

LEENA FORMA

Health and Social Service Use Among Older People

The last two years of life

ACADEMIC DISSERTATION To be presented, with the permission of the board of the School of Health Sciences of the University of Tampere, for public discussion in the Auditorium of School of Health Sciences, Medisiinarinkatu 3, Tampere, on December 9th, 2011, at 12 o'clock.

UNIVERSITY OF TAMPERE



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Abbreviations

ANOVA	Analysis of variance
CI	Confidence interval
COCTEL	Costs of care towards the end of life project
HCE	Health care expenditure
ICC	Intra-class correlation
ICD-10	International Classification of Diseases, tenth revision
LOS	Length of stay
MOR	Median odds ratio
MRR	Median rate ratio
MSAH	Ministry of Social Affairs and Health
OR	Odds ratio
SII	Social Insurance Institution
STAKES	National Research and Development Centre for Welfare and Health
THL	National Institute for Health and Welfare
TTD	Time to death

List of original publications

- I Forma L, Rissanen P, Noro A, Raitanen J, Jylhä M (2007): Health and social service use among old people in the last 2 years of life. European Journal of Ageing 4:145–154.
- II Forma L, Rissanen P, Aaltonen M, Raitanen J, Jylhä M (2009): Age and closeness of death as determinants of health and social care utilization: a case-control study. European Journal of Public Health 19:313–8.
- III Forma L, Jylhä M, Aaltonen M, Raitanen J and Rissanen P (2011): Municipal variation in health and social service use in the last two years of life among old people. Scandinavian Journal of Public Health 39:361–370.
- IV Forma L, Rissanen P, Aaltonen M, Raitanen J, Jylhä M (2011): Dementia as a determinant of health and social service use in the last two years of life 1996–2003. BMC Geriatrics 11:14.

Abstract

It is well known that older people use more health and social services than younger people, but the exact determinants of service use still remain unclear. More information is needed on whether the high use of services among older people is associated with their high age or the closeness of death, for instance. The aim of this study was to shed light on health and social service use among older people living their last two years of life and among controls who lived longer. Special consideration was given to how age, closeness of death, municipality of residence and dementia diagnosis are associated with service use and to how service use in the last two years of life has changed from 1996 to 2003.

The services in focus were (1) hospital inpatient care (2) long-term institutional care (3) regular home care (at least once a week) and (4) use of prescribed medicines. Hospital care included care provided at university hospitals, general hospitals (central, district and private) and health centre inpatient wards if length of stay was less than 90 days. Long-term care included care in residential homes for older people, sheltered housing with 24-hour assistance and health centre inpatient wards if length of stay was 90 days or over. The analysis determined the probability of using each of the services in the two-year study period and the number of days in care.

The data were derived from registers of Statistics Finland, National Institute for Health and Welfare and Social Insurance Institute. The study population consisted of all persons in Finland who died in 1998, 2002 or 2003 at the age of 70 years or over and a 40% random sample of those who died in 1999–2001 at the age of 70 years or over. The total population numbered 145,944 persons. For decedents who died in 1998–2000, a matched control was selected who lived at least two years longer. There were 56,001 case-control pairs, matched for age, gender and municipality of residence.

Closeness of death was a strong determinant of hospital and long-term care use. In all age groups decedents used these services more often than their matched survived controls. The difference between decedents and survivors was smaller in older than younger age groups. Age was also an important determinant of service use. Younger people used hospital care more often than older people, but older people used long-term care more often. Overall hospital use varied between municipalities and hospital districts less than the use of different types of hospital. Use of university hospital varied most, and there was also much variation in the use of general hospital services. The use of long-term care and home care did not vary between hospital districts. Municipal differences in the use of home care services were greater than in the use of long-term institutional care. The proportion of service users varied more than the number of days in care among users. Municipal level variables did not explain much of the differences.

Older people with a dementia diagnosis were more than nine times more likely to use long-term care than people without a dementia diagnosis. The use of hospital care, on the other hand, was more common among older people without dementia, even when comorbidity was adjusted for. Among users the number of days in care was higher for people with a dementia diagnosis. The use of university hospital and long-term care increased during the study period from 1996 to 2003, while the use of general hospital and home care decreased. The number of days in care increased on health centre inpatient wards and in long-term care, but decreased in general hospitals.

In conclusion, closeness of death is an important determinant of health and social service use among older people. However, the effect of closeness of death varies with age and between different services. Age also has an impact on service use among older people at the end of life. Further research is needed to determine whether older people living in different municipalities as well as those with and without a dementia diagnosis have equal access to care.

Tiivistelmä

Vanhojen ihmisten tiedetään käyttävän sosiaali- ja terveyspalveluita enemmän kuin nuorempien. Palvelujen käytön taustalla olevia tekijöitä ei kuitenkaan tunneta tarkasti, esim. missä määrin vanhojen ihmisten suurempi palvelujenkäyttö liittyy heidän korkeaan ikäänsä ja missä määrin siihen, että he ovat lähellä kuolemaa. Tutkimuksen tarkoituksena oli tuottaa tietoa vanhojen ihmisten sosiaalija terveyspalvelujen käytöstä kahtena viimeisenä elinvuotena ja niiden joukossa, jotka elivät pidempään. Erityisesti tutkittiin, miten ikä, kuoleman läheisyys, kotikunta ja dementiadiagnoosi ovat yhteydessä palvelujenkäyttöön, sekä miten käyttö kahtena viimeisenä elinvuotena muuttui vuodesta 1996 vuoteen 2003.

Tutkitut palvelut olivat (1) vuodeosastohoito sairaalassa (2) pitkäaikainen laitoshoito (3) säännöllinen kotihoito (vähintään kerran viikossa) ja (4) reseptilääkkeiden käyttö. Sairaalat olivat yliopisto-, ja yleissairaala (keskus-, alue- ja yksityinen sairaala) sekä terveyskeskuksen vuodeosasto, jos hoitopäiviä oli vähemmän kuin 90. Pitkäaikaishoitoa olivat vanhainkoti, tehostettu palveluasuminen ja terveyskeskuksen vuodeosasto, jos hoitopäiviä oli 90 tai enemmän. Tutkimuksessa analysoitiin 1) käyttikö henkilö kyseistä palvelua vähintään kerran tutkimusaikana (käytön todennäköisyys) ja 2) kuinka monta päivää henkilö vietti kyseisessä hoitopaikassa.

Tutkimuksen aineisto poimittiin Tilastokeskuksen, Terveyden ja hyvinvoinnin laitoksen sekä Kansaneläkelaitoksen rekistereistä. Tutkimusjoukkoon kuuluivat kaikki vuosina 1998, 2002 tai 2003 70-vuotiaana tai vanhempana kuolleet suomalaiset sekä 40 prosentin satunnaisotos vuosina 1999–2001 70-vuotiaana tai vanhempana kuolleista suomalaisista, yhteensä 145 944 henkilöä. Vuosina 1998– 2000 kuolleille poimittiin iän, sukupuolen ja kotikunnan mukaan kaltaistettu verrokki, joka oli elänyt vähintään kaksi vuotta pariaan pidempään. Kaltaistettuja tapaus–verrokki-pareja oli 56 001.

Kuoleman läheisyys määritti sairaalan ja pitkäaikaishoidon käyttöä voimakkaasti. Kaikissa ikäryhmissä ne, jotka elivät kahta viimeistä elinvuottaan, käyttivät enemmän palveluja kuin heidän kaltaistetut verrokkinsa, jotka elivät pidempään. Ero tapausten ja verrokkien välillä oli pienempi vanhimmassa kuin nuoremmissa ikäryhmissä. Myös ikä oli tärkeä palvelujenkäyttöä määrittävät tekijä. Nuoremmat käyttivät enemmän sairaalapalveluja, mutta vanhemmat enemmän pitkäaikaista laitoshoitoa.

Sairaalan käyttö kokonaisuutena vaihteli kuntien ja sairaanhoitopiirien välillä vähemmän kuin käytetty sairaalatyyppi. Yliopistosairaalan käyttö vaihteli eniten, ja myös yleissairaalan käytön vaihtelu oli suurta. Pitkäaikaishoidon ja kotihoidon käyttö eivät vaihdelleet tilastollisesti merkitsevästi sairaanhoitopiirien välillä. Kotihoidon käyttö vaihteli enemmän kuntien välillä kuin pitkäaikaishoidon käyttö. Palvelua käyttäneiden osuus vaihteli enemmän kuntien ja sairaanhoitopiirien välillä kuin hoitopäivien määrä palvelua käyttäneillä. Kuntien ominaisuudet eivät juuri selittäneet palvelujen käytön eroja.

Vanhat ihmiset, joilla oli dementia-diagnoosi, käyttivät pitkäaikaishoitoa yli yhdeksän kertaa todennäköisemmin kuin ne, joilla ei ollut dementia-diagnoosia. Sairaalan käyttö sen sijaan oli yleisempää niiden joukossa, joilla ei ollut dementiaa, vaikka muu sairastavuus oli vakioitu. Palvelua käyttäneiden joukossa dementiaa sairastavilla oli enemmän hoitopäiviä kuin ei-sairastavilla. Yliopistosairaalan ja pitkäaikaishoidon käyttö yleistyi tutkimusjakson aikana (1996–2003), kun taas yleissairaalan ja kotihoidon käyttö väheni. Hoitopäivien määrä kasvoi terveyskeskuksen vuodeosastolla ja pitkäaikaishoidossa mutta väheni yleissairaalassa.

Yhteenvetona voidaan todeta, että kuoleman läheisyys on tärkeä sosiaali- ja terveyspalvelujen käyttöä määrittävä tekijä. Kuoleman läheisyyden vaikutus on kuitenkin erilainen eri-ikäisillä ja eri palveluissa. Myös ikä vaikuttaa vanhojen ihmisten palvelujen käyttöön kahtena viimeisenä elinvuotena. Jatkossa pitäisi tutkia, miten tasa-arvo hoitoon pääsyssä toteutuu eri kunnissa asuvien vanhojen ihmisten kesken ja dementiaa sairastavien ja ei-sairastavien kesken.

1 Introduction

Old people use health and social services more than younger people do. They have more diseases and functional impairments than younger people, and therefore need care to compensate for the disability as well as treatment for the disease. The population in Finland is getting older, with both absolute numbers and the proportion of older people increasing rapidly; this is particularly true of the oldest old (85 years or over) (Official Statistics of Finland, 2009). These trends are expected to bring a sharp increase in health and social service use and expenditure in the near future.

In order that the health and social service system can properly respond to the needs of the ageing population, it needs to have access to detailed information about the determinants of service use. There are at least two possible explanations for the observation that service use is more common among older people than among younger people: either because they are old, or because they are near death. The use and costs of health and social services have found to be high in the last phase of life in all ages (Jakobsson, Bergh, Ohlen, Oden, & Gaston-Johansson, 2007), but there is also evidence of differences between age groups in levels of service use (Busse, Krauth, & Schwartz, 2002). End of life in old age is usually marked by disease and disability, and service use can be expected to accumulate in the last years of life.

This study builds on earlier research analysing the red herring hypothesis and high costs of dying, which has highlighted the effect of closeness of death on the use and costs of health services (e.g. Lubitz & Prihoda, 1984; Zweifel, Felder, & Meiers, 1999). However, there is lack of evidence on the role of age and closeness of death in the use of different types of health and social services. This study is concerned with health and social service use among older people. The focus is on service use in the last two years of life and on the differences in service use between those living their last two years of life and those living longer. The associations of age, closeness of death, municipality of residence, dementia diagnosis and year of death with service use among older people are studied in more detail.

This study applies the concepts and methods of health economics and health services research in the context of care for older people (70 years or older). A proper understanding of the mechanisms underlying health and social service use among older people requires the simultaneous application of many research disciplines, not only health sciences but also such fields as gerontology and demography.

The study was conducted as part of the COCTEL project (Costs Of Care Towards the End of Life), which is concerned with the effects of age, closeness of death and regional factors on health and social service use as well as with the costs and pathways of care.

2 Background

2.1 Ageing of population

The Finnish population is rapidly getting older, with both the absolute and relative number of older people rising sharply (Figure 1). A major new characteristic of the present population is the lengthening of old age, i.e. decreasing old age mortality. In 20 years, from 1989 to 2009, life expectancy in Finland at age 70 has increased from 13.8 to 17.0 years among women and from 10.9 to 13.7 years among men, and at age 80 from 7.5 to 9.4 years among women and from 6.2 to 7.6 years among men (Official Statistics of Finland, 2010). In most developed countries life expectancy has increased almost linearly, and this trend is expected to continue (Oeppen & Vaupel, 2002; Olshansky, Goldman, Zheng, & Rowe, 2009), although not all scholars agree (Olshansky et al., 2005).

Population ageing imposes a host of challenges for society. Most notable among these challenges are the provision of income transfers and the delivery of health and social services for older people. Income transfers account for the

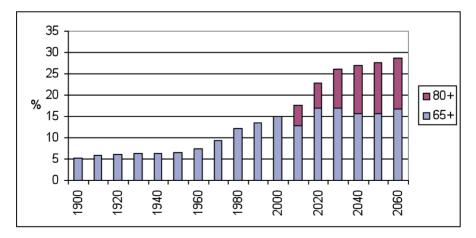


Figure 1. People aged 65 years or more as a proportion of the Finnish population from 1900 to 2010 and projection until 2060. Breakdown for age groups 65 or over and 80 or over provided from 2010 (Official Statistics of Finland, 2009).

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largest proportion of old-age expenditure (16.3 billion euro in 2008), from which services for older people accounted for 11.6% (National Audit Office of Finland, 2010). Health and social service expenditure starts to increase sharply on average at the age of 70 years (National Research and Development Centre for Welfare and Health, 2006). In the age group 80-84 years, for instance, health expenditure is four times and social service expenditure up to 20 times higher than in the age group 30–34 years (Heikkilä, 2007).

Need for health and social services among older people

The need for health and social services among older people is often due to disability and comorbidity (van Weel & Michels, 1997). It has been reported that the need for regular help (formal or informal) starts to increase after age 75 (Voutilainen et al., 2007). According to the findings of Vaarama (2004), one in six persons aged 65, one in three persons aged 75 and every other person aged 85 needed help on a daily basis.

