



Original article

Malnutrition related deaths

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SUMMARY

Background and aims: Studies have shown that malnutrition increases the risk of morbidity, mortality, the length of hospital stay, and costs in the elderly population. Approximately one third of all patients admitted to geriatric wards in Denmark are malnourished according to the Danish Geriatric database. The aim of this study is to describe and examine the sudden increase in deaths due to malnutrition in the elderly population in Denmark from 1999 and, similarly, the sudden decline in malnutrition related deaths in 2007.

Method: A descriptive epidemiologic study was performed. All Danes listed in the national death registry who died from malnutrition in the period from 1994 to 2012 are included.

Results: The number of deaths from malnutrition increased significantly during the period from 1999 to 2007, especially in the age group 70 years and over. Additionally, we document a surprising similarity between the development in excess mortality from malnutrition in the five Danish regions during the same period.

Conclusions: During the period 1999–2007 malnutrition was the direct cause of 340 extra deaths, and probably ten times more registered under other diseases. This development in excess mortality runs parallel in all five Danish regions over time.

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1. Introduction

International studies have shown that malnutrition in the elderly population increases the risk of morbidity, mortality, the length of hospital stay, and costs [1]. According to the Danish geriatric database [2], approximately one third of all patients admitted to the medical departments of geriatrics in Denmark are malnourished. Malnutrition is a common complication among elderly patients, as calorie intake, for different reasons, such as diseases, medical side effects, depression, and poor dental status, increases with age. However, poor access to good, healthy food also plays a critical role [3,4].

Every year, malnutrition leads to several deaths, according to the Danish death statistics.

The number of patients who are diagnosed with malnutrition may only be the tip of the iceberg, as malnutrition has not until recently been in focus among health professionals [5,6].

The Danish hospital nutrition was heavily criticized and reforms were proposed during the period 1999–2010 [5–10]. Likewise Danish nursing homes were criticized for their nutritional standard [11].

Malnutrition not only leads to deaths in its own right, but studies have shown that malnutrition also increases the risk of all-cause mortality in the elderly [12–18]. Studies have also shown that underweight increases the risk of among others post stroke mortality and Alzheimer's disease.

Experience from the Dutch famine indicates that malnutrition also has an impact on, among others schizophrenia, cold, and heart attack [19–21].

The death rate directly connected to malnutrition may therefore heavily underestimate the total number of deaths with malnutrition as the main factor.

1999 seems to be a remarkable year in the nutritional situation in Denmark. In all five regions (at that time organized in counties), the death rate from malnutrition increased rapidly. Until January 1, 2007 Denmark had 13 counties (Danish: Amt). The relevant factor for this study is that the counties had the responsibility for the hospitals. With the structural reform of January 1, 2007 the

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counties were replaced by 5 regions. From then the regions became responsible for the daily running of the public hospitals in Denmark.

The five regions are: Capital, Zealand, Southern Denmark, Central Denmark (Midt-jutland), and North Denmark (North-jutland).¹

By the same reforms the number of municipal units was reduced from 270 to 98. The factor of interest for this study is that the municipalities had (and have) the responsibility for elderly care.

The malnutrition period coincides with the Danish government's Public health program 1999–2008 [22]. In 1998 The Danish government introduced a new public health program that ran from 1999 to 2008. The program focused on general initiatives such as helping people stop smoking. We can see that the program runs parallel with the Danish malnutrition period. Introduction of the public health program may have been funded by savings on nutritional care to weak patients suffering from: Stroke, Alzheimer, Schizophrenia, and Diabetes. This could explain our findings.

2. Method and data

The method is primarily descriptive using regression analysis. As neither multicollinearity nor cohort effects were found in the data the method became simpler than the methods applied in [24–26].

The Danish data on the *death rate* from malnutrition can be found in [23]: The State Serum Institute (Statens Serum Institut): Malnutrition, B-040. "Malnutrition" is doctors classification of cause of death. This dataset is (based on separate studies [24–26]) connected to data for apoplexy, B-061, Alzheimer's disease, B-052, and Schizophrenia, B-046. The death rate is the number of deaths from a certain cause per 100 000 persons in a considered group. The present article is, in principle, based on the total dataset for deaths and death rates from malnutrition in Denmark 1994–2012; however, it is included here only from the age of 55; see Table A1 in the appendix.

3. The malnutrition period 1999–2007, distributed into regions

Figs. 1–5 show the death rates from malnutrition for women in the five regions. In the capital region, the malnutrition period starts 1999 and tops 2004.

