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# **Differences in avoidable mortality according to education attainment: situation in the Czech Republic**

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# Introduction

- **The Czech Republic is typical for its large differences in survival according to education attainment.**
- **Important differences in mortality according to education have been observed in spite of low social differentiation in former socialist societies and universal access to free health services.**
- **It is assumed that education attainment could be used as a proxy variable for the life style, socio-economic status or type of work.**
- **Because data about the socio-economic status in connection to mortality are not available in the Czech Republic, as well as in many other countries, the education attainment is used.**

# Outline

- Long term trends in mortality (Czech Republic, Hungary, France) and current European survival by education (International view).
- Productive (30-64) and post-productive (65+) age of mortality differentiation in the Czech Republic 2001-2005 (National view).
  - Do mortality inequalities remain larger at younger age?
  - How do mortality risks by education differ between males and females?
  - What causes of death impact mortality differentials the most ?
- Avoidable mortality in the Czech Republic
  - Data and Methods (descriptive, multivariate)
  - All cause mortality differentials
  - Amenable, preventable, and non-avoidable mortality analysis
- Conclusions



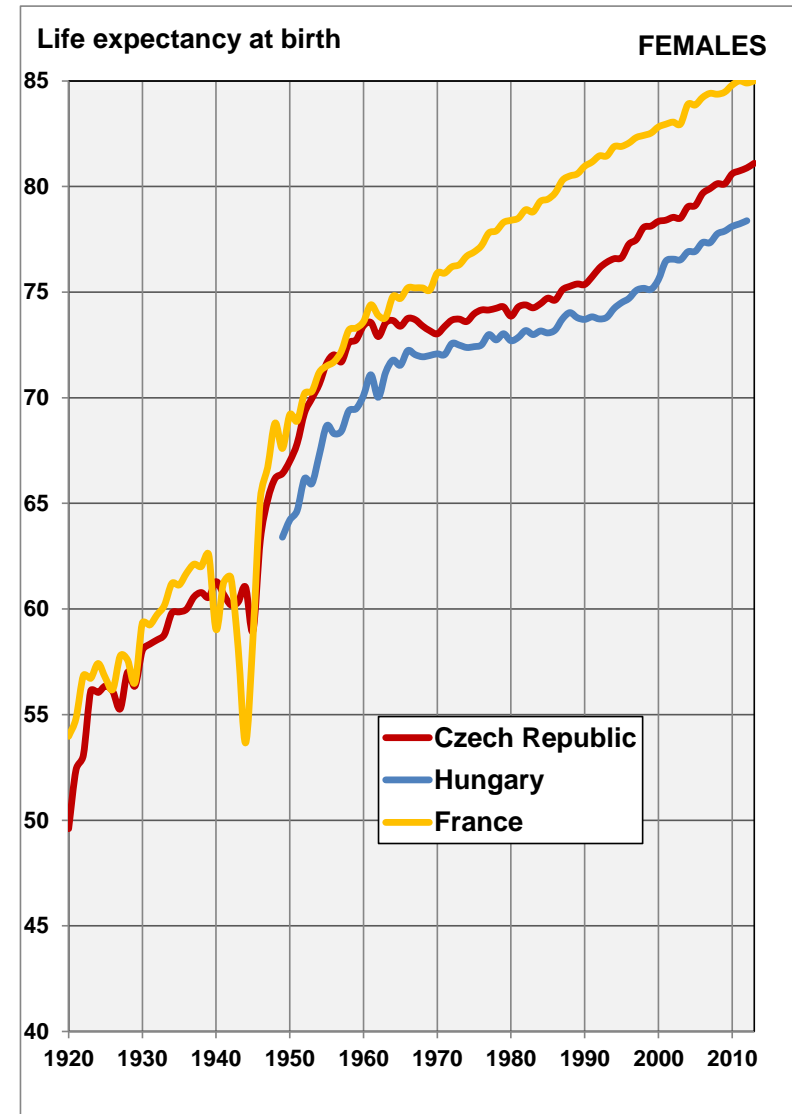
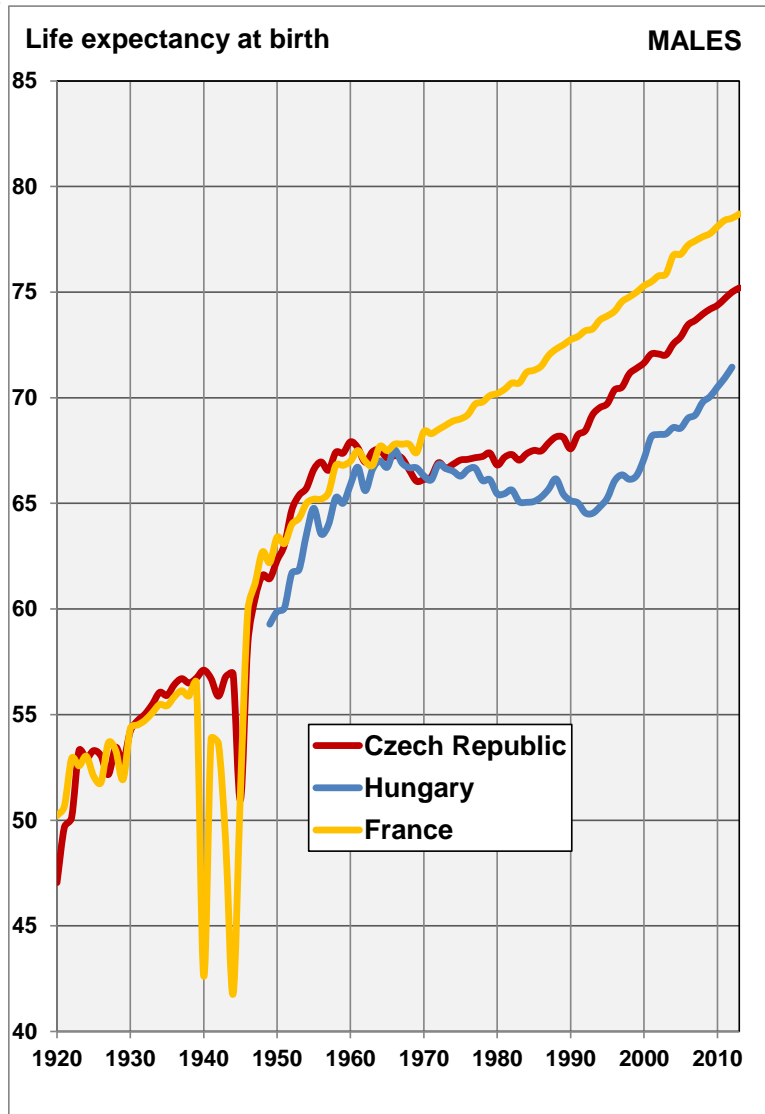
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# International perspective