The results on the development of disability vary or are even reversed between age groups and between different studies. Nationally representative data from Finland and other countries indicate decreasing disability for those aged 80 or younger from 1993 to 2005 (Sulander, Puska, Nissinen, Reunanen, & Uutela, 2007) and from 1978–1980 to 2000–2001 (Lafortune, Balestat, & Disability Study Expert Group Members, 2007; Martelin, Sainio, & Koskinen, 2004). The trends among the oldest old have been different: Sarkeala, Nummi, Vuorisalmi, Hervonen and Jylhä (2011) found that the level of disability among people aged 90 years or over in Finland was unchanged from 2001 to 2007. From 1978–1980 to 2000–2001, self-care ability and mobility decreased among people aged 85 years or more in the study of Martelin et al. (2004), and no decrease was seen in the prevalence of disability among people aged 85 years or more (Lafortune et al., 2007). In the USA the percentage of older people with mobility difficulty was shown to have increased markedly from 1998 to 2006 in all ages, but most steeply among people aged 80 or over (Crimmins & Beltran-Sanchez, 2011).

The likelihood of comorbidity and functional decline increases with age, which means that the need for services differs between age groups. However, epidemiological studies indicate that older people in their last years of life experience a steeper decline in functional status than do same-age survivors (Guralnik, LaCroix, Branch, Kasl, & Wallace, 1991; Wolinsky, Stump, Callahan, & Johnson, 1996), and among older people it is the oldest (85 years or over) who are more likely to experience a longer-term disability before death (Lunney, Lynn, Foley, Lipson, & Guralnik, 2003). Functional decline before death also differs by age, being greater with more advanced age at death (Guralnik et al., 1991). Diehr, Williamson, Burke and Psaty (2002) examined the associations of the ageing process and the dying process with changes in health variables such as self-rated health, activities of daily living (ADL), instrumental activities of daily living (IADL), bed days, walking speed and hospital use. They found that the effect of the dying process on all variables was substantially larger than the effect of ageing. No age effect was seen for hospital use.

The prevalence of diseases in the old population has increased over time (Christensen, Doblhammer, Rau, & Vaupel, 2009; Crimmins & Beltran-Sanchez, 2011). People today live longer with their diseases. They are more aware of them and get treatment for them more often. The time trend of the prevalence of dementia and low cognitive function among older people is not clear. The results depend upon the exact diagnosis and also vary between persons with diagnosis and measured lower cognitive functioning. In Finland dementia has become an increasingly common cause of death: in the space of two decades the numbers have more than doubled (Statistics Finland, 2010).

Development of health and functional ability

The effects of population ageing on the need for health and social services depend ultimately on the health of older people. The relationship between age and service use is not constant, nor will it be constant in the future (National Research and Development Centre for Welfare and Health, 2006). It has been predicted that the number of people with limited mobility will increase by 70% from 2000 to 2030 if their age-group specific proportions remain the same as in 1980-2000. However if functional ability continues to improve at the same pace, the number of people with disability will increase much more slowly, by about half that number (Martelin et al., 2004). In this case the need for health and social services would increase more slowly than population ageing gives reason to assume. Nonetheless the number of people aged 75 or older with disabilities has continued to rise sharply, despite the trends for the proportion of the disabled. In the future it is possible that the favourable trends in functional ability will reduce the need for services at least among those aged 80 or younger. However, there is no evidence of improving functional ability in the age groups 85-90 years or over, where service needs are highest.

Life expectancy can be divided into healthy and unhealthy life-years, during which needs for services vary. Christensen et al. (2009) concluded that people today are living longer than previously, and that they are living longer with less disability and fewer functional limitations. However, not all the empirical evidence supports this. Many studies have reported greater improvements in disability-free life expectancy (healthy life years, HLY) than in life expectancy (Crimmins, 2004; Jeune & Bronnum-Hansen H., 2008; Van Oyen, Cox, Demarest, Deboosere, & Lorant, 2008). In the UK, by contrast, it has been reported that HLY has increased less than life expectancy (Bebbington & Comas-Herrera, 2000). These discrepancies may be due to differences in ways of measuring disability (McNamee & Stearns, 2003).

There are at least three hypotheses regarding how increased life expectancy is associated with morbidity. The extreme hypotheses are compression and expansion of morbidity. Fries (2002) (first published in 1980) assumed that although the average length of life had increased, the maximum length of life had not. In the future, however, the amount of time people spend in poor health will be shorter and compressed to the end of life; hence the theory of compression of morbidity. Gruenberg (2005) (first published in 1977) assumed that age-specific risks for poor health are constant, but the survival of frail old people will increase, which will then lead to an expansion of morbidity. The third hypothesis is called dynamic equilibrium (Manton, 1982): longevity increases both the number of years that people spend in good and poor health, but the conditions suffered in poor health will be less serious.

The empirical results testing the hypotheses are contradictory. Cai and Lubitz (2007) found an increase in active life years (ALE) and a decrease in life expectancy among old Americans with severe disability from 1992 to 2003. These findings were consistent with certain elements of the theories of compression of morbidity and dynamic equilibrium. The findings of Crimmins and Beltran-Sanchez (2011) did not support the compression of morbidity hypothesis in the USA. In their review Robine, Saito and Jagger (2009) found no strong evidence of compression of morbidity in countries with the lowest mortality rates.

Population ageing and health expenditure

Although the evidence suggests that health care expenditure is higher for older people than for younger individuals (micro level), it is not clear whether population ageing will increase aggregate costs at macro level (Chernichovsky & Markowitz, 2004; Getzen, 1992). Total expenditure will grow rapidly if demographic trends combine with rising per capita expenditure (Garber, MaCurdy, & McClellan, 1999). However, the increasing number of older people will not necessarily increase health expenditure per capita. Lubitz, Beebe and Baker (1995) reported that lifetime Medicare¹ payments were higher for those who lived longer, but the payments associated with an additional year of life decreased with increasing age at death. There are also results indicating that the share of total health expenditure

¹ Medicare is a health insurance programme in the USA. It is intended for people aged 65 or older and people under age 65 with certain disabilities. Part A Hospital Insurance helps to cover inpatient care in hospitals and skilled nursing facilities (not long-term care), hospice care and some home care. Part B Medical Insurance helps to cover doctor's services and outpatient care (Centers for Medicare and Medicaid services, 2005).

allocated to the population aged 65 and over has decreased, for instance in England and Wales from 40% in 1985-87 to 35% 1996-99 (Seshamani & Gray, 2002).

Population ageing is not the only and not even the most important driver of health care expenditure. In OECD countries the age effect accounted for less than one-tenth of the growth of health expenditure between 1970 and 2002 (OECD, 2006). Dormont, Grignon and Huber (2006) studied the effect of demographic change, changes in morbidity and changes in care practices on the increase in health expenditure from 1992 to 2000 in France and concluded that ageing had a relatively minor impact on rising HCE. The impact of changes in care practices was 3.8 times higher, and changes in morbidity induced savings which more than offset the increase due to population ageing. The effect of changes in practices was particularly pronounced in the use of medicines. Earlier Chernichovsky and Markowitz (2004) and Getzen (1992) found that population ageing is not a significant cause of rising health care costs, but increasing GDP and per capita income emerged as statistically significant predictors.

Projections

Some projections have been made to evaluate the impact of population ageing on health and social service use and expenditure. The results of these projections vary because of their different background assumptions and because they cover different sets of expenditures (National Research and Development Centre for Welfare and Health, 2006). Many forecasts are based on current health and social expenditure in different age groups, which are then projected according the expected population trends (National Research and Development Centre for Welfare and Health, 2006). In other words they ignore possible future changes in morbidity and disability among older people (Lassila & Valkonen, 2011). Räty, Luoma, Mäkinen and Vaarama (2003) assumed that increasing life expectancy will shift the focus of demand for services by one year over every ten years, and Vaarama and Voutilainen (2002) took into account the current service structure recommendations and assumed changes in service demand and efficiency. However, the projections are affected by a host of other factors as well, including changes in the way services are organized and delivered, the prices of services, the development of health and functional status, and labour productivity.

In Finland several research institutes have projected that the strongest increase in health and social service use and expenditure will be seen from 2010 to 2030. This growth is forecast to continue from 2030 through to 2050, but it will be steadier (Lassila & Valkonen, 2002; National Research and Development Centre for Welfare and Health, 2006; Räty et al., 2003). It is thought that the growth of social care expenditure is primarily explained by the increasing use of home care and other services for older people, while the growth of health expenditure is additionally explained by the development of technology (Ministry of Social Affairs and Health, 2002). The main factors underlying the increase in social expenditure are assumed to be earnings-related pensions, health care and care for older people (Lassila & Valkonen, 2002).

Since it has been shown that health care expenditure increases substantially with the approach of death and that the effect of age is reduced when controlling for time to death, some projections have also taken into account time to death. Häkkinen, Martikainen, Noro, Nihtilä and Peltola (2008) projected health expenditure from 2016 to 2036, firstly, by using a naïve model (including age, gender and their interactions); secondly, by taking into account the proximity of death; and thirdly, by assuming an improvement in the functional capacity of older people so that need for long-term institutional care would be delayed by three years. The second model gave a 13% lower projection for total expenditure in 2036 than the naïve model, and the third model a 22% lower projection than the naïve model (Häkkinen et al., 2008).

Similar effects have been found in projections made in different countries. In the USA, naïve models overestimated predicted lifetime health expenditure by 9-15% (depending on the longevity assumption) over a 20-year forecast period (Stearns & Norton, 2004). A naïve method indicated 22.5% higher future health care costs than an improved method that took into account the proximity of death in Denmark from 1995 to 2020 (Serup-Hansen, Wickstrøm, & Kristiansen, 2002). Seshamani and Gray (2004b) projected that the real average age-specific per capita costs of the old population will decrease from 2002 to 2026. Aggregate hospital costs will therefore be much lower than indicated by naïve models. However, Breyer and Felder (2006) concluded that excluding the effect of costs of dying on HCE leads to a smaller error than underestimating the financial consequences of expanding medical technology.

2.2 Red herring hypothesis

"Red herring" refers to a false lead which points in one direction when in fact the truth lies somewhere else. In the context of health economics, the red herring hypothesis means that while it is assumed that the main driver of the use and costs of health and social services among older people at the individual level is age, the real reason is the closeness of death (or time-to-death, TTD). The hypothesis is interpreted to imply that population ageing will not have such a great impact on health care use and costs in the future because the most expensive phase of life will not necessarily lengthen.

The red herring hypothesis was first tested and named by Zweifel et al. (1999). Before them, research was concerned to explore the "high costs of dying".

Lubitz and Prihoda (1984) found that 28% of Medicare expenditure in 1978 was attributable to 5.9% of beneficiaries who died in that year, and they concluded that the higher costs of health care at older ages were largely due to higher mortality. A similar result was reported ten years later by Temkin-Greener, Meiners, Petty and Szydlowski (1992) and in 2002 in the UK, where decedents comprised 1% of the population and accounted for 28.9% of total hospital expenditures (Seshamani & Gray, 2004b). Riley and Lubitz (2010) found that the proportion of Medicare spending on those who were living their last years of life declined slightly from 1978 to 2006, but after adjusting for age, sex and death rates, the trend was not significant. The "high costs of dying" findings has provoked discussion about wasteful resource use on dying persons as well as claims about overly intensive treatments and heroic efforts to save lives, but there is no evidence to back up these claims (see e.g. Lubitz & Prihoda, 1984; McCall, 1984; Scitovsky, 2005).

Zweifel et al. (1999) tested two hypotheses: Does HCE during the last years of life increase as a function of closeness to death (hypothesis D), or does it increase as a function of age (hypothesis A)? This test allows for conclusions to be drawn about the future growth of HCE. If A is accepted, population ageing will drive up per capita HCE; if D is accepted, ageing cannot be a principal cost driver at the level of the individual. However, when the number of persons in their last two years of life increases as a proportion of the population, HCE will also increase. The results lend strong support to hypothesis D: no correlation was found between age and HCE for older people. In the last three months of life HCE was several times higher (307% and 218% in different samples) than in the three-month period two years before death. The last phase of life was costly in all old ages (Zweifel et al., 1999). These findings have subsequently been confirmed: proximity to death increases hospital costs more than age (Häkkinen et al., 2008; Hashimoto, Horiguchi, & Matsuda, 2010; Seshamani & Gray, 2004c). When the importance of time to death was recognized, models that excluded this factor became known as naïve (Werblow, Felder, & Zweifel, 2007).

The red herring hypothesis was first tested in the context of health care expenditure and hospital use and later in the context of long-term care and other services. Norton (2000) suggested that long-term care expenditure increases with age, but acute medical expenses do not. Yang, Norton and Stearns (2003) concluded that closeness of death was the main reason for higher hospital inpatient costs, while age was the main reason for higher long-term care costs. The authors of the original red herring paper later expanded their hypothesis to apply to other services as well (Werblow et al., 2007). They found that not age but proximity to death was affecting the use and costs of all other services, while age had a significant positive effect on long-term care (institutional and home care).

However proximity to death was also an important determinant of the use of long-term care services.

The original red herring paper by Zweifel et al. (1999) has subsequently been widely revisited and criticized. Getzen (2001) pointed out that Zweifel et al. failed to include survivors and persons younger than 65 years and that they derived macroeconomic variables simply from micro level findings. In addition, it has been found that studies testing the red herring hypothesis are susceptible to endogeneity: health care expenditure (HCE) is explained by TTD, but on the other hand HCE may also affect TTD (McNamee & Stearns, 2003; Salas & Raftery, 2001). Zweifel, Felder and Meier (2001) argued that the endogeneity claim was not supported by the available empirical evidence. Later on they found that endogeneity does in fact exist: HCE has a positive effect on TTD, except during the last month before death (Felder, Werblow, & Zweifel, 2010). Still, the core results that TTD rather than age determines HCE were confirmed.

Seshamani and Gray (2004a) tested the results of Zweifel et al. (1999) with their own data and argued that the Heckman selection model used by Zweifel et al. showed that neither age nor closeness of death have a significant effect on hospital costs. They demonstrated econometric problems and preferred to use a more robust two-part model, with which they proceeded to conclude that both age and proximity of death have effects on hospital costs. However, the effect of age was smaller than that of proximity of death (Seshamani & Gray, 2004a). Salas and Raftery (2001) also criticized the correction of selection bias used in the Heckman model for potential multicollinearity.

2.3 Basic concepts

Health economics comprises two main themes, viz. equity and efficiency. This study is concerned with the equity theme, i.e. with how health and social services are distributed among older people. The view is positive rather than normative: the aim is to answer the question of how services are distributed, not to establish how they should be distributed. Resources are always scarce in relation to unlimited needs (regardless of whether the population is ageing), and choices regarding allocation have to be made. Opportunity cost of the service is the utility that would be obtained from the best alternative use of resources.

