined whether the household belonged to the group with the smallest portion of poor households. For households with disabled children, only tertiary education ensured such a division. What is important is that the households in which the reference person had tertiary (or upper secondary in the case of households with non-disabled children) education are not divided further on, so they are relatively homogenous groups, with a low headcount rate.

Households in which the reference person's education is lower, were further divided according to the variable *number of unemployed* in a household. In households with at least one unemployed person, the place of residence became important (*voivodship*), and subsequently – *number of children* (more than 2 children in this node significantly increased chances for poverty). In the case of households with disabled children, where the reference person had no tertiary education, what mattered first was the place of residence (*voivodship*), while secondly – the presence of unemployed (more than one). In the node on the lowest level, chances for finding oneself in a group of poor households increase significantly if the *main source of income* are types of pension other than old-age pension.

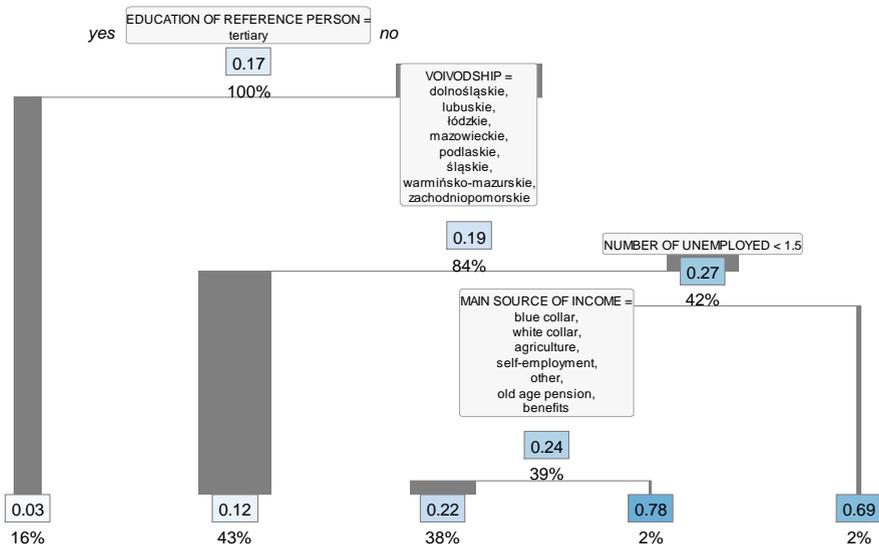


Figure 7. Classification tree of belonging to impoverished households, for households with disabled children in 2016

Source: Own study based on unit data from HBS 2016.

In general, classification trees for households with non-disabled and disabled children are similar. In both cases, only four variables were used for the division, of which three variables were the same, although the way they split the data and the level at which they were used differed slightly. Nevertheless, the general rules are the same – a larger percentage of poor households is associated with a lower level of education, unemployment of at least one member of the household, and a place of residence in the south-eastern voivodships.

A different method of verifying which factors affect the probability of finding oneself in a group of impoverished households is a logistic regression (Fahrmeir, et al., 2013). Just as in the case of classification trees, models were estimated separately for households with non-disabled and disabled children, with the same set of variables. Once the full model was estimated, a stepwise elimination of insignificant variables was applied according to AIC criterion. The basic results of the models are presented in Table 4.

Table 4. Odds ratios for changes in the value of explanatory variables in the logistic regression models for the probability of belonging to the group of poor households in 2016 (values in bold indicate statistically significant variables at the level of 0.05)

	Odds ratio	
	households with non-disabled children	households with disabled children
Variable: d= value of change or Variable: option under study – reference option		
Number of children: d= 1	1.17	x
Number of unemployed: d= 1	1.55	1.82
Number of adults: d= 1	1.29	1.27
Age of youngest child: d= 10	1.39	x
Reference person's education: lower secondary and lower – upper secondary	2.44	2.28
Reference person's education: basic vocational - upper secondary	1.80	1.05
Reference person's education: tertiary - upper secondary	0.38	0.21
Main source of income: white-collar wage work - blue-collar wage work	0.72	x
Main source of income: use of private farm in agricultural - blue-collar wage work	1.19	x
Main source of income: self-employment – blue-collar wage work	0.64	x
Main source of income: other - blue-collar wage work	2.33	x
Main source of income: old age pension - blue-collar wage work	0.89	x
Main source of income: other types of pension - blue-collar wage work	1.57	x
Main source of income: benefits - blue-collar wage work	2.11	x
Urbanisation degree: densely populated area – medium populated area	0.93	1.04