# Long term trends of life expectancy at birth in the Czech Republic, Hungary, and France



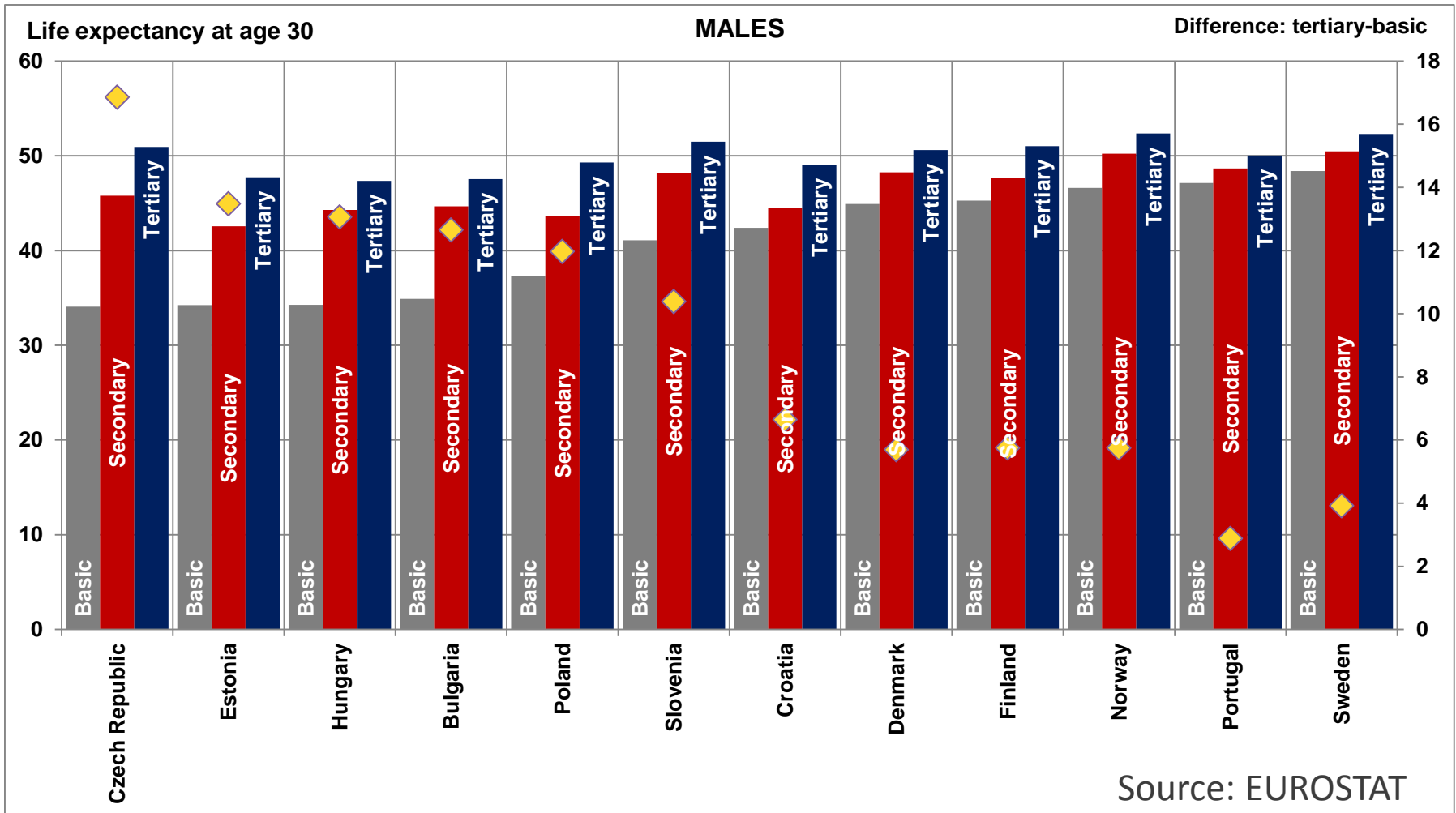
## Factors behind long term mortality trends

- From the beginning of the 20<sup>th</sup> century and into the interwar period, the mean length of life increased, and male and female survival in the Czech Republic was close to the levels observed in the Western Europe (represented here by France).
- During the post-war period (the 1950s), life expectancy at birth increased rapidly in the Czech Republic. This significant decline in Czech mortality was due to a quick development of a health care system that covered the entire population with basic but comprehensive health services.
- From the mid-1960s to the mid-1980s, the gap in life expectancy between the Czech Republic (Hungary or other former socialist countries) and „western“ developed countries began to widen due to an “epidemic” of heart diseases.
- Health conditions slightly improved in the Czech Republic in the end of the 1980s. However, the delay of the Czech Republic in the reduction of mortality rate compared to the „West“ did not diminish. Life expectancy at birth followed almost a parallel trend with the „Western“ countries.