This study is concerned to describe and analyse the use of health and social services. Service use takes place when demand meets supply (Figure 2). Demand is derived from need, from the individual's interpretation that certain symptoms call for services. Demand is also preceded by the individual's desire for services. Needs and desires are unlimited, whereas resources are limited, and the individual will aim to choose the option that they believe will give the highest utility.

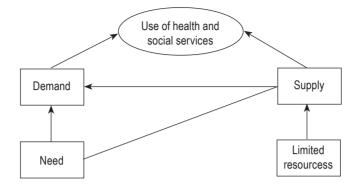


Figure 2. Relations of demand, supply and use of health and social services.

Need has been defined as the ability to benefit: need is the ability of individuals or groups to benefit from the consumption of health care, where benefit is measured in terms of health improvements (Culyer, 1991). Another way of defining need is to suggest that the needed entity (1) is actually necessary and (2) it ought to be received (Culyer, 2005). In health care contexts individuals do not necessarily know what their needs are nor what the costs and utilities of care are. Therefore health professionals have an important role in decisions about the use of services.

Demand expresses the quantity of commodity that the buyer wishes to purchase at current prices, and supply the quantity of commodity that sellers are willing to sell at current prices. In health and social care markets the impact of prices and the roles of purchaser and seller are less clear.

Demand for health care is irregular and unpredictable (Arrow, 1963). In the field of health care it is possible to distinguish at least three kinds of demand: demand for health, demand for health care or services (which is derived from demand for health) and supplier-induced demand (SID). SID arises from the asymmetric information between physician (or other health care professional) and patient, when the physician is in the position to influence the demand for his own services (Evans, 1991) (Figure 2).

It has been suggested that demand for long-term care is fundamentally different in nature from demand for other health services. Long-term care is designed for the care for chronic illness or disability, and the length of stay may be measured in years (Norton, 2000). As a rule the demand for long-term care is not acute, but the consumer has relative freedom of choice in deciding where to seek help, provided that supply is available. It is also easier for the consumer to evaluate the quality of long-term care than that of more specialized health care (Norton, 2000).

The supply of health and social services differs from that of other commodities. The most critical differences are information asymmetry, uncertainty and externalities (Sintonen, Pekurinen, & Linnakko, 1997). For these reasons health care markets and the public health care sector are regulated by the government.

In an analysis of the use of health and social services, it is not easy to specify which factors represent the demand side and which represent the supply side. Usually what is interpreted as demand is in fact a combination of demand and supply (Norton, 2000). For example, age may be a determinant of demand for long-term care, but if access to long-term care varies by age, it is also a determinant of the supply of long-term care.

The literature of use and costs of services overlap, for costs are derived from the use (C = p * q), C = costs, p = price and q = quantity of services. Therefore, even though the present analysis does not extend to costs, the literature review here also comprises studies that look into both the use and costs of health and social services.

2.4 Health and social services for older people in Finland

Services for older people can be considered to include two main components: care and cure. Care is about helping people with their daily activities and personal care, while cure has a stronger medical emphasis: the purpose is to make a person's health better or to palliate symptoms. Cure is more typically provided formally, while most care is informal. Distinctions are always going to be artificial, but formal care services are usually provided in the social sector and cure in the health sector. Services for older people are arranged at the interface of health and social services, and they may come under different branches of administration.

At the national level, health and social care delivery is regulated by the Ministry of Social Affairs and Health (MSAH), which issues guidelines and recommendations, e.g. the National framework for high-quality services for older people (Ministry of Social Affairs and Health & Association of Finnish Local and Regional Authorities, 2008) to the municipalities that are responsible for service provision. It also has overall financial and supervisory responsibility. Central government transfers to municipalities were formerly earmarked for specific services, but today municipalities are free to decide how to allocate these funds (National Research and Development Centre for Welfare and Health, 2006). Most services are statutory and governed by different laws (Social Welfare Act 710/1982 and Primary Health Care Act 66/1972). However, scarcity of resources often makes it difficult for municipalities to meet their legal obligations. There has been long-standing discussion on the introduction of separate legislation on services for older people. A new Health Care Act entered into force on 1 May 2011. The basic structures of care for older people will remain unchanged, but clients will have greater freedom to choose where they want to receive care.

Finland is divided into 21 hospital districts, which provide secondary care. Each hospital district has a central hospital, five of which are university hospitals. University hospitals produce tertiary care as well as some secondary care in their district. Most hospital districts also have one or more district hospitals.

Responsibility for the provision of health and social services for local residents rests with municipalities, of which there were 336 in 2011. Municipalities may produce the services themselves, jointly with other municipalities, or purchase them from another public or private (for-profit) or third sector (not-for-profit) service producer. Users may also purchase the services they need directly from the private or third sector; these purchases are partly subsidized by the Social Insurance Institution (SII). Municipalities have significant powers and autonomy to plan and implement their services as they best see fit (Vuorenkoski, Mladovsky, & Mossialos, 2008), and indeed there is much variation in how they respond to the needs of their residents.

For the most part older people use the same health care services as other age groups, but there are some services that are specifically targeted at them. Acute care is provided by different types of hospitals, and inpatient wards of health centres also provide long-term care. Every municipality or joint municipal authority has a health centre that provides primary outpatient and inpatient services. Health centre inpatient wards allocate some 60% of their capacity to the provision of acute care, the rest is allocated to the long-term care of older people (Kokko, 2009). The share of acute and long-term care varies between health centres (Vuorenkoski et al., 2008). Health centre inpatient wards play an important part in the care of older people: 91% of the patients at these units are 65 years or older (National Research and Development Centre for Welfare and Health, 2006).

Residential homes for older people are primarily intended for long-term care, but they also admit clients for shorter stays for instance for the duration of an informal carer's leave. In sheltered housing older people live in their own apartments and can purchase services according to their needs. Personnel at ordinary sheltered housing facilities are available during the daytime only, but there are also facilities with 24-hour assistance. Only the latter facilities are classified as long-term institutional care.

Older people living in their own homes or ordinary sheltered housing can obtain home help services, home nursing and support services, e.g. meals on wheels, cleaning or transportation services.

Private health care mainly comprises ambulatory care, which is only available in larger cities. The private sector provides about 16% of all outpatient visits to physicians, 41% of visits to dentists and 5% of inpatient care (Vuorenkoski et al., 2008). The capability of older people to pay is improving, and they are now in the position to buy services from the private sector if the supply is available (Vaarama, 2004).

In 2002 three-quarters of all care services for older people were provided by the public sector, the remaining one-quarter by the private sector and the third sector (Parkkinen, 2004). The roles of the private and the third sector are different in different services. In 2010, 96% of inpatient care in health centres was public and 4% private (National Institute for Health and Welfare, 2011). Care in residential homes was mainly (87%) produced by public providers, 10% by the third sector and only 3% by the private sector. The major provider of sheltered housing with 24-hour assistance was the public sector (42%), followed by the third sector (32%) and the private sector (26%). No exact figures are available for home nursing, but it is primarily produced publicly. In 2003 76% of home help was produced publicly, 10% privately and 14% by the third sector (National Research and Development Centre for Welfare and Health, 2004). As for services delivered to homes, privately produced services are mainly used for smaller needs and public services for larger needs (Vaarama, 2004). There is some inter-sectoral cooperation, but overall the service field tends to be highly fragmented, and according to National Audit Office of Finland (2010) the planning of care leaves much to be desired. Regardless of the sector that produces the services for older people, the responsibility for service delivery to local residents rests with the municipality.

Informal care is help provided for coping with daily domestic tasks and in everyday life as well as care and prevention of diseases by a spouse, children, other relatives or friends. Informal care is typically long-term (Norton, 2000). The evidence suggests that among older people, informal care is a more common source of help than formal care (Anttonen & Sointu, 2006; Blomgren, Martikainen, Martelin, & Koskinen, 2006; Vaarama, 2004; van Aerschot & Majanen, 2010). In the study of Blomgren et al. (2006) most of those older people (\geq 70 years) who received formal help also had access to informal help, but very few received formal help only. However, not all older people have people around them who can offer them help. Older men living alone and both women and men with no children were found to receive formal help only (Blomgren et al., 2006). It has been found that older people with children or a spouse have better access to formal care (Pot et al., 2009).

Financial support is available for informal care providers (Statute 318/1993, Act of Support for Informal Care 937/2005 came into effect on 1 January 2006). This is based on formal agreements signed between the municipalities and the caregivers, who will receive payment according to local terms and conditions as well as two days off a month; on those days the patient will receive care through municipal services. In 2005 support for informal care provision was provided to the carers of 2.3% of people aged 65 or over (Voutilainen et al., 2007). The

proportion of carers eligible to receive the support is higher, but not all of them apply.

It has been suggested that generally, informal and formal care are substitutes for each other, but in the case of severely disabled people they complement each other (van Houtven & Norton, 2004). Commodities or services are substitutes if increases in the price of one commodity or service lead to an increase in the demand for the other commodity or service (A. J. Culyer, 2005). Informal care is not intended as a substitute for all kinds of formal care. In one study informal care was found to reduce the use of home health care services and to delay nursing home entry, and also to substitute hospital care and physician visits (van Houtven & Norton, 2004). A Finnish study found that informal care substituted for an estimated 11,400 inpatient bed-day in 2002 (Vaarama, 2004).

Health services are financed by municipalities (35%), central government (24%), the Social Insurance Institution (15%), private households (20%), employers (3%) and others (4%) (National Institute for Health and Welfare, 2010). User fees account for a variable proportion of total financing depending on the service in question. In 2005, user fees accounted for one-fifth of the costs of home care and for one-sixth of the costs of residential home care (National Research and Development Centre for Welfare and Health, 2007). User fees for short-term care are usually fixed. Fees for regular home care are based on the overall volume of services and on the size and income of the care recipient's family. In the case of long-term institutional care, user fees are based on the client's ability to pay (National Research and Development Centre for Welfare and Health, 2007). Private health care and prescription medicines are partly reimbursed under National Health Insurance (NHI), which is based on compulsory insurance fees. Sheltered housing residents may be eligible to receive an allowance from the SII to cover a part of their rent and service fees (Väisänen & Hujanen, 2010). Municipalities have an incentive to find alternatives to their own service provision and in this way to shift the burden of financing to other parties. For instance, in residential homes the costs of patient medication is covered by the municipality, whereas in sheltered housing they are covered under the NHI (Häkkinen, 2005).

Over the past two decades services for older people have failed to keep up with the growth of the elderly population: while the number of older people has continued to rise, services have been shrinking (Parkkinen, 2002). The proportion of people aged 75 or more and using services for older people decreased from 1988 to 2000, with the exception of the use of sheltered housing, which actually increased (Vaarama & Voutilainen, 2002). A similar trend was observed from 2000 to 2009 (National Institute for Health and Welfare, 2011). The main reason for reduced service coverage is usually thought to lie in the lack of money, but attitudes and values also come into play (Vaarama, 2004).

Most older people prefer to live in their own home. In 1992 the Ministry of Social Affairs and Health took the decision to start moving away from institutional care towards sheltered housing and home care arrangements (Ministry of Social Affairs and Health, 1992). Since then, the proportion of older people in long-term care has remained at close to 10%, but the proportion of sheltered housing residents has increased and the use of institutional care has decreased (Kokko & Valtonen, 2008; Voutilainen et al., 2007). However, home care has not been found to increase to offset the decrease in institutional care (Kokko & Valtonen, 2008). The recession of the 1990s also had an effect on the service structure and the coverage of services (Vaarama & Voutilainen, 2002).

The supply of home services in particular falls short of current service needs. The resources made available to home care have not increased in line with targets (National Audit Office of Finland, 2010). The coverage of services provided to people living at home decreased from 1990 through to 2002, when coverage started to increase (Vaarama, 2004). Home care clients are increasingly old and have an increasing number of disabilities. The proportion of those receiving home care services up to several times a day has increased, while those receiving less visits has decreased (Kokko & Valtonen, 2008; Vaarama, 2004). The proportion of home care users varies in different regions from less than 10% to 17.4% (Voutilainen et al., 2007). Home care is considered a cheaper option than institutional care, but that is not necessarily the case if it is necessary to arrange a number of visits a day or other services to support those living at home (National Audit Office of Finland, 2010).

The proportions of older people getting support for informal care and admitted to sheltered housing with 24-hour assistance has been on the increase (National Institute for Health and Welfare, 2011). Responsibility for care provision has been delegated to family members, and priority given to sheltered housing. The service structure still leans towards institutional care (Vaarama, 2004), particularly when sheltered housing with 24-hour assistance is considered a form of institutional care.

The National framework for high-quality services for older people (Ministry of Social Affairs and Health & Association of Finnish Local and Regional Authorities, 2008) also recommended reducing the level of institutional care, especially long-term care in health centres. A working group (Ikähoiva) set up by MSAH to look into ways of developing care for the elderly proposed discarding the fragmented three-tier 24-hour care system in favour of one-tier 24-hour care, and furthermore recommended that institutional care not be replaced by institutional solutions. The working group concluded that preference should be given to homelike housing for older people and that transitions between care facilities be minimized in situations where residents' needs were changing.

The challenges arising from population ageing will affect Finnish municipalities at different stages. In many municipalities the number of older people has already exceeded the projected national average for 2030 (Vaarama, 2004). The old age dependency ratio (i.e. the number of older people aged 65 or over as a proportion of working age population) varies widely in different areas and is projected to exceed 100% by 2030 in some areas (Parkkinen, 2002). The organization of services for older people also varies: for instance the coverage of institutional long-term care has increased in 40% and decreased in 60% of Finnish municipalities (Kokko & Valtonen, 2008).

3 Use and costs of health and social services at the end of life among older people

The studies reviewed here were focused on the use and costs of health and social services in the last years of life among older people. The services included, the age limits applied and the follow-up periods all differ across these studies. The following reports the main results of these studies, which are summarized in Appendix tables 1–3. Health service use at the end of life has also been studied among younger age groups, for instance at the age of ≥18 years (Jakobsson et al., 2007) and all ages (Busse et al., 2002). Studies dealing with the last year of life of cancer sufferers or other people with a terminal illness were excluded from the review.

3.1 Impact of closeness of death

This section reviews earlier studies dealing with the use and costs of services (1) among decedents and survivors and (2) monthly service use in the last year of life.