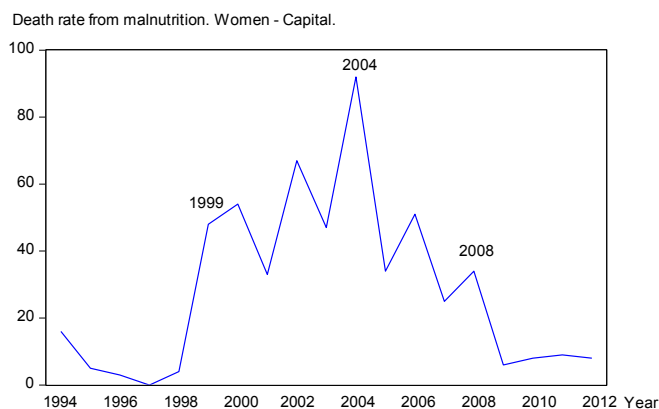


Fig. 1. Capital: The malnutrition period lasted from January 1999 to January 2009.

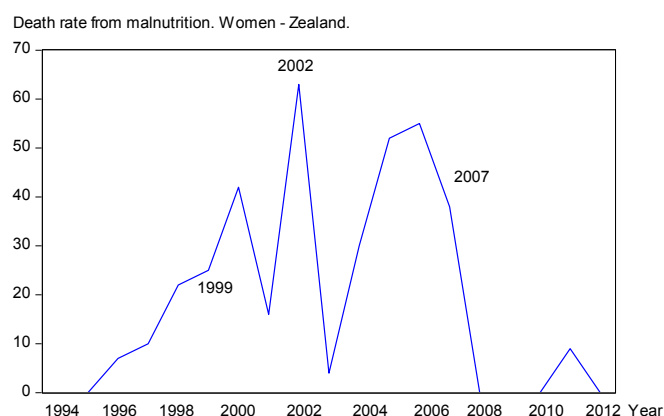


Fig. 2. Zealand: The malnutrition period lasted from January 1999 to January 2008.

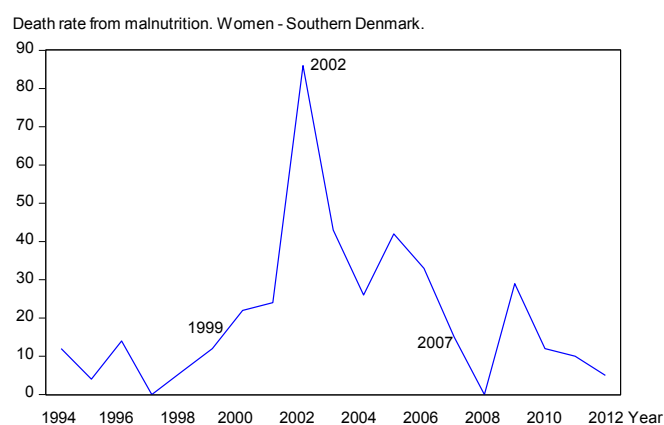


Fig. 3. Southern Denmark: The malnutrition period lasted from January 1999 to January 2008.

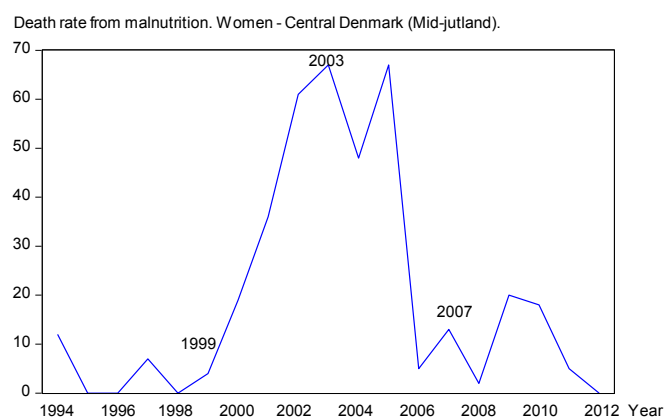


Fig. 4. Central Denmark (Mid-jutland): The malnutrition period lasted from January 1999 to January 2006.

In the Copenhagen municipality a diet policy for the elderly, supported by the Health and Care Management in Copenhagen, was approved in 2003. An annual appropriation of 5 million DKK was granted in 2004 and 2005 to finance three pilot projects. In that context a new organization for the implementation of a nutritional policy was set up. In 2005, a Dietary Secretariat under the Health and Care Management was created and dietary consultants were appointed in all local areas.