Basic=Pre-primary, primary and lower secondary education (ISCED levels 0-2)  
 Secondary=Upper secondary and post-secondary non-tertiary education (levels 3 and 4)  
 Tertiary=First and second stage of tertiary education (levels 5 and 6)

## MALES

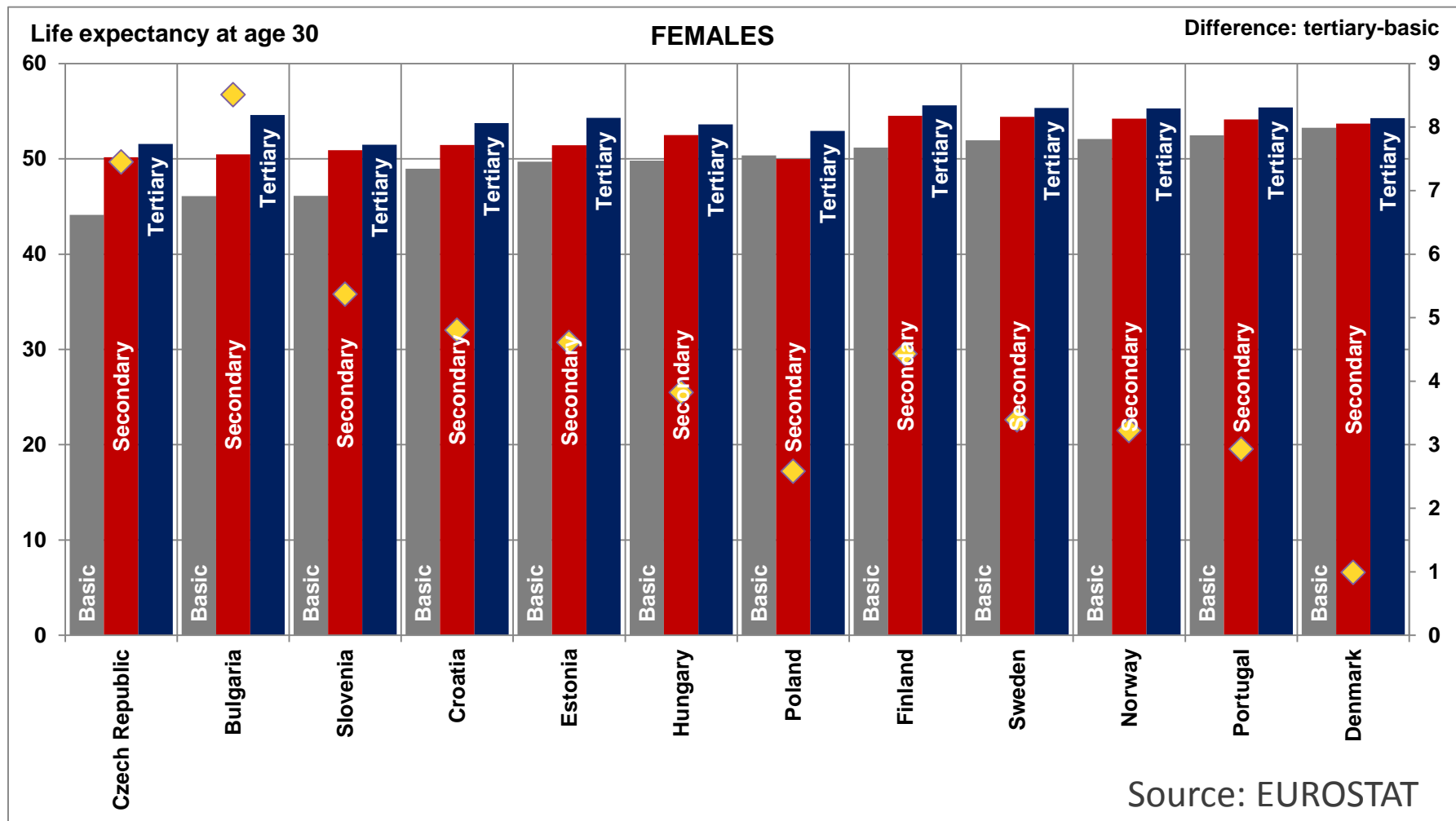
### Life expectancy at age of 30 according to education level in 2010



Basic=Pre-primary, primary and lower secondary education (ISCED levels 0-2)  
 Secondary=Upper secondary and post-secondary non-tertiary education (levels 3 and 4)  
 Tertiary=First and second stage of tertiary education (levels 5 and 6)

## FEMALES

### Life expectancy at age of 30 according to education level in 2010





## Mortality differentials by education

- **The Czech Republic shows a rather short life expectancy at age 30 for males and females with the lowest education even when compared with countries of higher mortality (Estonia, Hungary, Bulgaria).**
- **The difference between life expectancy at 30 of people with the highest and the lowest educational attainment reaches 16.9 years among Czech men compared to 2.9 years in Portugal or 3.9 in Sweden.**
- **The gap in female mortality between the highest and the lowest education level is the second high (7.5), after the Bulgarian one (8.5).**
- **Our study will address two age groups 30-64 and 65-84 years (age last birthday) using education-cause (amenable, preventable, non-avoidable) analysis.**



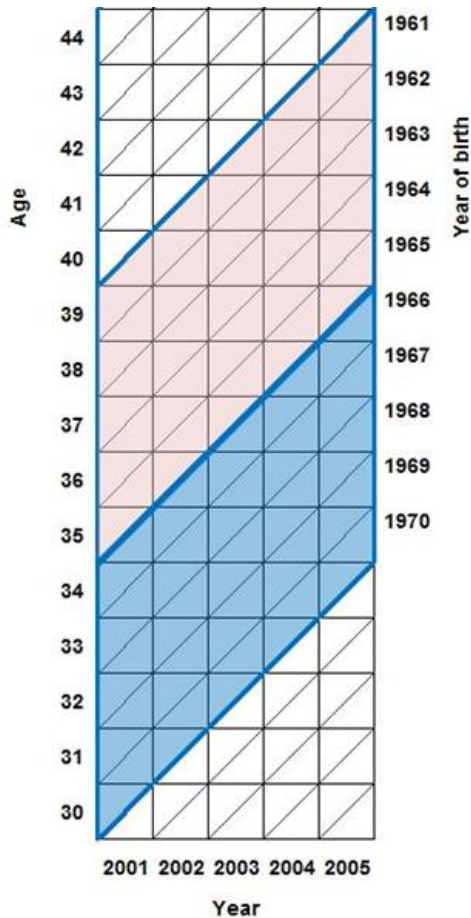
# **Avoidable mortality in the Czech Republic**

# DATA



Two unlinked datasets of deaths (449 968) and census population (6 065 610)

Lexis diagram:  
data structure



Men and women aged 30–84 years January 1, 2001 and followed over the period 2001–2005 by five year birth cohorts.