It has been reported that HCE is several times higher for decedents than for survivors: on average 276% higher in the study of Experton, Ozminkowski, Branch, and Li (1996), 3–6 times higher in the study of McCall (1984) and 13.5 times higher in the study of Polder, Barendregt and van Oers (2006). Werblow et al. (2007) found that HCE was 5 times higher for decedents than survivors one year before death and two times higher four years before death, and Hoover, Crystal, Kumar, Sambamoorthi and Cantor (2002) reported that HCE was more than 5-fold for the last year of life as compared to non-terminal years.

Marked differences have been found in service use. Experton et al. (1996) reported that decedents were seven times as likely to have any hospital admission, four times as likely to be admitted to a skilled nursing facility and twice as likely to use home health services than survivors. Decedents' hospital use was more than twice as high as survivors' in the study of Wolinsky, Stump and Johnson (1995). Among those who had hospital episodes, decedents were found to have 11.5 days longer total stays than survivors. Decedent status (decedent = 1, survivor = 0)

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had the greatest impact of any variable describing hospital resource consumption (Wolinsky, Culler, Callahan, & Johnson, 1994).

Decedent status was found to have a significant effect on the use of both acute and long-term care in the Netherlands when age and gender were adjusted for (Pot et al., 2009). The results were not affected by adding enabling variables (see Andersen & Newman, 1973) to the model, but adding need variables (disease and disability related) eliminated the effect of decedent status in other services than long-term institutional care. In Japan decedents were found to have a higher probability to use institutional care than survivors, but there was no difference in expenditure per user (Hashimoto et al., 2010).

The cost ratio of decedents and survivors has been found to decrease sharply with age (Häkkinen et al., 2008; Perls & Wood, 1996; Polder et al., 2006; Serup-Hansen et al., 2002). In the study of Temkin-Greener et al. (1992), the health care costs for younger decedents in the last year of life were on average 285% higher than those for survivors, but the costs for the oldest (85 years or over) decedents were only 35% higher than those for the survivors of their age. In the use of acute care, the difference between decedents and survivors was greater in younger than older age groups (from 55–60 to 85–91 years) in the Netherlands (Pot et al., 2009). The difference has diminished with age because the probability of service use and the expenditure decreased with advancing age among decedents and increased among survivors (Hashimoto et al., 2010; Lubitz & Prihoda, 1984). In the use of long-term care, on the other hand, the difference between decedents and survivors was actually found to grow with increasing age in the studies of Pot et al. (2009) and Werblow et al. (2007).

There is no consensus on whether the effect of decedent status on the use and costs of services is due to decedents' diseases and disability, or whether some other mechanism is at play. Rhee, Degenholtz, Muramatsu and Lau (2009) found that decedents were more likely to use care and that they received more hours of both formal and informal care than survivors, even when physical and cognitive disability was adjusted for. According to Scitovsky (1988) the care of dying older people involves additional burdens beyond those that can be explained on the basis of health status alone. However, Hogan, Lunney, Gabel and Lynn (2001) suggested that the "high cost of dying" is due simply to the cost of caring for severe illness and functional impairment. In their study decedents' costs were not much higher than those of others who had similarly complex medical needs.

In addition to differences between decedents and survivors, research has been undertaken to explore the effect of closeness of death on the use and costs of services within the last year(s) of life in order to establish the exact point at which use and costs begin to increase when life approaches its end. It has been reported that costs rise in the very last month of life (Liu, Wiener, & Niefeld, 2006). In the USA 30% of all Medicare expenditure (Lubitz & Prihoda, 1984) and in the Netherlands 36.5% of HCE (Stooker et al., 2001) in the last year of life were incurred in the last month. In the USA the increase in HCE was found to start 24 months before death, accelerating from 6 months up to the last month before death (Yang et al., 2003). In a Swiss data HCE was much higher in the last three months of life than in the 24–22 last months (Felder, Meier, & Schmitt, 2000). Liu et al. (2006) found that Medicare acute care (mainly hospital) costs rose dramatically in the last three months of life.

In Sweden Larsson, Kåreholt and Thorslund (2008) reported that hospital use started to increase 9 months before death. In the USA it was found that total health services use, dominated by hospital use, increased seven months before death, with the largest increase occurring in the last month (Mukamel, Bajorska, & Temkin-Greener, 2002). McCall (1984) found that 60% of care (mostly hospital care) in the last year of life was provided during the last three months, and Garber et al. (1999) found that the number of days in hospital or hospice rose sharply as the date of death approached. Long and Marshall (2000) reported that the intensity of care increased in all age groups in the last month of life. In Japan, the probability of using hospital inpatient care increased month by month before death, as did expenditure per user, but decreased in the very last month of life (Hashimoto et al., 2010).

In Sweden the use of institutional care was found to increase sharply in the last 6 months before death (Larsson et al., 2008), but the effect of closeness of death has been found to extend even further: in Canada the use of nursing home increased steadily for the last four years of life (Roos, Montgomery, & Roos, 1987). In Japan Hashimoto et al. (2010) found a decreasing trend in institutional care use towards the end of life. Here both the probability of using institutional care and expenditure per user remained stable in the last year until the second last month of life and then decreased (Hashimoto et al., 2010). Medicaid² long-term care costs were also found to be stable for the last year of life until the very last month, when they decreased (Liu et al., 2006).

Although the sharpest increase in hospital use has been found to occur during the last year of life, there are also indications that this trend continues over a longer period. Hospital use doubled from the fourth to the second last year of life in all but the youngest (45-64 years) age group in the study of Roos et al. (1987). Seshamani and Gray (2004c) found that the probability of hospital use increased from year 16 before death and quadrupled from the second last to the last year of

² Medicaid is a state administered health insurance programme in the USA. It is available to low-income individuals who meet certain eligibility criteria (Centers for Medicare and Medicaid services, 2005).

life. In their study the costs among those who were hospitalized also increased in the last 11 years of life.

Age has been found to modify the time effect, with a shorter period of increased service use detected among the oldest than among younger decedents (Roos et al., 1987; Seshamani & Gray, 2004c; Temkin-Greener et al., 1992).

3.2 Impact of age and gender

The effect of age on the use and costs of health and social services at the end of life has been extensively researched. Three differing results have been reported: use and costs increase with advancing age, use and costs decrease with advancing age, or use and costs initially increase but after a certain threshold age start to decrease. The effect of age on costs seems to depend largely on which services are included in the analysis.

The studies concluding that total health care expenditure (HCE) increases with age have mostly covered nursing home or long-term care expenditure (Häkkinen et al., 2008; Roos et al., 1987; Werblow et al., 2007). Several studies have found that the use of institutional long-term care increases with advancing age (Bickel, 1998; Bird, Shugarman, & Lynn, 2002 Oct; Häkkinen et al., 2008; Liu et al., 2006; Lubitz & Prihoda, 1984; Menec, Lix, Nowicki, & Ekuma, 2007; Pot et al., 2009; Yang et al., 2003).

Total HCE has been found to decrease with age in Switzerland (Felder et al., 2000), the Netherlands (Polder et al., 2006), the USA (Bird et al., 2002; Hogan et al., 2001; Levinsky et al., 2001; Lubitz et al., 1995; Lubitz & Riley, 1993; Shugarman et al., 2004; Stearns & Norton, 2004; Temkin-Greener et al., 1992) and Germany (Brockmann, 2002). In Finland Häkkinen et al. (2008) showed that expenditure on somatic care and prescribed medicines decreased with age. Levinsky et al. (2001) concluded that about 80% of the decrease in Medicare expenditure was due to less aggressive medical care with advancing age.

Acute care costs were found to be higher among younger old people, but nursing home expenditure higher among older olds (Hoover et al., 2002; Liu et al., 2006; Scitovsky, 1988; Spillman & Lubitz, 2000; Temkin-Greener et al., 1992). Similarly the number of hospital days was found to decrease slightly with advancing age, but the number of nursing home days to increase dramatically (Brock, Foley, & Salive, 1996).

The use of hospital care has been found to decrease with advancing age on a number of indicators: probability of use (Bickel, 1998; Brameld, Holman, Bass, Codde, & Rouse, 1998; Menec et al., 2007), number of days (Busse et al., 2002), total inpatient resource use (Brameld et al., 1998), number of care episodes (Wolinsky et al., 1995) and intensity of care (Long & Marshall, 2000).

A threshold in hospital use has been found at the age of 80–85 years. In the UK Seshamani and Gray (2004a) found that the probability of hospital use increased with advancing age until 85 years and then started to fall, and in another study by the same authors Seshamani and Gray (2004c) hospital costs in the last year of life increased with age until 80 and then decreased. In the Netherlands, the use of acute care (hospital admission and contact with medical specialist) increased with age until 80 years and then started to decrease (Pot et al., 2009).

The decreasing effect of age on HCE seems to be typical of the last year of life: age differences have found to vary between the last year of life and preceding years. Shugarman et al. (2004) found that in the second and third last year of life, older age (90 years or over) implied higher costs. In the study by Temkin-Greener et al. (1992), no difference was seen between the oldest (85 years or over) and younger (65–74 years) age groups in the year before the last year of life. Seshamani and Gray (2004c) found no age differences in hospital costs ten years before death, and in the study of Lubitz et al. (1995) Medicare payments decreased only slightly by age in the 3–10 years before death.

The results of earlier studies on gender differences in the use of long-term institutional care show consistently that use is more common among women than men (Bird et al., 2002; Häkkinen et al., 2008; Klinkenberg et al., 2005; Roos et al., 1987). Polder et al. (2006) found no difference between men and women in HCE in the last year of life in the Netherlands, and Liu et al. (2006) reported the same result for Medicare and Medicaid spending in the USA. It has been found that the share of costs attributable to women and men varies in different age groups: among younger olds (68–74 and 75–79) the costs were higher for women, whereas among older olds (90 years or over) men had higher costs in their last year of life (Shugarman et al., 2004). In the study of Spillman and Lubitz (2000) HCE was consistently higher for women than men after adjusting for the increased longevity of women. Bird et al. (2002) found no difference between women and men in total Medicare expenditure in the last year of life, but in the oldest age group (85 years or over) expenditure was higher for men. In Germany the last year of life was found to be less costly among the oldest olds (90 years or over), more often so among women than men (Brockmann, 2002).

Although all the studies mentioned above were agreed that service use is concentrated in the last years of life, Wilson and Truman (2002) reported from Canada that acute hospital use in the last five years of life was low and that age, gender and illness did not distinguish use.

3.3 Impact of dementia

Marked differences have been found in health and social service use between older people with and without dementia. Dementing illnesses have found to be the most important predictor of long-term care among older people (Aguero-Torres, von Strauss, Viitanen, Winblad, & Fratiglioni, 2001; Andel, Hyer, & Slack, 2007; Bharucha, Pandav, Shen, Dodge, & Ganguli, 2004; Brock et al., 1996; Kendig, Browning, Pedlow, Wells, & Thomas, 2010; Luppa et al., 2010; Taylor & Sloan, 2000; Viramo & Frey, 2001). In a six-year follow-up study in Finland, 70% of women with dementia and 55% of men with dementia were institutionalized (Nihtilä et al., 2008). According to Voutilainen et al. (2007), 95% of clients of long-term institutional care and 60% of clients of home care have some dementia symptoms. Although long-term institutional care accounts for a substantial proportion of the costs from dementia, no significant difference was found between the costs of care for demented people living at home and in a nursing home in Hungary (Ersek et al., 2010).

The results for the associations of dementia with hospital use are contradictory. It has been reported both that people with dementia are more (Bynum et al., 2004; Caspi, Silverstein, Porell, & Kwan, 2009; Zuliani et al., 2011) and less (McCormick et al., 2001; Rosenwax, McNamara, & Zilkens, 2009) likely to be treated in hospital than those without the disease. Among those receiving care in hospital, length of stay has been found to be higher among people with dementia (Guijarro et al., 2010; Lyketsos, Sheppard, & Rabins, 2000).

In the study of Taylor and Sloan (2000), average total Medicare costs for persons with Alzheimer's disease (AD) were almost three times higher than the costs for persons without AD, but when adjusting for age, gender, disability and other diagnoses, the difference was 1.6-fold. In another study by the same authors (Taylor, Schenkman, Zhou, & Sloan, 2001), disability (as measured by ADL) was a more important predictor of total costs of care than AD diagnosis, and comorbidities also increased costs.

The care of people with dementia has been found to depend heavily on informal care: figures for 2008 show that informal care accounted for 56% of total costs in Europe (Wimo et al., 2011).

The costs and phase of dementia have been found to be consistently related (Gustavsson et al., 2010). According to Gustavsson et al. (2011) the progression of dementia has consequences for ADL ability, implying increased need for care and use of care settings and higher costs of care. In the study of Taylor et al. (2001), persons with severe Alzheimer's disease and related dementia (ADRD) had higher total costs of care than persons with moderate or no ADRD. In their review Quentin, Riedel-Heller, Luppa, Rudolph and Konig (2010) found that

costs more than doubled from mild to severe dementia and total annual costs were six times higher in severe than in mild dementia in a study carried out in Sweden, Denmark, Norway and Finland (Jönsson et al., 2006). Medicare costs, by contrast, have been found to be highest soon after the AD diagnosis, decreasing subsequently year by year (Taylor & Sloan, 2000). In a Swedish study the costs of the diagnostic procedure were 1% of the total costs of dementia (Jedenius, Wimo, Stromqvist, Jönsson, & Andreasen, 2010).

Studies on the effects of dementia on service use have applied somewhat different definitions of the disease. Some studies have only included those with a certain diagnosis, while others have evaluated the persons' cognitive status (Caspi et al., 2009). The costs of dementia vary depending on whether all living arrangements and informal care are included in the calculations (Quentin et al., 2010). These differences make it difficult to compare and sum up the results.

3.4 Time trend

The proportion of Medicare spending attributable to beneficiaries in the last year of life has found to have remained stable at around 25% over the past 20 years (Buntin & Huskamp, 2002; Riley & Lubitz, 2010). However, Riley and Lubitz (2010) found that the mix of services has changed substantially over time among both decedents and survivors. Inpatient hospital care accounted for a declining percentage of payments, whereas outpatient care, skilled nursing facility and hospice accounted for an increasing percentage. Riley and Lubitz (2010) concluded that technological advances and other factors driving medical care use and costs have increased the amount of care received by decedents and survivors in a similar manner, and both aggressive and palliative care seemed to have increased.