¹ In Denmark the English names for Midt-jutland and North-jutland are generally unknown.

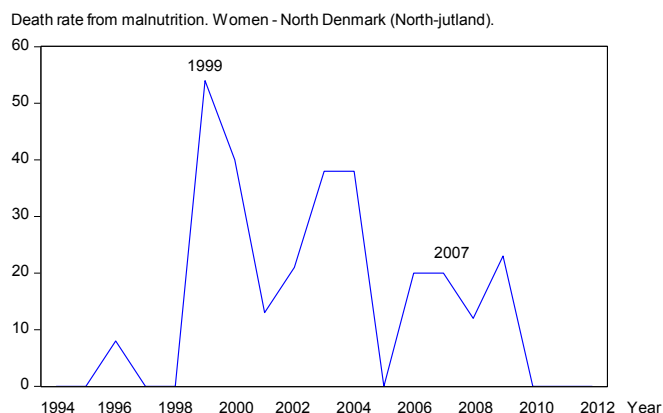


Fig. 5. North Denmark (North-jutland): The malnutrition period goes from January 1999 to January 2010.

In the Capital region, the malnutrition period starts in 1999 and peaks in 2004.

From 1999 to 2003 we see almost a *sevenfold increase* of the death rate from malnutrition in Central Denmark (Mid-jutland).

In North Denmark (North-jutland) a remarkably change in the death rate happens in 1999. It looks like an “efficient introduction” of a new system started that year.

4. Death rate and the number of deaths for all Denmark – men and women

4.1. The death rate

Fig. 6 shows the death rate from malnutrition for all Denmark for women. **Fig. 7** shows approximately the same for men.

The death rate for women is on average 5.8 deaths per 100 000 *before* the malnutrition period, and 9.6 *after*, versus 39.6 during the malnutrition period.

The death rate for men is on average 7.5 deaths per 100 000 *outside* the malnutrition period, versus 39.4 during the malnutrition period.

4.2. The number of deaths

Fig. 8 shows the number of deaths from malnutrition for all Denmark for women. **Fig. 9** shows approximately the same for men.

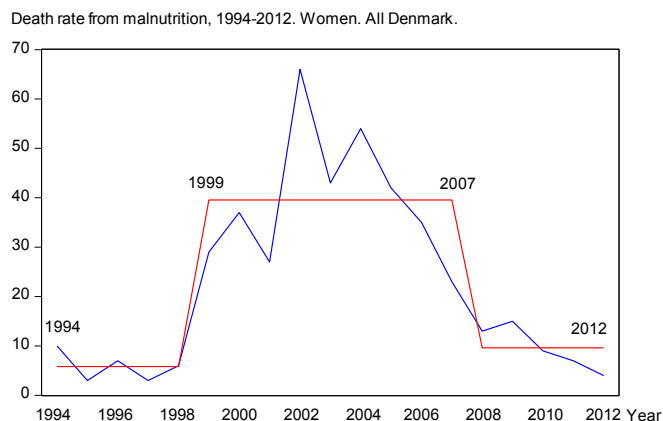


Fig. 6. The malnutrition period for all Danish women, 1999–2007.

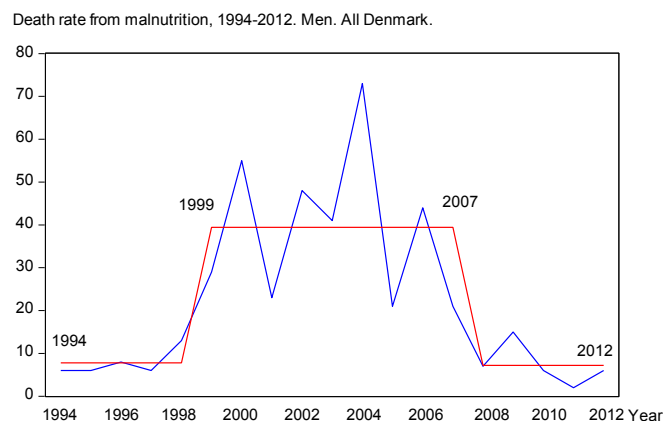


Fig. 7. The malnutrition period for men hits rather precisely the years 1999–2007.