## Four education levels

Level of education	Educational attainment (ISCED 97)	Educational attainment (ISCED 2011)
Basic	ISCED 2A,C	ISCED 2 and lower
Vocational	ISCED 3C	ISCED 35
Secondary	ISCED 3A, 4A	ISCED 34
University	ISCED 5A and higher	ISCED 64 and higher

Three groups of causes of deaths:  
amenable (treatable), preventable and non-avoidable causes

Amenable	Preventable	Non-avoidable
A00–A09, A33, A38–A41, A46, B50–B54, G00, G03, L03, C18–C21, C50, C53–C55, C62, C67, C73, C81, C91–C95, D1–D2; D30–D36, E00–E07, E10–E14, G40–G41, I01–I14, I15, I60–I69, J00–J08, J2–J3, J45–J49, J5–J9, K25–K28, K35–K38, K40–K46, K80–K83, K85–K86, K915, N00–N07, N13, N17–N19, N20–N21, N25, N27, N35, N40, N991, O00–O99, P0–P8, P90–P96, Q00–Q99, Y60–Y69, Y83–Y84	A15–A19, A35–A37, A80, B05, B15–B24, B90, C00–C16, C22, C33–C34, C43–C44, F10–F16, F18–F19, K70, K73–K74, K860, G312, G621, I426, K292, I20–I26, I77, I801–I803, I809, I829, J09–J18, J40–J44, V00–V99, W0–W5, X6–X7, X80–X89, X9, Y1–Y2, Y0, Y30–Y34, U509	Others

## Avoidable Mortality definitions used:

1. **Amenable mortality** – deaths occurring before age 75 from causes that are considered **amenable to medical intervention**. Examples include: breast cancer, cancer of colon and rectum, leukemia, gastric and duodenal ulcer, and hypertensive diseases. Deaths from these causes may be avoidable through treatment of the condition after onset.
2. **Preventable mortality** – deaths occurring before age 75 from causes that are considered to be **preventable through (a) individual behaviour**, and/ or (b) public health measures limiting individual exposure to harmful substances/conditions (e.g. through things such as social interventions or immunisation programmes). Examples include: lung cancer, illicit drug use disorders, land transport accidents, and Hepatitis B. Deaths from these causes are avoidable through prevention of the disease, or external event, occurring altogether.
3. **Unavoidable mortality** – deaths occurring before age 75 from causes that are considered both (a) not amenable to medical intervention and (b) not preventable through changes in individual behaviour/public health measures. Examples include cancers of the pancreas, ovary, and prostate.

*Source: Wheller et al 2007 Trends in avoidable mortality in England and Wales, 1993–2005 ; Health Statistics Quarterly 34. 6-25*

*ICD Cause coding available on:*

[http://www.adls.ac.uk/wp-content/files\\_flutter/1326277634ZFeng.Nolteavoidablemortality.do](http://www.adls.ac.uk/wp-content/files_flutter/1326277634ZFeng.Nolteavoidablemortality.do)

**In our study, we have applied this concept for ages 30-64 , 65-89, and 30-89 years, apart for males and females.**

# Education System in the Czech Republic

The Czech education system is based on a long tradition **beginning in 1774**, when **compulsory school attendance was instituted**. The literacy rate in the country was, according to the census of 1930, already above 98 % among people aged 10 years and over.

Czech elementary (**basic**) education takes nine years, usually from the ages of 6 to 15. It consists of a primary and lower secondary stage, where the primary stage encompasses grades 1-5, while the lower secondary stage is grades 6-9. Upper secondary education which is either general (**secondary**) or **vocational**, is generally four years in length (grades 10-13), and is not considered mandatory.

Tertiary or **university** education includes all studies following the completion of primary and secondary education with a successful final examination (maturita, CGSE, SAT).

[http://www.mzv.cz/washington/en/culture\\_events/education/education\\_system\\_in\\_the\\_czech\\_republic\\_1](http://www.mzv.cz/washington/en/culture_events/education/education_system_in_the_czech_republic_1)

*There are no unknown cases of education in the death file for the period 2001-2005, because of rules-based corrections provided by the Czech Statistical Office within the individual death records.*

## Czech Republic

### Percentage of population aged 15+ according to education level

Education	Census years						
	1950	1961	1970	1980	1991	2001	2011
Basic	82,96	80,41	53,07	44,57	33,13	23,03	17,56
Vocational	9,78	7,66	28,89	32,58	35,37	37,96	32,99
Secondary	4,98	9,00	13,56	16,98	22,94	28,35	31,18
University	1,03	2,19	3,42	4,99	7,16	8,89	12,46
no education	0,32	0,34	0,29	0,25	0,34	0,44	0,47
unknown	0,93	0,40	0,78	0,63	1,05	1,32	5,33
<i>Total</i>	<i>100,00</i>	<i>100,00</i>	<i>100,00</i>	<i>100,00</i>	<i>100,00</i>	<i>100,00</i>	<i>100,00</i>

### Percentage of unknown education in the census data

Age	Percentage of unknown education			
	Census 2001		Deaths 2007	
	Males	Females	Males	Females
30-34	1,99	1,30	6,40	10,00
35-39	1,88	1,11	8,03	5,51
40-44	1,68	0,96	7,60	7,47
45-49	1,49	0,87	7,37	4,94
50-54	1,28	0,80	6,58	4,63
55-59	1,09	0,80	6,26	5,96
60-64	0,95	0,77	5,68	5,15
65-69	0,87	0,88	5,87	6,13
70-74	1,00	1,03	5,14	5,39
75-79	1,24	1,46	5,44	5,14
80-84	1,35	1,92	6,59	6,67
85-89	1,94	2,68	6,85	6,65

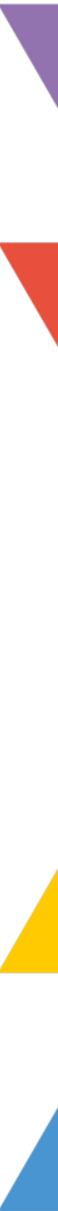
## METHODS

- **Standardized death risks** (direct standardization, using new European 2013 standard and SAS 9.4 software, STDRATE Procedure) were computed by gender, education (4 categories), and cause (3 groups) for two broad age groups 30–64 and 65–84 years.
- Method of simple **correspondence analysis** (using SAS 9.4 software, CORRESP Procedure). The associations between 3 groups of causes of deaths (columns) and 4 education levels (row) were estimated for four datasets (two age groups x two sexes) and plotted into symmetric maps.
- Method of **multinomial logistic regression** (using SAS 9.4 software LOGISTIC Procedure). Dependent (response) variable had 4 categories (3 groups of causes: amenable, preventable, non-avoidable, and reference category was represented by survivors). The effect of education (independent, explanatory variable) on mortality by cause was examined when controlling for age. The reference category was age group 40–44 years and vocational education. The regression model was computed for each sex separately.