The proportion of older people treated in hospitals in the last year of life has increased over time, but there has been a trend towards shorter hospital admissions (Barnato, McClellan, Kagay, & Garber, 2004; Brameld et al., 1998; Henderson, Goldacre, & Griffith, 1990). Brameld et al. (1998) found a trend that differed by age: total inpatient resource use remained constant among the oldest (85 years or over), but increased among younger older people from 1985 to 1994. Dy, Wolff, and Frick (2007) found that the proportion of hospital users in the last year of life was roughly the same in 1989 and 1999, while the proportion of skilled nursing facility users increased among Medicare beneficiaries. The use of hospice and home health services was found to be rapidly growing, especially among patients who died with a predictably terminal illness such as lung cancer in the USA from 1988 to 1995 (Garber et al., 1999). Among Medicare beneficiaries it was found that the use of skilled nursing facility and hospice increased from 1989 to 1999 (Dy et al., 2007).

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The change over time in service use may be explained by both demand and supply side factors. Changes in practice patterns may be due to new ideologies and recommendations of care, but also to such factors as the introduction of a new payment system (Gaumer & Stavins, 1992).

3.5 Regional variation

The local care system has been found to be an even more important factor explaining service use at the end of life than individual characteristics (Mukamel et al., 2002; Pritchard et al., 1998; Virnig, Kind, McBean, & Fisher, 2000). In addition, variation in service use (hospital, nursing home and primary care physician visits) explained by managed care programme sites was found to increase as death approached (Mukamel et al., 2002). Wennberg et al. (2004) found extensive variation in hospital and hospice use as well as in physician visits among older people loyal to 77 highly respected hospitals in the last six months of life.

It is unclear which factors lie behind the variation in service use; neither preferences nor the population's needs seem to provide an explanation (Barnato et al., 2007). Pritchard et al. (1998) reported that end-of-life care in the highestintensity regions was not compatible with residents' wishes. While average baseline health status was similar across regions, patients in higher-spending regions received approximately 60% more care in the study of Fisher, Wennberg, Stukel, Gottlieb, Lucas and Pinder (2003a). Goins and Hobbs (2001) found that the number of persons aged 85 years or over as a proportion of the population was negatively associated with the use of home and community-based long-term care services.

Health care resources and the way in which services are organized have been found to be associated with service use. According to Pritchard et al. (1998), risk of hospital death was increased in regions with higher hospital bed availability and use, and decreased in regions with greater nursing home and hospice availability and use. Virnig et al. (2000) found that hospice use was lower in areas with high numbers of hospital beds per capita and high in-hospital death rates. Goins and Hobbs (2001) reported that the ratio of institutional long-term care beds to the number of older people was negatively associated with the use of home and community-based long-term care services. In the USA persons residing in states with higher home and community-based services expenditure were found to be more likely to use formal personal assistance, but not less likely to use informal assistance when need factors were controlled for (Muramatsu & Campbell, 2002).

In Finland Häkkinen and Luoma (1995) reported that income level, level of central government transfers, allocative efficiency (mix of institutional and non-

institutional care), efficiency of service providers and factors associated with need for services were the most important determinants of the variation in expenditure on health care and care for older people.

In the Netherlands a higher degree of urbanity was found to increase the probability of contacts with medical specialists, but to decrease the probability of using professional home care (Pot et al., 2009). Use of hospital, nursing home and physician services, on the other hand, was unrelated to rural or urban residential location and the availability of health resources in the areas of the USA included in the study of McConnel and Zetzman (1993).

There is no evidence that the outcomes and appropriateness of care are any better, but in fact have even been worse, in higher-spending than in lowerspending areas. Quality of care and access to care were not found to be better in higher-spending regions (Fisher, Wennberg, Stukel, Gottlieb, Lucas, & Pinder, 2003a). In another study by the same authors (Fisher, Wennberg, Stukel, Gottlieb, Lucas, & Pinder, 2003b), patients in higher-spending regions received more care but did not have better health outcomes or higher care satisfaction scores. In his review Casparie (1996) found that the level of appropriateness was not associated with the level of health care service use. In the studies of Fisher et al. (2000) and Skinner and Wennberg (1998), regional variation in Medicare spending had no effect on mortality outcomes, and Temkin-Greener, Bajorska and Mukamel (2008) reported that more hospital care was associated with worse functional outcomes.

3.6 Summary of literature

There has been quite extensive research into the costs of care in the last phase of life, but service use has not received very much detailed attention. An examination of total costs alone does not suffice to show how the determinants of use vary between different services (e.g. Andersen & Newman, 1973; Häkkinen et al., 2008; Perls & Wood, 1996). It is extremely difficult to make meaningful comparisons of the results of different studies when the range of services they include vary, or when they do not even detail which services are included. A careful analysis and reporting of separate services helps to understand the complex determinants of service use at the end of life.

Most studies analysing service use in the last years of life have focused on acute hospital care (McNamee & Stearns, 2003). This is an important and expensive part of end-of-life services, but in order to gain an in-depth picture of service use at the end of life it is important also to consider the role of long-term care, home care and ambulatory services. The main reason why services are excluded from analyses is the lack of data. If claims data are the only source available, then obviously the research can only consider those services that are covered by insurance: Medicare data, for instance, which are widely used in studies in this field, mainly cover acute care. Most studies are based on administrative register data, some include interview or questionnaire sources or both administrative and survey data (see Appendix tables 1–3). Interviews provide an important additional source of information on living conditions and the availability of informal care, for instance. However, self-reports or reports by next of kin may be susceptible to recall problems.

Many samples collected and studied in the USA and Europe have consisted of persons covered by a sickness fund, rather than being representative of the whole old population. In addition, some studies have been restricted to communitydwelling older people only, which may lead to selection bias: after all living in an institution is very common among old disabled people. Research is needed that covers the total old population regardless of their living arrangements or insurance type.

Earlier studies have compared the use and costs of services between decedents and survivors on a group level. However, among older people decedents are older than survivors, mortality is higher among men than women and local care practices vary. If these factors are not properly controlled for, this will impair the comparability between decedents and survivors. As yet there has been no research applying a case-control design and matching old decedents and survivors for age and gender, for instance.

Earlier studies also vary in respect of their follow-up periods (see Appendix tables 1–3). The shortest follow-up has been one month, many studies have had a three-month time frame, and the most common follow-up has been one year. A long enough follow-up is important to cover the whole effect of the closeness of death on service use and costs. A shorter follow-up may be suitable for studies analysing hospital use, but the effect of closeness of death on the use of long-term care might be longer.

In Finland there is considerable variation in surgical procedures followed in different municipalities and hospital districts (Keskimäki, Aro, & Teperi, 1994; National Research and Development Centre for Welfare and Health, 2003). As for health and social services for older people, which are a very different type of service from surgery, it is not yet known whether methods of service delivery vary from region to region. There is some evidence of regional variation in end-of-life care, but multilevel analyses suitable for analysing hierarchical structured data have not been employed.

There is a scarcity of research on how end-of-life service use and costs change over time, and the existing studies are quite dated. In addition, there is no Finnish research into changes in service use over time, and cross-country generalizations about service systems and practices are difficult. In Finland there has been some drive towards increasing home care at the expense of institutional long-term care (Ministry of Social Affairs and Health, 1992; Ministry of Social Affairs and Health & Association of Finnish Local and Regional Authorities, 2008). It is not known how these developments have been associated with the use of health and social services at the end of life.

4 Study design and objectives

The purpose of this study was to find out how age, closeness of death, regional factors, dementia diagnosis and year of death are associated with health and social service use in old age. The age limit was set at 70 years: it is known that both mortality and the use of health and social services increase after age 70.

The study used two approaches: analyses focusing on older people living their last two years of life and a case-control study of decedents and survivors. The case-control pairs were older people living their last two years of life (decedents) and people who were alive at least two years after their pair's death (survivors). The pairs were matched for age, gender and municipality of residence.

The research questions were as follows:

- 1. How is age associated with health and social service use in the last two years of life among people aged 70 years or over?
- 2. How does health and social service use differ between decedents and survivors?
- 3. To what extent does health and social service use in the last two years of life vary between municipalities, and which factors are associated with this variation?
- 4. How does health and social service use differ between people with and without a dementia diagnosis in their last two years of life?
- 5. How did health and social service use in the last two years of life of people with and without dementia change between 1998 and 2003?

5 Data and methods

5.1 Data sources: registers

The data for this study were derived from national registers, which have been maintained for decades in Finland and which are widely used for research purposes (Gissler & Haukka, 2004). Register data are a secondary data source: initially they have been collected for administrative purposes and therefore need to be modified for research. This processing is an important and difficult part of the study that involves ideologically driven qualitative choices (Sund, 2003).

The personal identity code was introduced in Finland in 1964 (Statistics Finland, 2006). Since then all administrative registers have used the same ID codes (Gissler & Haukka, 2004), which facilitates the linking of data within and across registers.

It has been suggested that the use of register data can help to significantly reduce study costs and the amount of time spent on data collection (Gissler & Haukka, 2004). However, permissions procedures and the collating and modifying of the data before analysis can be very time consuming. There are strict data protection laws. The institutions that maintain and control registers can authorize researchers to access register data without the informed consent of the individuals concerned. However research that makes use of register sources has to be well-justified, and ethical issues are given careful consideration. All personal identity codes are removed from the data before they are made available to researchers (Gissler & Haukka, 2004).

The data for this study were derived from registers maintained by Statistics Finland, the National Institute for Health and Welfare (THL, formerly the National Research and Development Centre for Welfare and Health STAKES), and the Social Insurance Institution of Finland (SII). The register sources are briefly described below; the information drawn from each register is described in Table 1.

Statistics Finland's Causes of Death Register contains basic demographic characteristics: dates and places of birth and dates, causes, and circumstances of death.

The Finnish Population Information System is maintained by the Population Register Centre. It contains basic information about Finnish citizens, including names, personal identity codes, addresses, dates of birth and death if applicable.

The THL Care Register for Health Care (earlier Hospital Discharge Register) covers all hospitals in Finland. It contains data on the provider of hospital services and on patients, admissions, discharges, diagnoses, and care received. The Care Register for Social Welfare, also maintained by THL, registers the care episodes of residents in all long-term-care institutions in Finland. This register dates from 1996. It contains data on service providers, clients, admissions, and discharges to care, as well as on services and care received. These two care registers include both information of care episodes that ended during the year, and census information for those care episodes that continued beyond the end of each calendar year. The Home Care Census was taken on one day every other year in November from 1995 to 2007. Since then, the census has been taken every year. It covers clients of regular municipal home care as well as the services they have received in the previous month. The register contains information on service providers, clients, admissions and discharges to care, and on services and care received. There is broad consensus that the Care Registers offer good quality data, which are consistent with information from patient records (Keskimäki & Aro, 1991). It has been shown that basic information items in the Care Registers such as those on home municipality, admission and discharge days and main diagnoses, are at least 95% accurate (Sund et al., 2007).

The SII prescription database covers prescribed medicines for which noninstitutionalized people have claimed reimbursement. The database includes information on ATC code (Anatomical Therapeutic Chemical classification system), date of purchase, costs and SII reimbursement received. The prescription database covers 97% of all prescription medicines purchased by outpatients and reimbursed (Klaukka, 2004).

SOTKAnet is an indicator bank maintained by THL and is publicly available on the Internet. It contains no individual data, but only population-level welfare and health data for all Finnish municipalities since 1990.

Researchers on the COCTEL project obtained permission to access the registers listed above from the relevant controllers. The research plan was approved by the ethics committee of the Pirkanmaa hospital district.

5.2 Study population

The data include individuals who were resident in Finland and who died between 1 January 1998 and 31 December 2003 at the age of 70 years or older. For those who died in 1998–2000, surviving matched pairs were identified. The data were

drawn in two phases. Decedents were identified from the Causes of Death Register and survivors from the Population Information System.

Dataset 1 includes

- 1. all those who died at the age of 70 or older in 1998,
- 2. those who belonged to a 40% random sample of all persons aged 65 or over alive at 31 December 1997 and who died in 1999–2001 at the age of 70 or older and
- 3. survivors identified from the 40% random sample of persons aged 65 or over.

Dataset 2 includes

4. all those who died at the age of 70 or older in 2002 or 2003.

The reason for selecting a 40% sample rather than including all decedents from 1999–2001 was that the COCTEL project received this dataset through a research group from the University of Helsinki and STAKES, and that group had decided to draw a random sample only. However, the random sample is representative of the underlying study population (Forma, Rissanen, Noro, Raitanen, & Jylhä, 2007).

The survivors were identified from the 40% random sample of persons aged 65 or over. One-to-one matched pairs were constructed of decedents and survivors who were alive at least two years after their pair's death. The pairs were matched for age (± 2 years), gender and municipality of residence. The purpose was to ensure that the age and gender distribution was the same in decedents and survivors, and to eliminate the effects of municipal service structures on service use. An identical match for every combination of variables was found for 90.5% of the decedents. Almost half of all municipalities in Finland have a population of less than 5,000, and in small municipalities it was impossible to find a suitable control person for all individuals. If a similar control person was not found, the decedent was excluded from the analyses.

Service use was studied in the last two years of life (730 or 731 last days of life) and on the same calendar days for the matched surviving control persons. In other words data on service use begin from 1996 for those who died in 1998 and for their surviving pairs (Figure 3).

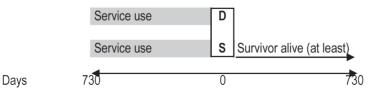


Figure 3. Time frame for service use by a case-control pair. Day 0 = day of decedent's death, D = decedent, S = survivor.

Dataset 1 was used in Study I. Study II used matched case-control pairs. Dataset 2 was used in Study III, and both datasets were used in Study IV. In addition, part of the results of this summary study is based on both datasets.

At the time of the study in 2002 and 2003, there were 448 and 446 municipalities in Finland, respectively, but by 2007 the figure had dropped to 416 due to municipal amalgamations. Municipality numbers valid at the beginning of 2007 were used. Individuals, who died in municipalities that were later merged with another municipality, were coded as inhabitants of the new municipality. The Åland Islands (16 municipalities) and municipalities with less than 2,500 inhabitants (85) were excluded from the analyses because the annual number of deaths in small municipalities is very low and therefore service use may vary randomly. In addition there was the risk that individual subjects from small municipalities might be identifiable.

5.3 Dependent variables

Based on the numbers of days spent in each type of care, three outcome variables were constructed:

- 1. Participation. 1 = the individual used the service at least once during the two-year study period, 0 = the individual did not use the service during the study period.
- 2. Number of days in care. Number of days in care in the two-year study period was calculated for those who received score 1 for participation. This is the sum of days in potentially multiple care episodes.
- 3. Monthly use. Number of days in care was calculated separately for each of the 24 months in the study period for the whole study population, regardless of participation.