Urbanisation degree: <i>sparsely populated area - medium populated area</i>	1.30	1.77
Voivodship: <i>dolnośląskie - pomorskie</i>	0.97	x
Voivodship: <i>kujawsko-pomorskie - pomorskie</i>	1.12	x
Voivodship: <i>lubelskie - pomorskie</i>	1.39	x
Voivodship: <i>lubuskie - pomorskie</i>	0.76	x
Voivodship: <i>łódzkie – pomorskie</i>	0.77	x
Voivodship: <i>małopolskie - pomorskie</i>	1.66	x
Voivodship: <i>mazowieckie - pomorskie</i>	1.02	x
Voivodship: <i>opolskie - pomorskie</i>	0.68	x
Voivodship: <i>podkarpackie - pomorskie</i>	1.52	x
Voivodship: <i>podlaskie - pomorskie</i>	1.25	x
Voivodship: <i>śląskie – pomorskie</i>	1.14	x
Voivodship: <i>świętokrzyskie - pomorskie</i>	1.74	x
Voivodship: <i>warmińsko-mazurskie - pomorskie</i>	1.86	x
Voivodship: <i>wielkopolskie - pomorskie</i>	1.60	x
Voivodship: <i>zachodniopomorskie - pomorskie</i>	0.95	x
Disabled parent: <i>yes – no</i>	x	1.88

Source: Own calculation based on unit data from HBS 2016.

In the case of the model for households with non-disabled children, all variables, except for *disabled parent*, were preserved, which to a large extent results from the large sample size. On the other hand, in the model for households with disabled children, only five variables were preserved, which partially results from the small sample size. Quality measures (Table 5) show that both models are moderately fitted to the data. It should be emphasised, however, that the objective of models under assessment, both logistic regression and classification trees, was not developing a predictive tool, but finding out if any relationships exist between the variables under analysis.

Table 5. Quality measures of logistic regression models

	Households with non-disabled children	Households with disabled children
Area under the ROC curve	0.77	0.73
Sommers' D_{xy}	0.54	0.47
Nagelkerke R^2	0.18	0.16
Likelihood ratio test	$\chi^2_{v=31} = 1154.7$ $p < 0.0001$	$\chi^2_{v=8} = 59.1$ $p < 0.0001$

Source: Own calculation based on unit data from HBS 2016.

The interpretation of outcomes in Table 4 is as follows: in the first column there is the name of a variable, followed by a colon, then, for numerical variables, the value of change denoted by the letter d , or, for categorical variables, the value for a given odds ratio followed by the reference value for this variable. And the odds ratio is the ratio of the odds of being poor when explanatory variable is greater by d (in the case of numerical variables) or equals specific value (in the case of categorical variable), and the odds of being poor when explanatory variable is not changed (in the case of numerical variables) or equals the reference value (in the case of categorical variable). For example: the odds ratio for *number of unemployed* for households with non-disabled children is 1.55 (for $d=1$), which means that increasing the number of unemployed persons by 1 lengthens the odds of being poor by 55%. Another example: the odds ratio for *reference person's education* for households with disabled children (for *lower secondary and lower – upper secondary*) is 2.28, which means that the odds of being poor when the education attainment level is *lower secondary and lower* is by 128% greater compared to *upper secondary* level.

When one compares the odds ratios for statistically significant variables in both models, it can be seen that the direction of impact for specific variants is always the same, but its strength is somewhat different. In the case of the two household groups, tertiary education markedly reduces the odds of becoming poor; however, in households with disabled children, this effect is more pronounced. Lower secondary and lower education, as well as basic vocational education, markedly increase the chances of falling into poverty, but this effect is weaker in households with disabled children. The presence of an unemployed person in a household has a stronger negative impact in families with disabled children.

As an additional element of the assessment of impact of specific explanatory variables on the response variable, the Wald statistics was calculated (Harrell, 2015, p. 191, 194) to test the significance of variables (the statistics have asymptotic chi-squared distribution) and a ranking of predictor importance was created, which is presented in Figure 7. In both models, as in the case of classification trees, the variable having the strongest impact on the chance of belonging to the poor is the *reference person's education*. In the case of households with non-disabled children, the *main source of income* and *voivodship* ranked second and third, whereas in the model for households with disabled children they did not occur at all, as they were removed at the stepwise elimination stage. The second most important variable in the group of households with disabled children turned out to be the *number of unemployed*. Variables that do not affect the chances of finding oneself in a group of impoverished or whose effect is relatively small in both groups of households, are: *age of youngest child*, *urbanisation degree*, *number of children* and *disabled parent*.