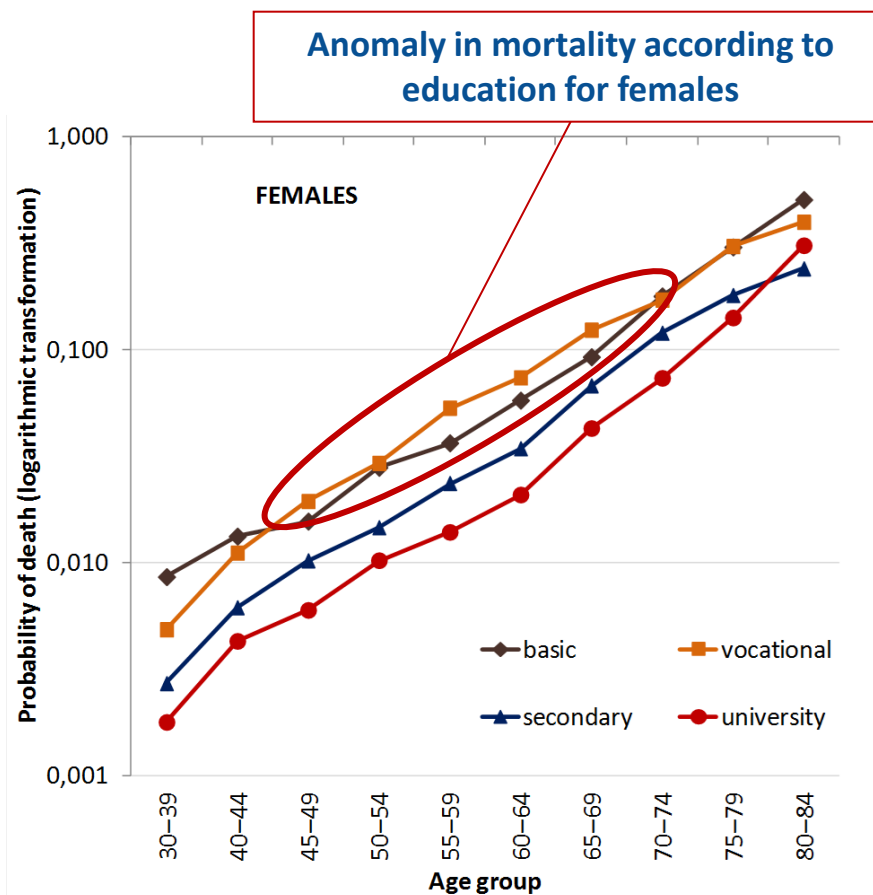
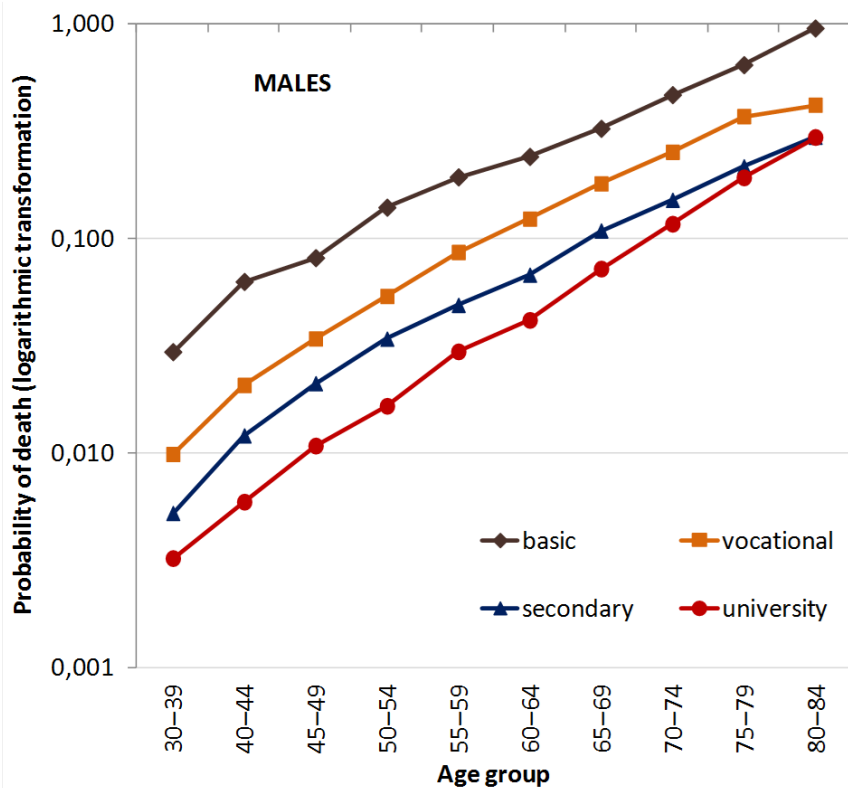