The number of days in care was calculated based on the dates of admission and discharge in the Care Registers. The first and last days in care are usually not full days, and therefore days of admission were calculated as care days, but days of discharge were not. For home care, data were not available on the number of visits.

The services included in the analysis were (1) hospital inpatient care (2) longterm institutional care (3) regular home care (at least once a week) and (4) use of prescribed medicines. Hospitals included university hospitals, general hospitals (central, district and private) and health centre inpatient wards if the length of stay (LOS) was less than 90 days. Long-term care included care in residential homes, sheltered housing with 24-hour assistance and health centre inpatient wards if LOS was 90 days or more³. Care at a health centre inpatient ward has usually been classified as long-term care if LOS was over three months, or if a decision had been made about long-term care (Forsström & Pelanteri, 2010). Public and private long-term care were analysed together because private care use was limited. Home care included both home nursing and home help.

Residential homes, sheltered housing and home help were taken to represent social care and hospitals and health centres to represent health care. Long-term care refers here to formal institutional care, although in some studies home care and informal care are also considered as forms of long-term care.

Use of medicines was reported as the number of different prescribed medicines (ATC codes to an accuracy of seven characters; pharmaceutical ingredient) purchased.

Discrepancies were found for 0.2% of admissions. These included inpatient days after the date of death, and double recordings of the same admission. These admissions were removed from the data. Corrections were made to 0.15% of the admissions. Most of these corrections were related to admission dates that referred to the same admission but differed between census and discharge data. In these cases the admission date in the discharge data was replaced by the admission date in the census data.

5.4 Independent variables

Independent variables (or explanatory or right-hand side variables) are not necessarily completely independent, since endogeneity has been found in analyses of service use and costs at end of life (Felder et al., 2010; Salas & Raftery, 2001). Service use is explained by closeness of death, but service use might also for its part explain (postpone) closeness of death. However, analyses of quarterly or monthly expenditures before death have shown endogeneity. In the present study the focus was on the use of services in a two-year period; exact time to death was not an issue of concern.

The analyses included independent variables on individual, municipal and regional levels. The variables and their sources are presented in Table 1.

Individual level

Age refers to decedent's age at death and survivor's age on the day of the pair's death. Age was used both as a continuous variable and in 10-year age groups

³ There is some variation in how Finnish terms for care facilities are translated into English. This study uses the terms adopted in a report by the National Research and Development Centre for Welfare and Health (2007).

(70–79, 80–89 and \geq 90 years). Survivors were included in the same age group as their matched pair regardless of their possible ±2 years age difference.

Two interaction terms were calculated. Decedent status * age was used to examine whether the effect of decedent status on service use varied according to age. Year of death * dementia was used to examine whether the effect of dementia varied between different years of death.

Dementia and comorbid diagnoses were identified from the Causes of Death Register, Care Register for Health Care, Care Register for Social Welfare and Home Care Census. The ICD-10 codes for diagnosis categories are presented in Table 1. In addition to the ICD-10 codes, dementia was identified on the basis of class 25 for dementia in a separate 54-class cause of death classification (Statistics Finland, 1996). All etiologies of dementia were included. Contributing, immediate, intermediate, and underlying causes of death were included as well as both main and secondary diagnoses from Care Registers.

_evel		Extension	Source
ndividual	Age		Statistics Finland, CoD ¹
	Gender	1=woman 0=man	Statistics Finland, CoD ¹
	Decedent status	1=decedent 0=survivor	Statistics Finland, CoD ¹
	Interaction term (decedent status * age)		
	Municipality of residence		Statistics Finland, CoD ¹
	Use of other services		THL, Care registers
	Any use	1=yes, 0=no	-
	Days in care among users		
	Diagnoses (ICD-10) Dementia (F00–F03, G30) Cancer (C00–C97) Diabetes (E10–E14) Mental (F04–F99) Neurological (G00–G99, not G30) Respiratory (J00–J99) Arthritis (M05–M06, M15–M19) Hip fracture (S72) Stroke (I60–I69) Heart diseases (I20–I25, I30–I425, I427–I52) Other circulatory (I00–I15, I26–I28, I70–I99)	1=yes, 0=no	Statistics Finland, CoD ¹ and THL, Care registers
	Year of death Interaction term_2 (dementia * year of death)	1998–2003	Statistics Finland, CoD ¹

Table 1. Independent variables on individual, municipal and regional levels and their sources.

Municipal	Population Number of inhabitants Average age of decedents Proportion of 65 years and older Proportion of living alone, ≥75 years Economic conditions Annual contribution margin, € / capita		SOTKAnet THL, Care registers SOTKAnet SOTKAnet SOTKAnet
	Tax revenue, € / capita Total operating health and social expenditure, € / capita		SOTKAnet SOTKAnet
	Degree of urbanity	Urban Semi-urban Rural	Statistics Finland, Regional classification
	Service pattern		
	Support for informal care, % of ≥65 Outpatient care orientation (opco)		SOTKAnet Created on the base of SOTKAnet
	Proportion of service users (%) Hospital in total University hospital General hospital Health centre Long-term care Home care		THL, Care registers
	Days per user (if users in municipality) Hospital in total University hospital General hospital Health centre Long-term care		THL, Care registers
Regional	University hospital in hospital district	1=yes, 0=no	Association of Finnish Local and Regional Authorities

CoD=Causes of Death register. For survivors age, gender and municipality of residence were derived from the Population Information System.

Municipal level

The municipal level variables were for the year 2003 and described the population (number of inhabitants, average age of decedents, proportion of those aged 65 or over in the population and the proportion of older people living alone), economic conditions (annual contribution margin, tax revenue, health and social expenditure and degree of urbanity) and service pattern (support for informal care, outpatient care orientation, proportion of service users and days in care per user). "Outpatient care orientation" (opco), one of the indicators of service pattern, was developed on the basis of the SOTKAnet database (Hammar, Rissanen, & Perälä, 2008; Rissanen & Noro, 1999) using such indicators as municipalities' new care practices, relationship of inpatient and outpatient care and supported living at home. The opco value ranged from 1 to 20; a low value indicated that the municipality had placed much emphasis on outpatient care. Some continuous variables were categorized because of their wide range or non-normal distribution.

Regional level

The regional level was represented by the hospital district. The regional level variable was the presence of a university hospital in the hospital district.

5.5 Descriptive analyses

Statistical testing is the method usually applied to determine whether the observations support the hypotheses about the population. The observations are usually made on a sample of the population. In this study the data comprised the whole population, i.e. all those who died at age 70 or older in 1998, 2002 and 2003. For these kinds of datasets statistical testing would not be necessary because the results do not need to be generalized to the population; for these years the results are absolute. However, statistical tests were nonetheless performed in this study: in this way the years in focus can be considered a sample of adjacent years, or Finnish older people a sample of older people in other similar countries, such as the Nordic countries. In addition, statistical tests are a conventional way of presenting scientific results and determining whether the observation is accurate and whether the null hypothesis or alternative hypothesis is approved.

However, the dataset also included two samples: the analyses for 1999–2001 were based on a 40% sample of decedents, and matched controls were found for 90.5% of the decedents. To ensure that these samples were representative of the population, their age and gender distributions were compared to those of all deaths at age 70 and older in the study years in Finland, using data from Statistics Finland.

The number of care days was heavily skewed or bimodal, and therefore nonparametric tests were employed. Kruskall-Wallis tests were used to determine whether the number of care days differed between the three age groups, and Mann-Whitney U-tests were performed to test differences between two age groups. Comparisons between age groups were performed separately for women and men.

Wilcoxon signed rank tests were used to compare the number of days in longterm care between decedents and their matched survived controls. Wilcoxon signed rank test is a statistical comparison of two related samples, such as matched pairs or repeated measures. It uses the signs and relative magnitudes of the data, but not their actual values (Kirkwood, 1988). Tests were performed among those pairs who both used long-term care, separately for six age and gender groups. Chi-square test was performed to determine whether the proportions of those with a dementia diagnosis differed between years of death. T-tests were performed to compare the mean age of older people with and without dementia.

5.6 Multivariate analyses

A two-stage approach was used in multivariate analyses. The first step was to establish whether the individual used the service at least once during the study period, and the next step to determine how many days users had spent in care. This was done because data on health service use typically contain a large amount of zero observations (Jones, Rice, d'Uva, & Balia, 2007).

5.6.1 Binary logistic regression analyses

Binary logistic regression analyses were performed to examine the probability of the individual using each of the services at least once during the two-year study period. The dependent variable was dichotomous (1 = used the service, 0 = did not use the service). Two special cases of binary logistic regression analysis, conditional and multilevel analyses, are described below.

Binary logistic regression analyses were used to examine the effects of dementia and year of death on service use. The independent variables were age, gender, dementia, year of death and an interaction term of dementia and year of death (dementia * year of death) and ten comorbidity dummies. If the coefficient of interaction variable differed from zero (p<.05), additional analyses were performed separately for those who died in different years to examine how the effect of dementia varied between the years of death. The comorbidity dummies were included to adjust for the effect of other diseases than dementia on service use.

5.6.2 Poisson and negative binomial regression analyses

The number of days in care yields non-negative integer values. It is a count variable, which usually follows Poisson or negative binomial distribution (Jones et al., 2007). Poisson and negative binomial regression analyses belong to a family of generalized linear models (GLM). Poisson regression is the standard method for modelling count data. However, it assumes that mean and variance are equal, which rarely happens. Variance is usually greater than mean, which means that the dataset is overdispersed. In this case negative binomial regression analysis is a suitable method (Hilbe, 2008).

Negative binomial regression analyses were performed to examine the impact of dementia and year of death on the number of days in care. Only those who had used the service at least once in the last two years of life were included in the analyses. Thus, the number of days in care was modelled with a truncatedat-zero count data model (Jones et al., 2007). The independent variables and modelling strategy (of interaction terms) were the same as in the binary logistic regression analyses of the effect of dementia and year of death. The conditional and multilevel Poisson regression analyses used in this study are described below.

5.6.3 Case-control study: conditional analyses

A conditional approach is essential in order to avoid biased estimates of relative risk in a matched case-control design (Breslow & Day, 1980; McCullagh & Nelder, 1989). The pairs in which both case and control had used or had not used the service give no information about the association between decedent status and service use: the only source of relevant information comes from pairs in which the case and the control differ. The odds ratio (OR) is calculated as the number of pairs in which the case used services but the control did not, divided by the number of pairs in which the control used services but the case did not (Kirkwood, 1988).

Conditional binary logistic regression analyses were performed to identify differences between decedents and their surviving matched controls in the probability of using each of the services. Decedent status was used as the independent variable. Conditional Poisson regression analyses were performed to examine the service users' number of days in care. These analyses only included the case-control pairs in which both used the service in question. Decedent status and the interaction term (decedent status * age) were used as independent variables. Age and gender could not be included because the cases and controls were matched for both (Breslow & Day, 1980).

5.6.4 Regional variation: multilevel analyses

The service use of individuals living in the same municipality may not be assumed to vary independently. From this it follows that the data of this study probably have a hierarchical structure. Individuals (level one) live in municipalities (level two) that belong to hospital districts (level three). This data structure necessitated the use of multilevel models, which allow for the inclusion of municipal and regional variables in the analyses and for an examination of the effects of variables at each level on service use after controlling for the effects of variables at other levels (Goldstein, 1987). The random intercept model allows the intercepts to vary across municipalities. The random coefficient model also allows regression coefficients to vary across municipalities. Random intercept (and random coefficient) models were used when the variance of the intercept (and that of the coefficient) was more than twice as high as its own standard error (Twisk, 2007). Otherwise naïve models, which consider all individuals to be independent, are reported.

To determine the probability of use of each of the services, three-level binary logistic regression analyses were performed. The number of days in care among users was analysed by three-level Poisson regression analyses. Second order penalised quasi-likelihood (PQL) estimation procedure was used. In addition to null models, four logistic and four Poisson regression models were constructed for each of the services

I: individual-level independent variables

II: I + variables describing population and economic conditions in municipality

III: II + variables describing service pattern in municipality

IV: III + regional level variable.

The results of models I–III showed only little variation, and only the fixed effects of the final (IV) models are reported. The fixed effects presented in Tables 7 and 9 are conditional on the random effects, i.e. the individual-level fixed effects may be interpreted as odds ratios for within-municipality comparisons and municipal-level fixed effects as OR's for within-hospital district comparisons (Larsen & Merlo, 2005).

Random effects are described by partitioning the variance of the dependent variable between the hospital district and municipal levels in a null model and models I–IV. The rest of the variation is between individuals. For normally distributed continuous variables, variances at all three levels are given by the software, and intra-class correlation (ICC) can be calculated to describe the percentage of variation at each level. Individual-level variance is not given for dichotomous and count variables. Median odds ratios (MOR) were calculated for the interpretation of variation.

MOR = $\exp(0.954^*\sqrt{(6_{hd}^2 + 6_m^2)})$ 6_{hd}^2 = variance between hospital districts, 6_m^2 = variance between municipalities

If MOR is 1, there is no variation between hospital districts or municipalities. When MOR is greater than 1, there is considerable between-clusters variation. MOR is directly comparable with fixed effects odds ratios (Larsen & Merlo, 2005). For Poisson regression models median rate ratios (MRR) were calculated in the same way as MORs for logistic models. Descriptive and binary logistic regression analyses were performed with SPSS (versions 12.0.1, 14.0, 15.0 and 16.0). Multilevel analyses were performed with MLwiN (2.10) and Poisson, negative binomial and conditional analyses with Stata (8.2).

6 Results

6.1 Description of study population

The study population included 145,944 decedents, of whom, 59.3% were women and 40.7% men. Their average age was 82.3 years, 83.8 for women and 80.1 for men. Age distributions by gender and year of death are shown in Table 2. The average age at death increased during the study years (p<.001). The age and gender distribution of the 40% random sample of those who died in 1999–2001 did not differ from those of all decedents in Finland during those years (Study I).

	Year of death		Women			Men	
		70–79	80-89	≥90	70–79	80-89	≥90
Data 1							
	1998	6 179	10 083	3 936	7 033	5 679	1 206
	1999 ¹	2 435	4 178	1 619	2 887	2 241	536
	2000 ¹	2 438	4 071	1 782	2 802	2 223	533
	2001 ¹	2 346	3 910	1 815	2 869	2 205	572
Data 2							
	2002	5 851	10 354	4 966	7 538	5 623	1 489
	2003	5 412	10 227	4 969	6 775	5 632	1 530
Case-control pa	irs ²						
	98-00	11 052	18 014	4 167	12 716	9 200	852

Table 2. Study population by age, gender and year of death (n = 145,944 decedents and 56,001 survivors).