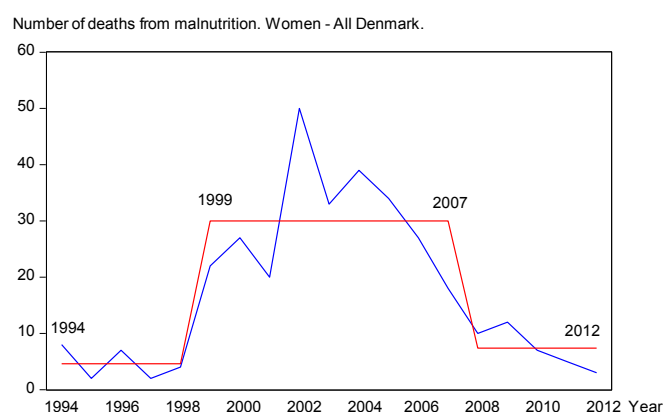


Fig. 8. Around 25 women *more* than expected died per year from malnutrition during the malnutrition period.

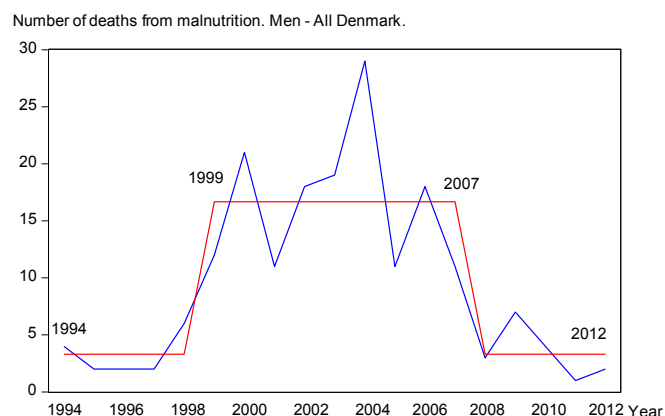


Fig. 9. Around 13 men *more* than expected died per year from malnutrition during the malnutrition period.

4.3. Death rate from malnutrition per 100 000 (D_{mal}). **Figs. 6 and 7**

The effect of malnutrition on the death rate as well as on the number of deaths can be calculated by rather simple models.

D_1 is 1 for the malnutrition period and 0 otherwise.

D_2 is one for the period after the malnutrition period, and 0 otherwise.

$$D_{mal} = 7.50 + 31.94 \cdot D1$$

t (1.89) (5.56)

Men

$$R^2 = .645 \quad \text{Obs} = 19$$

$$D_{malw} = 5.80 + 33.75 \cdot D1 + 3.80 \cdot D2$$

t (1.29) (6.03) (.59)

Women

$$R^2 = .750 \quad \text{Obs} = 19$$

In the malnutrition period 31.94 more men and 33.75 more women died annually compared to the previous period per 100 000 persons. The difference (the dummy for the malnutrition period, D1) is highly significant as indicated by the t-values below the coefficients.

4.4. The number of deaths from malnutrition (NoD). Figs. 8 and 9

$$NoD_m = 3.30 + 13.36 \cdot D1$$

t (2.36) (6.58)

Men

$$R^2 = .718 \quad \text{Obs} = 19$$

$$NoD_w = 4.60 + 25.40 \cdot D1 + 2.80 \cdot D2$$

t (1.35) (6.01) (.58)

Women

$$R^2 = .750 \quad \text{Obs} = 19$$

In the malnutrition period on average 13.36 more men and 25.40 more women died annually compared to the previous period. The t-values show that the dummies for the differences (D1) are highly significant.

The models shown above made a realistic calculation of the number of people who died from malnutrition during the nine-year period 1999–2007.

Annual averages for the numbers of unexpected deaths from malnutrition are:

Table 1
Calculated excess numbers of deaths from malnutrition during the malnutrition period.

Women	24.40	Total: 9 years	219.6
Men	13.36	Total: 9 years	120.6

The total (unexpected excess) number of deaths from malnutrition 1999–2007 is **340**.

In all the communities, nutritional therapy became a permanent offer for the elderly in home care in 2008. The Danish Health and Medicines Authority (Sundhedsstyrelsen, 2008) likewise described nutritional therapy in its quality standards [27].

4.5. The derived effects of malnutrition

Inspired by the Dutch famine [19–21], the study also considers the derived effects of malnutrition on death rates from apoplexy, schizophrenia, Alzheimer's disease, COLD, and breast cancer.

This study was inspired by The Dutch famine studies where an entire population in a given geographic area was exposed to famine.