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# Descriptive results

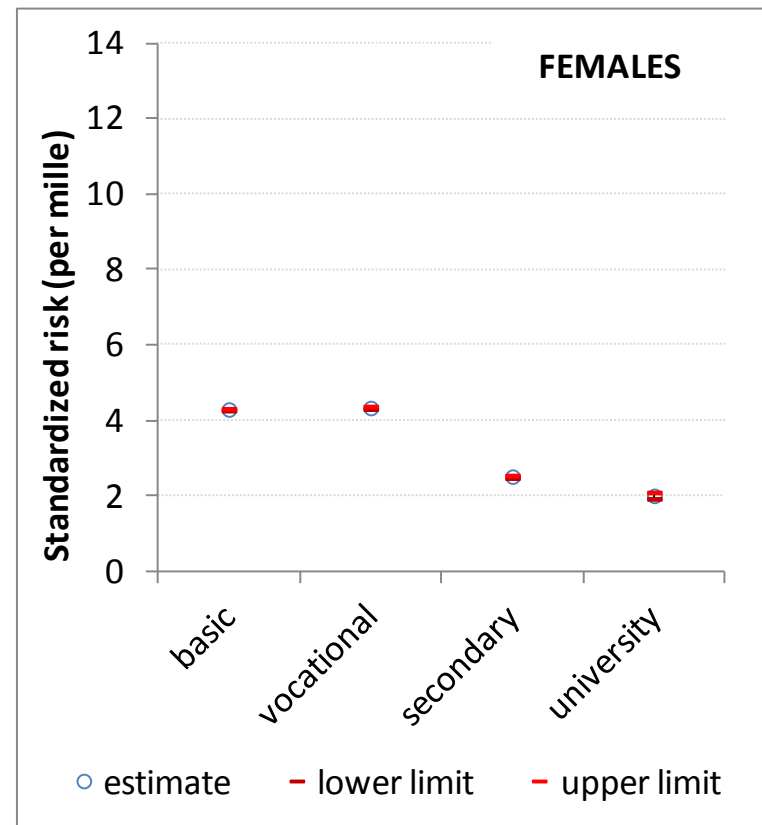
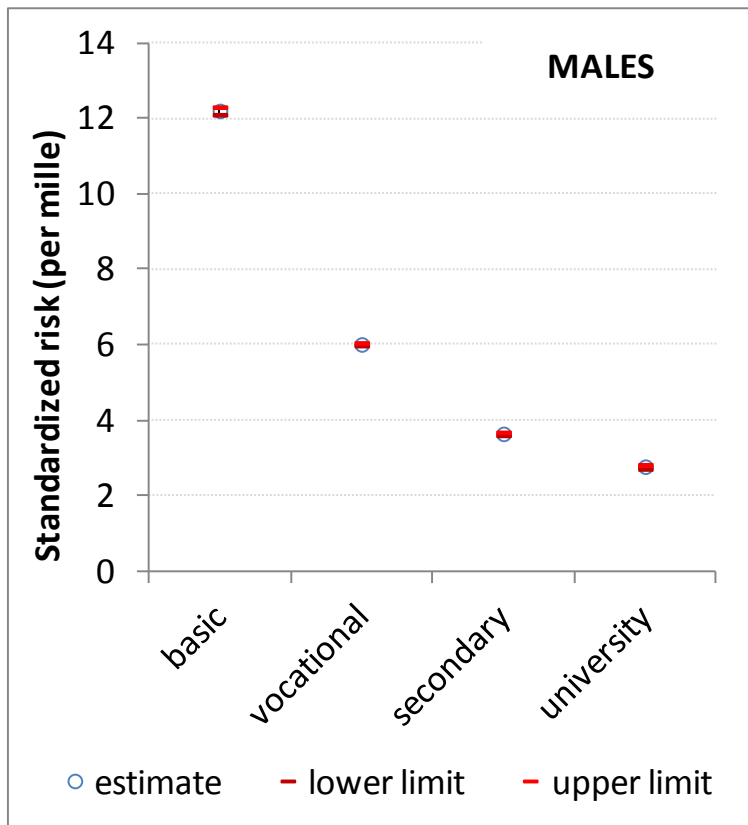


# Probability of death according to levels of education and age, males, females, Czech Republic 2001–2005





## Standardized risks according to levels of education, age 30–84, males, females, Czech Republic 2001–2005



- **Male inequality in mortality by educational attainment exceeds female inequality.**
- **The results show a consistency in the effects of education on male mortality – negative correlation.** Much higher mortality of males with basic education can be related to very poor health conditions due to hard work (mines, construction) and to unfavorable life style (alcohol, smoking).
- **The particular anomaly in the mortality gradient is observed when comparing basic and vocational education among women – women with basic education show lower mortality level compared to their vocational counterparts.** It can be hypothesized that these women with vocational education worked during socialist era mostly in factories with detrimental working conditions. Less demanding work (agriculture, cleaning, house wife) was practiced by the least educated women.



# Multivariate analysis

**Correspondence analysis (reduction of dimensionality)**

**Logistic regression (response and predictors)**

## Hypotheses

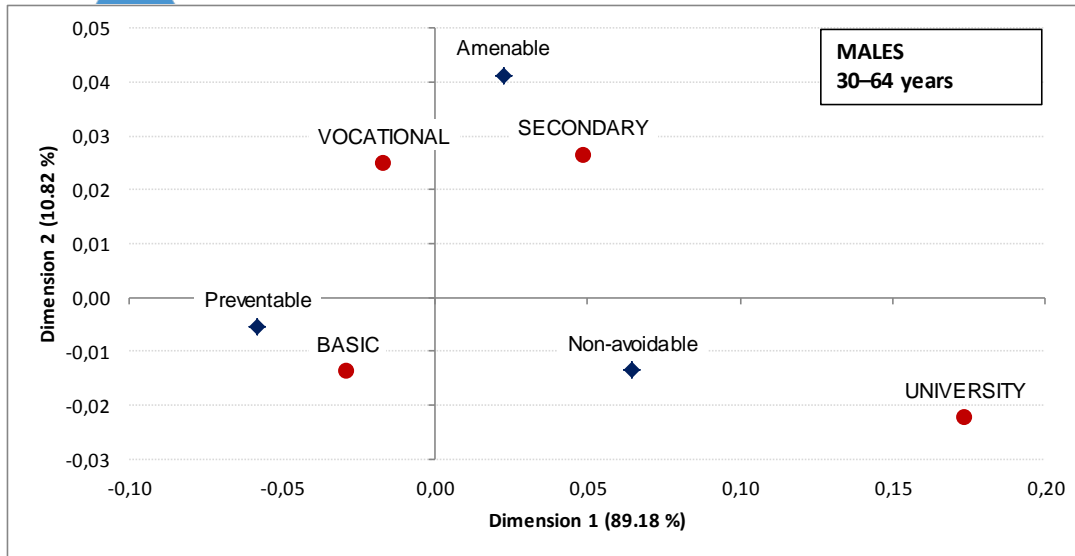
- We suppose that higher education level is connected with lower overall mortality level. Higher education level is more tied to non-avoidable mortality.
- On the other hand, for lower education levels the preventable and amenable causes of death should be more common.