¹ Data include 40% of decedents in 1999–2001.

² Cases are decedents who died in 1998–2000 and controls their surviving pairs.

Among those who died in 1998–2000, 56,001 (90.5%) received a control pair matched for age, gender and municipality of residence. The age and gender distribution of case-control pairs differed from those of all decedents in Finland in those years. The age group 70–79 years was overrepresented (42.4% vs. 38.2% in general population) and the age group ≥90 years was underrepresented (9.0% vs. 15.8%). It was harder to find matched control pairs for the oldest than for younger old persons; those who did not get a pair were excluded from the analyses.

6.2 Impact of age and gender on use of services in the last two years of life (Study I)

The impact of age and gender on service use in the last two years of life was studied among all decedents (died in 1998–2003). The proportion of university hospital users decreased and the proportion of long-term care users increased steadily with advancing age (Figure 4). Total hospital use, health centre use and home care use initially increased with age, but then started to decrease after a certain age. Among women the proportion of general hospital users decreased with age, but among men the proportion initially increased and then decreased. The age at which service use started to decrease was highest for health centre use and home care use. The decrease started at a younger age among women than among men in all services.

Total hospital use, general hospital use and health centre use was more common among younger women than men (Figure 4). The proportion of users did not differ between women and men for the next five years or so, but in the age group 80 or over the proportion of users was higher among men. The proportion of university hospital users was roughly the same among women and men, but in the oldest age group (90 years or over) men were more frequent users. The proportion of long-term care users was about 10% higher among women than men in all ages. The use of home care services was higher among women than men at younger ages, but after about 90 years home care use was more common among men.

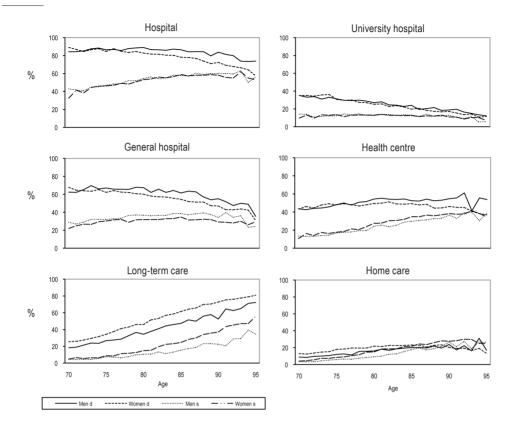


Figure 4. Service users (%) by age, gender and decedent status (d=decedents, s=survivors). N=145,944 decedents (died in 1998–2003) and 56,001 survivors (controls for those who died in 1998–2000). Persons aged 95 or older were categorized as 95-years-olds for the small number of observations.

Number of days in care was studied for those who used services at least once in the last two years of life. The total number of days in hospital and the number of days in university hospital and general hospital decreased with age (Figure 5). The number of days in health centre increased with age, but there was no statistically significant difference (p>.05) between age groups 80–89 and 90 or over. Days in long-term care increased markedly, almost doubling from age group 70–79 to 90 or over.

6.3 Impact of closeness of death on service use (Study II)

Decedents had a higher probability of using hospital care and long-term care than their surviving matched controls in all age groups (Table 3). In the youngest age group and among men aged 80–89 years, use of home care was more common

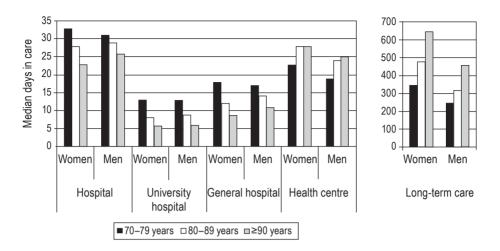


Figure 5. Days in hospitals and long-term care among users in the last two years of life (decedents died in 1998–2003).

among decedents than survivors, but among women in the oldest age group (90 years or over) it was more common among survivors.

The difference in hospital and long-term care use between decedents and survivors narrowed with increasing age; however it was statistically significant even among the oldest old (Table 3). This was due to the different effect of age on service use among survivors than among decedents: the proportion of hospital users overall and general hospital and health centre users increased with age until the age of 90 years (Figure 4).

		-	•			
	70-	-79 years	80-	-89 years	2	90 years
	OR	95% CI	OR	95% CI	OR	95% CI
Women, n of pairs		11 052		18 014		4 167
Hospital inpatient care	6.85	6.34, 4.30	2.75	2.62, 2.11	1.71	1.56, 1.43
University hospital	4.70	4.88, 3.79	2.26	2.81, 1.83	1.66	1.84, 1.24
General hospital	5.24	5.24, 1.95	2.96	4.39, 1.00	2.03	3.61, 0.52
Health centre	4.03	7.39, 5.15	1.92	2.89, 2.41	1.35	1.88, 1.92
Long-term care	5.70	5.63, 4.35	4.62	3.11, 2.00	4.02	2.25, 1.48
Home care	2.12	6.21, 2.30	1.05	4.87, 1.10	0.57	4.46, 0.64
Men, n of pairs		12 716		9 200		852
Hospital inpatient care	7.53	6.98, 4.11	4.70	4.33, 2.38	2.68	2.15, 1.52
University hospital	4.46	4.91, 4.81	2.62	3.32, 2.90	2.09	1.66, 1.86
General hospital	5.26	4.70, 2.05	3.57	4.52, 1.26	2.04	3.36, 0.65
Health centre	5.16	8.11, 4.85	3.10	5.09, 2.87	2.29	3.34, 2.87
Long-term care	5.13	5.63, 5.53	4.90	3.84, 3.32	4.22	2.51, 2.82
Home care	2.25	5.60, 2.48	1.37	5.31, 1.48	0.82	5.31, 1.03

Table 3. Any use of services during the two-year study period. Conditional logistic regression analyses: odds ratios (OR) and 95% confidence intervals (95% CI) for matched case-control pairs (1 = decedent died in 1998–2000, 0 = surviving control).

The number of days in care was analysed for the matched pairs who both used the service. Decedents spent more days in all types of hospitals than did their matched surviving controls (Table 4). The effect of interaction term (decedent status * age) on hospital days was negative, indicating that the difference between the decedent and surviving control was smaller among older than among younger case-control pairs.

Table 4. Number of days in care among case-control pairs (died in 1998-2000 and their controls) who both used the service at least once in the two-year study period. Conditional Poisson regression analyses.

	Hos	pital		ersity pital	General	hospital	Health	centre
N of pairs	24	111	3 :	545	12	557	7	670
	β	р	β	р	β	р	β	р
Decedent status 1=decedent 0=survivor	2.76	<0.001	2.73	<0.001	2.01	<0.001	1.28	<0.001
Interaction term (decedent status*age)	-0.03	<0.001	-0.03	<0.001	-0.02	<0.001	-0.01	<0.001

Since the distribution of the number of days in long-term care was bimodal, it was not possible to conduct multivariate analyses using any distribution assumption. The median numbers of days in long-term care and the results of Wilcoxon's signed rank tests are presented in Table 5. In the age group 70–79 years, the

number of days in long-term care did not differ statistically significantly between decedents and their surviving matched controls. In the age group 80–89 years deceased women spent more days in long-term care than survivors, but among men no such difference was seen. In the oldest age group decedents spent more days in long-term care than controls, both among women and men.

	70–79	years	80-89	years	≥90 y	/ears
	D	S	D	S	D	S
Women						
Ν	395	395	2 920	2 920	1 424	1 424
Median	345	365	469	431	603	531
Quartiles	134, 689	103, 713	172, 719	127, 723	271, 730	195, 730
р	8.0	97	0.0	02	0.0	003
Men						
Ν	210	210	678	678	137	137
Median	276	228	298	284	553	393
Quartiles	113, 618	44, 591	122, 644	56, 667	199, 721	79, 716
р	0.1	18	0.1	57	0.0)36

Table 5. Number of days in long-term care among case-control pairs (died in 1998–2000 and their controls) who both used long-term care at least once in the two-year study period.

D = decedents, S = survivors

p-values refer to the results of Wilcoxon's signed rank tests

Figure 6 shows the average monthly number of days in care for all decedents and surviving controls, regardless of service use. For the whole two-year study period, decedents had a higher number of days in care than survivors. At the start of the study period, however, the difference was not large. Among survivors hospital use remained at around the same level throughout the two-year study period, while among decedents it increased in the last months of life. In the youngest age group inpatient days at university hospital started to increase one year before death, in older age groups (80–89 and \geq 90) only four months before death. The number of days in both general hospital and health centre increased about four months before death. In contrast to other hospital types, the use of health centre did not differ markedly between age groups.

Days in long-term care increased during the two-year study period in every age group, most clearly among decedents and also slightly among survivors (Figure 6). In the very last month, however, use among decedents did not increase.

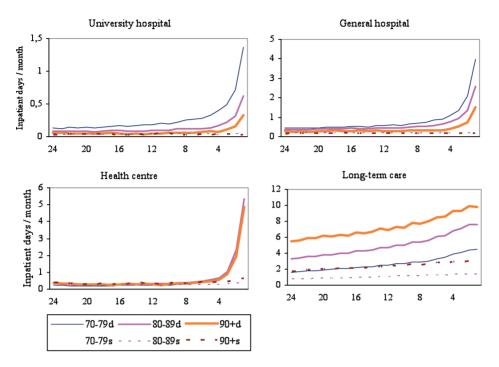


Figure 6. Average monthly number of days in hospitals and long-term care in the two-year study period, all 56,001 case-control pairs regardless of service use (d=decedents in 1998–2000, s=survivors). Different services are on different scales.

6.4 Municipal variation in service use in the last two years of life (Study III)

Municipal variation in service use was analysed among decedents who died in 2002 or 2003. The random effects of three-level binary logistic regression analyses are shown in Table 6. The variances of intercepts are presented for two levels: hospital district and municipality. The directions of fixed effects in models IV are presented in Table 7.

The probability of hospital use overall did not vary very much between hospital districts or municipalities (Table 6), but the probability to use different types of hospitals did vary. The use of university hospital varied mostly between hospital districts and the use of general hospital varied as much between hospital districts and municipalities. The probability of using health centre inpatient ward varied less than that of other hospital types. Hospital district had no effect on the probability of using long-term care or home care.

Although the variances were quite low, the reported variation between hospital districts and municipalities was statistically significant. It is easier to interpret

the variation by reference to median odds ratios (MOR). For long-term care, for instance, MOR was 1.28 (null model), meaning that an individual living in a municipality and hospital district with high long-term care use had a 28% higher probability of using long-term care than an individual of the same age and gender in a municipality with lower long-term care use.

In all services the variance between municipalities disappeared when variables describing the service pattern in the municipality were added to the model (model III).

	Null model:	Model I:	Model II:	Model III:	Model IV:
	empty	Individual	l + population and	II + service pattern	III + university hospital
			economics	pattern	nospital
Hospital					
б ² _{hd}	0.019	0.026	0.027	0.017	0.007
б ² m	0.045	0.048	0.046	ns	ns
MÖR	1.27	1.30	1.29	1.13	1.08
University hospital					
б² _{hd}	1.944	2.620	2.616	0.262	0.073
б ² m	0.192	0.358	0.335	ns	ns
MÖR	4.03	5.19	5.15	1.63	1.29
General hospital					
б² _{hd}	1.045	1.515	1.522	ns	ns
б²m	1.183	1.614	1.518	0.016	0.015
MÖR	4.15	5.41	5.28	1.13	1.12
Health centre					
б² _{hd}	0.088	0.133	0.112	ns	ns
б ² m	0.235	0.286	0.277	ns	ns
MÖR	1.72	1.85	1.81		
Long-term care					
б ² _{hd}	0.009	ns	ns	ns	ns
б ² m	0.057	0.070	0.063	ns	ns
MÖR	1.28	1.29	1.27		
Home care					
6 ² hd	ns	0.030	ns	ns	ns
б ² m	0.131	0.139	0.139	ns	ns
MÖR	1.41	1.48	1.43		

Table 6. Random effects parameters for the random intercept binary logistic regression models for any use of services.

 6^{2}_{hd} = variance between hospital districts, 6^{2}_{m} = variance between municipalities

MOR = median odds ratio

ns = not statistically significant

When municipal and regional variation was adjusted for, younger old persons and men had a higher probability of using university and general hospital than older and women, who in turn had a higher probability of using long-term care and home care (Table 7). Users of any type of hospital had a higher probability of using other hospitals or home care, but a lower probability of using long-term care. Users of long-term care had a lower probability of using all other services.

Use of long-term care and home care was more common in municipalities with a lower average age of decedents (Table 7).

	University hospital	General hospital	Health centre	Long-term care	Home care
Individual level					
Age	-	-	+	+	+
Gender 0=man, 1=woman	-	-	ns	+	+
User of university hospital		+	+	-	+
User of general hospital	+		+	-	+
User of health centre	+	+		-	+
User of long-term care	-	-	-		-
User of home care	+	+	+	-	
Municipal level					
Average age of decedents	ns	ns	ns	-	-
Proportion of service users					
University hospital	+	-	ns	ns	ns
General hospital	ns	+	ns	ns	ns
Health centre	ns	ns	+	+	ns
Long-term care	ns	ns	+	+	ns
Home care	ns	ns	ns	ns	+
Regional level					
University hospital	+	+	ns	ns	ns

Table 7. Directions of statistically significant (p<.05) associations with any use of services. Three-level binary logistic regression models. Results described in more detail in Study III.

+ = positive association, - = negative association

ns = not statistically significant (p>.05)

The number of days in hospital in total and in long-term care among users did not vary between hospital districts (Table 8). The use of different hospital types varied between hospital districts, but not in all models. Statistically significant variation was seen between municipalities in all services regardless of the factors controlled for, except in health centre models III and IV that included the variables describing service pattern. Any use of services (Table 6) varied more than the number of days in care among users (Table 8). The median rate ratios (MRR) were calculated to describe the probability of having one more day in care in municipalities and hospital districts where use was high than in municipalities where use was low. In general hospital, for instance, the probability was 97%.