Children conceived or born during this period have been studied closely, and the findings are that children exposed to intrauterine famine have an increased risk of developing schizophrenia, breast cancer, depression (men), coronary artery disease, COPD and asthma, and diabetes.

Further investigations were made [24–26] of the effect of the Danish malnutrition period on the death rates from stroke (apoplexy), Alzheimer's disease, schizophrenia, diabetes, breast cancer, COLD and suicide in separate studies.

5. Results

The association between death from malnutrition and other causes of death as indicated by the Dutch famine can be calculated on Danish data based on death rates from other diseases for the elderly people.

Based on separate studies we can calculate how many indirect cases of death the malnutrition period has led to (see Table 1):

The number of people who died directly or indirectly from malnutrition during the period 1999–2007.

Table 2
Calculated number of deaths directly or from other diseases due to malnutrition.

	Malnutrition	Stroke ^a	Alzheimer's Dis. ^{a,b}	Schizophrenia ^a
Women	219.6	2106	266	138
Men	120.6	1248	79	52
Total	340.2	3354	345	190

^a Based on separate studies [24–26].

^b With a delay of one year.

The number of deaths related to diabetes was calculated with great insecurity result but was found to be significantly above zero.

We found no significant connection between malnutrition and deaths from breast cancer, COLD, and suicide.

6. Discussion

Table 2 is a strong indication that the malnutrition period is not simply a result of doctors register malnutrition as cause of death due to new public awareness. We find that diseases that are known to worsen in malnourished patients thrive during this period.

6.1. What brought on the 1999–2007 malnutrition period?

We can suggest three reasons:

6.1.1. Reform bias

Reallocation of resources in relation to the government's Public Health Programs Program 1999–2008. The redistribution of funds to areas where the effect is measured, and from areas where the effect is not measured as for example, savings in "other areas". Possibly resulting in savings on nutritional care to weak patients suffering from: Stroke, Alzheimer, and Schizophrenia.

The effect of lower life quality (malnutrition) is hidden by better cures for diseases.

6.1.2. Irresponsible administration

Before the anticipated reforms of counties and municipalities to regions and bigger municipalities. During the reform period introduction of new systems may have had flaws that lead to a lower level of eldercare service.

6.1.3. New technique

The quality of new methods of treating and preparing food not evaluated correctly may have had unseen secondary effects.

6.1.4. General saving

General eagerness for saving may lead to counterproductive saving for some subsectors.

6.2. Adequate food vs. adequate nutrition

The general understanding of which foods (meals) are unhealthy (harmful for health) is probably too narrow and misleading for the elderly population. Factors such as taste, smell (or scent), visual impression, circumstances of serving, and other psychological circumstances could have significant effects.

When new saving on food for elderly are introduced for instance as Jyllands-Posten. 5, 2014 wrote: "Vacuum-packed dishes that can be stored for up to 15 days, will now be supplemented by up to 9 days old sandwiches for our senior citizens."

We might in fact be starving the elderly despite the fact that the food in itself is sufficiently nutritious.

The increased life expectancy and higher wealth for everyone might have opened new unknown aspects of what life quality and good food is.

The malnutrition period took place in the last 9 years of the existence of the counties, however, the fact that the malnutrition period was uniform all over the county leaves the impression that the changes that created the malnutrition was centrally inspired.

7. Conclusion

In the period 1999 to 2007 the nutritional state of elderly people in Denmark deteriorated to such a degree that 340 people (extra) died from malnutrition. There was a high degree of similarity between the developments in the five Danish regions. Associated with (provoked by) malnutrition an estimated 3354 people died from apoplexy (stroke), 345 from Alzheimer's disease, and 190 from schizophrenia during the Danish malnutrition period.

The strength of this conclusion is that it is based on all deaths in Denmark from the discussed causes of deaths in the period 1994–2012.

The limits are that we can't say for certain what precisely caused the Danish malnutrition period.

Appendix

Table 1A

Number of death from malnutrition related to age, 1994–2012.

	Men			Women		
	1994–1998	1999–2007	2008–2012	1994–1998	1999–2007	2008–2012
55–59	1	6	1	0	3	0
60–64	1	3	0	0	4	2
65–69	1	5	1	1	7	0
70–74	1	19	2	1	16	1
75–79	0	16	1	5	20	6
80–84	4	27	5	6	40	9
85+	8	67	7	8	178	20
Total	16	143	17	21	268	38

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