# Correspondence analysis – Males



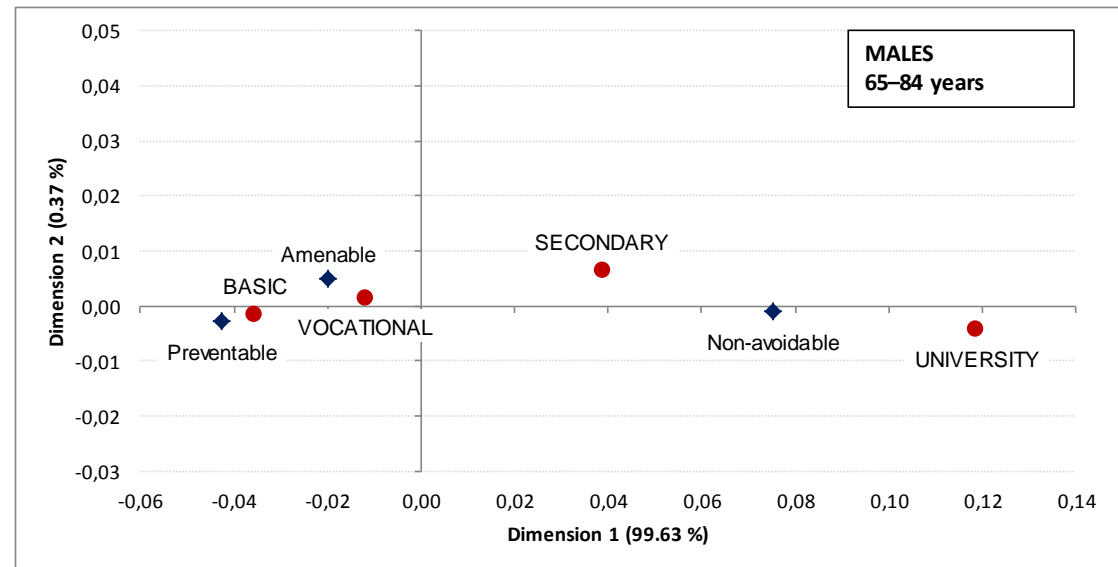
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Symmetric map of associations between education and avoidable mortality



**Lower education is more tied to preventable or amenable (treatable) causes of death**

**The educational gradient in mortality levels is more visible in case of older males (65-84 years)**

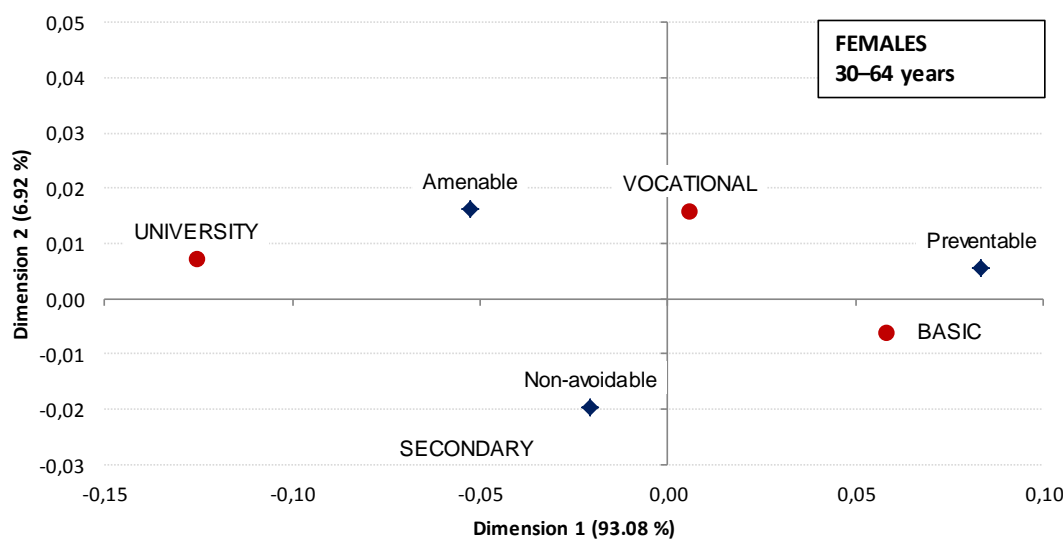


# Correspondence analysis – Females



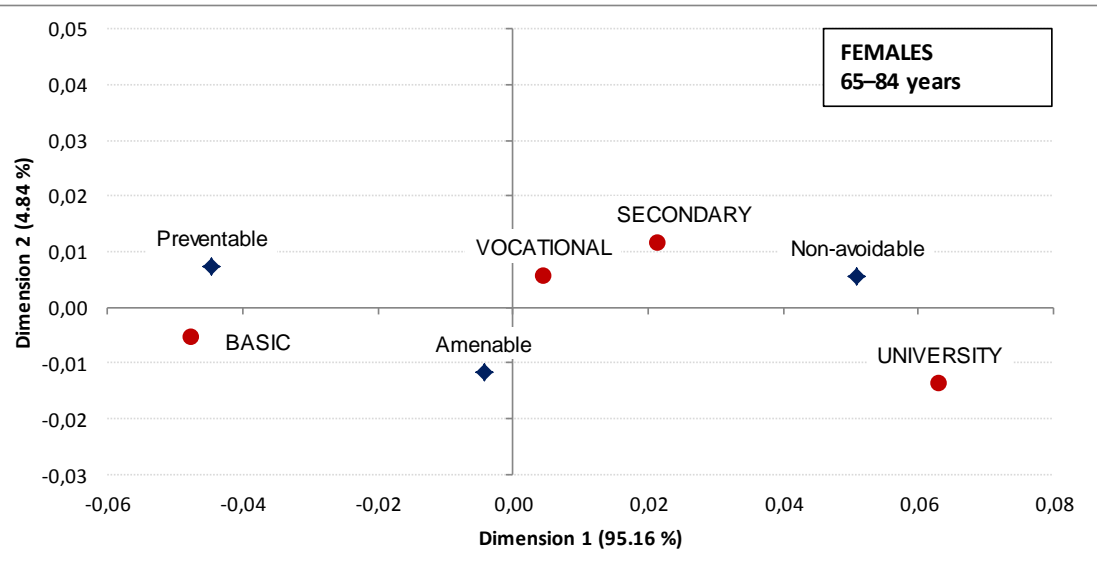
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Symmetric map of associations between education and avoidable mortality