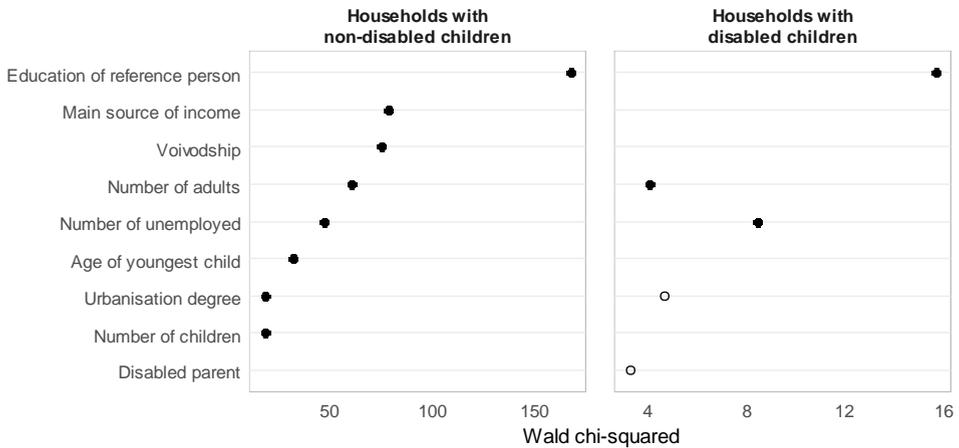


Figure 7. Ranking of predictors in logistic regression models – based on the Wald χ^2 (filled point means a statistically significant variable at the significance level of 0.05, unfilled – significant at the level of 0.1)

Source: Own study based on unit data from HBS 2016.

The above analysis was also conducted for the data from 2014. As far as the classification trees are concerned, for households with non-disabled children the division was very similar to the one presented above for the 2016 data. In the case of households with disabled children, however, the division was very different. The strongest discriminating variable was the *number of unemployed*, followed by the *reference person's education* for the subset of households without the unemployed. Apart from that, the tree was more extensive with 11 leaf nodes compared to five leaf nodes in 2016. Additionally, eight variables were used, and the final subsets were more homogenous.

Both models of logistic regression from the period of two years earlier were similar in general. The differences that could be observed in both types of households included: a stronger negative effect (i.e. greater chance for poverty) of *number of children*, *number of unemployed* and living in a sparsely populated area. The decrease of the negative impact of those variables in 2016 can be a result of better economic prosperity (lower unemployment rate) and the introduction of the “Family 500+” programme in mid-2016 (thus, the smaller impact of a large number of children on poverty). In a sense, the consequence of these changes is the fact that both regression models in 2016 were fitted to the data worse than in 2014, so it is now more difficult to determine typical characteristics of the poor households on the basis of available data.

5. Conclusions

Based on the analysis, it can be stated that households with a disabled child were in a worse financial situation when compared to households with non-disabled children – both in 2014 and in 2016. Households with a disabled child tend to rely to a greater extent on all sorts of benefits, and so they are more vulnerable to changes in state policies in this area. The 2016 introduction of the “Family 500+” support programme is likely to have been one of the factors that contributed to poverty reduction in both groups under analysis; however a more pronounced improvement can be noticed in households with a disabled child, which led to the reduction of the disproportion in financial situations reported by the two household types.

The factor that discriminates the most between poor and non-poor households, especially in households with a disabled child, was the education attainment level of the household head. In households where the person with the highest income was a university graduate, the percentage share of the poor was the lowest. Furthermore, worse financial condition are linked to unemployment of at least one family member and the fact of residing in the south-eastern voivodships of Poland.

Households with non-disabled children located in less densely populated areas were exposed to a greater risk of poverty as compared to households from more populous areas. However, the impact of this variable is moderate. In the case of households with a disabled child, the impact of the size of their place of residence is even weaker.

An interesting observation is the impact of the number of children on the risk of falling into poverty. It is quite common to associate multi-child families with financial hardship. Although in 2014 the number of children was a fairly important factor contributing to the risk of poverty, in 2016 the impact of this variable was far weaker. What might have brought about this change is the aforementioned “Family 500+” programme, but a different explanation could be the fairly strong impact of the variable *number of adults*. The analysis is based on the assumption that a child is a person aged 18 or under, while all the other household members are treated as adults. In the next stage of the analysis it would be of interest to check whether the “adult children”, persons over 18 still living in the household with their parents, are a factor increasing the risk of poverty.

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