For females, there is a clear correspondence between basic education and preventable causes of death

The educational gradient in mortality levels is again more visible in case of older persons (women 65–84 years)



## Results – Correspondence analysis

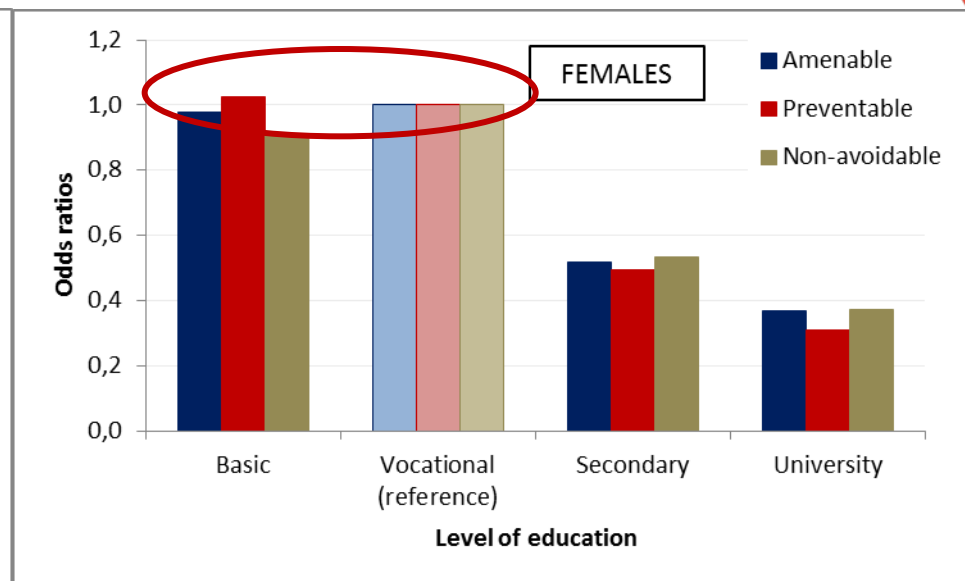
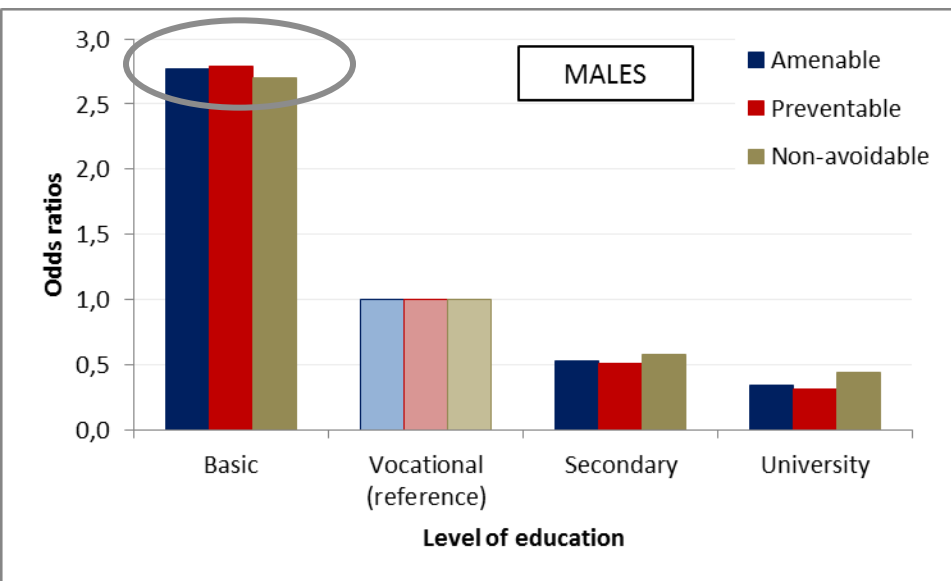
The correspondence analysis confirmed the typical pattern of mortality differences:

- For both sexes, lower education level is more tied to preventable or amenable causes of death.
- On the other hand, higher education (especially university education) is connected with non-avoidable causes.
- For seniors (ages 65–84 years) the pattern was even clearer, especially in the case of males.

# Multinomial logistic regression for avoidable mortality (reference category=survived)

Explanatory variable: education; reference category=vocational

Control variable: age groups for age interval of 30-84 years; reference category=40-44 years



Significant excess mortality of males with basic education – is mostly due to all causes of death, (based on more detailed analysis) but particularly from cardiovascular diseases, external causes and alcohol related causes.

**Anomaly for females: females with basic education have a lower risk of death from amenable and non-avoidable causes when compared with their vocational counterparts. The risk of death from preventable causes is the highest among women with the lowest education (basic).**

*All results are statistically significant at 5% level of significance.*





## Results – Multinomial logistic regression

- **The odds ratios confirm the previous results – for those with vocational education, the risk of death from any of three groups of causes is almost three times higher than the risk for university graduates. This holds for males as well as for females.**
- **Secondary education halves the risk of death in comparison to vocational education, especially in case of preventable causes of death for females.**
- **Basic education is highly unfavorable in case of males. Their risk of death is nearly triple in comparison to vocational education – especially for preventable causes of death.**
- **In case of females there is almost no difference between basic and vocational education.**

## References:

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## Conclusions

- In spite of the recent increase in survival, the Czech Republic still lags behind „western“ developed countries in mortality figures.
- Male-female differential in life expectancy at birth was 5,9 years in 2013. However, the mortality divide between people with the highest and the lowest educational attainment is very pronounced compared to the male-female difference in life expectancy.
- Significantly high mortality risk is especially seen among men with basic education.
- Mortality of men and women with the lowest education is mostly associated with amenable and preventable causes. Higher education (especially university) is connected with non-avoidable causes. The pattern is stronger among seniors (65-84 years old), primarily in men.
- Females with basic education have lower risk of death from amenable and non-avoidable causes when compared with their vocational counterparts.



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**Thank you for your attention**