	Null model: empty	Model I: individual	Model II: I + population	Model III: II + service	Model IV: III + university
	empty	marriadai	and economics	pattern	hospital
Hospital					
б² _{hd}	ns	ns	ns	ns	ns
6 ² m	0.023	0.022	0.020	0.012	0.012
MRR	1.16	1.15	1.14	1.11	1.11
University hospital					
б ² _{hd}	0.148	0.186	0.134	ns	ns
б ² m	0.069	0.087	0.112	0.016	0.009
MRR	1.56	1.65	1.61	1.13	1.09
General hospital					
б² _{hd}	ns	ns	0.119	ns	ns
б ² т	0.505	0.427	0.155	0.025	0.025
MRR	1.97	1.87	1.65	1.16	1.16
Health centre					
б² _{hd}	ns	ns	0.009		
б ² т	0.014	0.016	0.015	ns	ns
MRR	1.12	1.13	1.16	ns	ns
Long-term care					
б ² _{hd}	ns	ns	ns	ns	ns
б ² т	0.019	0.017	0.016	0.003	0.003
MRR	1.14	1.13	1.13	1.05	1.05

Table 8. Random effects parameters for the random intercept Poisson regression models for days in care among users.

 6_{hd}^2 = variance between hospital districts, 6_m^2 = variance between municipalities

MRR = median rate ratio

ns = not statistically significant

The number of days in university hospital was higher among users of other hospitals and long-term care, but lower among users of home care (Table 9). The number of days in general hospital and health centre was higher and the number of days in long-term care lower among users of all other services analysed.

Some of the municipal level variables describing population, economic conditions and service patterns were associated with the number of days in hospital, but none of them were associated with the number of days in long-term care (Table 9).

The presence of a university hospital in the hospital district was associated with a higher number of days in university hospital and long-term care and a lower number of days in general hospital and health centre inpatient ward (Table 9). For instance, users of university hospital services resident in a district with a university hospital had a higher number of days in care than those users of university hospital who lived in a hospital district without a university hospital.

Analyses of days in care among users were also performed with a negative binomial distribution assumption. The results were mainly in line with those obtained in Poisson regression analyses.

		O	11	1
	University hospital	General hospital	Health centre	Long-term care
Individual level				
Age	-	-	+	+
Gender 0=man, 1=woman	ns	ns	+	+
User of university hospital	+	+	+	-
User of general hospital	+	+	+	-
User of health centre	+	+	+	-
User of long-term care	-	+	+	-
User of home care				
Municipal level				
Number of inhabitants				
0=<5000, 1=5000–9999	+	ns	+	ns
0=<5000, 1=>10 000	+	ns	ns	ns
Average age	ns	+	-	ns
Annual contribution margin	ns	ns	+	ns
0=<0, 1=>0				
Tax revenue				
0=<2000, 1=2000–2999	ns	ns	ns	ns
0=<2000, 1=>3000	-	ns	ns	ns
Informal care	ns	-	ns	ns
Outpatient care orientation	ns	+	ns	ns
Days per user				
University hospital	+	ns	ns	ns
General hospital	ns	+	ns	ns
Health centre	ns	ns	+	ns
Regional level				
University hospital	+	-		+

Table 9. Directions of statistically significant (p<.05) associations with days in care among users. Three-level Poisson regression models. Results described in more detail in Study III.

+ = positive association, - = negative association

ns = not statistically significant (p>.05)

6.5 Impact of dementia on use of services in the last two years of life (Study IV)

The impact of dementia on the use of services in the last two years of life was analysed with a dataset of decedents who died in 1998–2003. Of them, 34,232 (23.5%) had a dementia diagnosis. The proportion of people with a dementia diagnosis increased (p<.05) over the six-year study period (from 21.7% in 1998 to 25.3% in 2003). People with dementia were on average 3.5 years older and more often women (69.6%) than people without dementia (56.2%).

When age, gender, year of death and comorbidity were adjusted for, people with a dementia diagnosis had a lower probability of using all types of hospitals and home care at least once in the last two years of life than people without a dementia diagnosis (Table 10). By contrast people with a dementia diagnosis had a much higher probability of using long-term care than those without the diagnosis.

Among users, people with a dementia diagnosis had a higher number of days in care in all types of hospitals and long-term care than those without dementia (Table 11).

The dataset of persons who had died in 1998–2003 was also used in analyses of the possible change in service use over time. The probability of using hospital in total, general hospital and home care decreased during the six-year study period (Table 10). The probability of using university hospital and long-term care increased. The probability of using health centre remained unchanged over the study period.

Interaction term (year of death * dementia) was included to find out whether the effect of dementia on service use varied between years of death. The effect of the interaction term was statistically significant in all services, and additional analyses were conducted separately for each year of death. These analyses showed that the difference in service use between people with and without a dementia diagnosis diminished during the study period.

The number of days in hospital care overall and in general hospital among users decreased and the number of days in health centre and long-term care increased over the study period (Table 11). The number of days in university hospital did not change.

The interaction term had no statistically significant effect on days in general hospital or long-term care, meaning that the trend was similar for people with and without dementia. Additional analyses were performed for total hospital use and the use of university hospital and health centre services. The tendency for dementia to increase the total number of days in hospital and health centre diminished during the study period. A dementia diagnosis increased the number of days in university hospital at the start of the study period, but decreased it towards the end of the period.

Statistically significant (p<.05) odds ratios (OR) are shown in boldface.	05) odds r	atios (OR) ar	e shown	in boldface.								
		Hospital							Long	Long-term care	Н	Home care
			Univers	University hospital	Genei	General hospital	Hea	Health centre				
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age	0.97	0.97, 0.97	0.96	0.96, 0.96	0.97	0.97, 0.98	1.01	1.01, 1.01	1.09	1.09, 1.09	1.03	1.03, 1.03
Gender (0=man, 1=woman)	0.81	0.78, 0.83	1.02	1.00, 1.05	0.82	0.80, 0.84	0.95	0.93, 0.97	1.50	1.46, 1.54	1.29	1.26, 1.33
Dementia (0=no, 1=yes)	0.33	0.31, 0.35	0.48	0.44, 0.52	0.46	0.44, 0.49	0.58	0.55, 0.62	9.30	8.60, 10.06	0.50	0.46, 0.54
Year of death	0.98	0.98, 0.99	1.05	1.05, 1.06	0.93	0.92, 0.93	1.00	1.00, 1.01	1.05	1.04, 1.05	0.98	0.98, 0.99
Interaction: Dementia * year of death	1.04	1.03, 1.06	1.03	1.01, 1.04	1.04	1.02, 1.05	1.02	1.01, 1.03	0.96	0.94, 0.98	1.08	1.06, 1.10
Model statistics												
Z	145 944		145 944		145 944		145 944		145 944		62 158*	
-2 Log likelihood	126 682		159 658		189 194		198 231		158 708		134 320	
In all models comorbidity is adjusted for. * Data on home care include years 1999, 2001 and 2003	sted for. rs 1999, 200	11 and 2003										

Table 10. Use of services (1 = did use, 0 = did not use) in the last two years of life (decedents died in 1998-2003). Binary logistic regression analyses.

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	Hospital	University hospital	General hospital	Health centre	Long-term care
Age	-	-	-	+	+
Gender (0=man, 1=woman)	ns	ns	-	+	+
Dementia (0=no, 1=yes)	+	+	+	+	+
Year of death	-	ns	-	+	+
Interaction: Dementia * Year of death	-	-	ns	-	ns

Table 11. Direction of association with number of days in care among those who used services. Negative binomial regression analyses (decedents died in 1998–2003). Results described in more detail in Study IV.

In all models comorbidity is adjusted for.

+ = positive association, - = negative association

ns = not statistically significant (p>.05)

7 Discussion

7.1 Summary of results

Age and closeness of death

The major finding in this case-control study was that decedent status was a very important determinant of service use. Decedents had a much higher probability of using both hospital and long-term care than surviving controls matched for age, gender and municipality of residence. Among users, decedents also spent more days in care than survivors, except in long-term care in the youngest age group and men aged 80–89 years. In the oldest age group (\geq 90) home care was more often used by survivors, probably because so many of the decedents were in long-term institutional care.

There were marked differences between old age groups in service use in the last two years of life. In the last two years of life the use of university and general hospital in particular decreased with age, whereas the use of health centre inpatient ward and long-term care increased. The increase in hospital use started earlier in the youngest age group.

So do the results support the red herring hypothesis that closeness of death, rather than age, is the most important determinant of health and social service use and costs? They do, but not unambiguously. Both decedent status and age had a significant effect on service use, and they had an interaction: the effect of closeness of death on service use was strongest in the youngest age group (70–79 years). The effect of decedent status was also different on different services: it was strong on hospital use, whereas long-term care use in particular was heavily dependent on age.

It is important in any assessment of the use and costs of health and social services at the end of life to take account of the fact that they vary by age. At the end of life service use is high in all ages, but the type of services used depends on age. Since increasing longevity means that deaths are being delayed to more advanced ages and the oldest-old use more long-term care and less hospital care at the end of life than those who die at a younger old age, it may be expected that hospital use will not increase as much as the use of long-term care. The need and demand for different kinds of long-term care arrangements will increase with continued population ageing.

On the basis of this study it is impossible to conclude whether the strong effect of decedent status on service use is due to diseases and disability at the end of life, or whether that effect applies regardless of health indicators. It has been reported that the severity of health problems explains the high use of acute care among decedents (Pot et al., 2009). De Meijer, Koopmanschap, Koolman and van Doorslaer (2010) found that closeness of death was not a predictor of home care and long-term care use when disability was controlled for. They argued that closeness of death acts as a proxy for disability. On the other hand there are also studies where need factors have been adjusted for, and still decedent status has had a significant effect on the use of long-term care (Pot et al., 2009) and the use of both formal and informal care (Rhee et al., 2009). Since disability increases sharply with age, age may be considered to represent need for services when no data are available on disability.

Regional variation

There was considerable regional variation in health and social service use in the last years of life. Hospital use overall did not vary markedly between hospital districts and municipalities, but there was wide variation in university and general hospital use. Any use of services varied more than the number of days in care among users. It is possible that any use of services is more dependent on the availability of services, while the number of days in care is associated with medical and social factors that do not vary regionally.

Some factors describing the population and economic conditions in the municipality had an effect on service use, but they varied between services and did not systematically explain use. The only regional factor, the presence of a university hospital in the hospital district, not surprisingly explained university hospital use. Most of these factors were beyond the control and influence of municipalities. Variables describing the municipal service pattern were constructed on the basis of individual data. These variables described the proportion of service users and the number of days in care among users in the municipality and explained most of the variation. However, this may be due to the way that the variables were constructed, and in the future other variables describing service pattern need to be developed. Municipalities have their own historical patterns of care delivery for older people. Underlying these municipal differences are factors that are difficult to describe and quantify, such as care practices that are based on local traditions and politics (Nordberg & Häkkinen, 1997; Rissanen et al., 1999; Teperi & Keskimäki, 1993; Valtonen, 2000). Major changes and upheavals are currently underway in the Finnish municipal sector, which has a key role to play in service

delivery for older people. The number of municipalities is being reduced and services are being restructured. However, changing established care practices is always a difficult and slow process because the changes may be at variance with the interests of the professional groups involved and the existing structures of municipal service units (Parpo & Kautto, 2007).

The present analyses focusing on municipal differences also included individuals' use of other services, and statistically significant associations were found. The use of long-term care was negatively associated with hospital and home care use and vice versa. This was found at the individual level, but at the municipal level there was no indication of negative association between home care use and long-term care use. Earlier studies have revealed no such evidence either in Finland (Kokko & Valtonen, 2008) or in Sweden (Davey, Johansson, Malmberg, & Sundström, 2006). Hospital use and home care use reinforced each other: the use of home care may increase after hospital episode, and clients of home care are also more likely to be admitted to hospital care.

Dementia and time trend

People with a dementia diagnosis were nine times more likely to use long-term care in their last two years of life than people without dementia, which supports earlier findings (Andel et al., 2007; Kendig et al., 2010; Luppa et al., 2010). The probability of using hospital care was much lower among people with a dementia diagnosis than among those without a diagnosis. These differences persisted even when comorbidity was adjusted for. It is possible that the reason for this is that people with advanced dementia are unable to express their need for care or to seek care, or possibly that they have been evaluated as being unable to benefit from care as much as people without dementia. It is important that older people with dementia get the same amount of care and attention for their other diseases as other older people.

The probability to use university hospital increased and the probability to use general hospital decreased from 1996 to 2003. The total number of days in hospital and the number of days in general hospital decreased among users. The difference between people with and without dementia narrowed during the study period. In contrast to Ministry recommendations (Ministry of Social Affairs and Health & Association of Finnish Local and Regional Authorities, 2008), no decrease was seen in the use of institutional long-term care. However, these recommendations apply to the care of all older people, and those living their last years of life are a special group for whom long-term care might well be appropriate. Both institutional and home care are needed, and alternative forms of care should also be developed in-between. As a result of the decline in HCE during the years of recession from 1991 to 1994 and the slow return to pre-recession levels by 2003, health expenditure showed a tendency to increase over the study period (Heikkilä, 2007). Although this study provides no expenditure figures, it seems that levels of use have not risen significantly. It is possible that the increase in HCE has occurred elsewhere in the health care sector than in the care of old people in the last two years of life.

Equality

One of the key objectives of the health care system is the equitable delivery of health services. Various definitions have been offered of equity in the health care context, including "equality of access for equal need" and "equality of utilization for equal need" (Mooney, 1983). Although the achievement of equity was not a specific interest in this study, the results do raise some concerns about equality of access to care. Firstly, do older people with dementia have equal access to care with people without dementia? People with dementia used hospitals much less often than people without dementia even when they had the same diseases and therefore probably the same need for services. Secondly, do older people living in different municipalities have equal access to care? The use of care services varied considerably between older people living in different municipalities, but it is unlikely that the need for services varied: a more likely explanation is provided by the overuse or underuse of services in some municipalities. The third equity issue concerns equality between women and men: men were more likely to use hospital care. Based on this study it is not clear whether this difference is due to differences in morbidity and therefore in the need for services between the genders, or whether the differences are due to individuals' own choices, their preferences, or whether women and men are in a different position with respect to their access to care.

Gender

One reason for women's lower use of hospital care lies in their high use of longterm care. It has been reported that hospital use is lower among those living in an institution than among community-dwelling older people (Dy et al., 2007; Jakobsson et al., 2007; Liu et al., 2006). One possible reason why women are more likely to use long-term care could be that they have more functional limitations and difficulties with ADL and IADL than men (Christensen et al., 2009), and that they more often live alone and therefore have more limited access to informal care (Brock et al., 1996). In addition, men with a partner are less likely to need longterm care than women with a partner (9.6% vs. 12.1%) (Martikainen et al., 2009). In a Finnish study women were 40% more likely to enter a long-term care facility than men. Almost three quarters of this was due to women's older age, and much of the rest was due to living arrangements (Martikainen et al., 2009).

Appropriateness of care

Since this study did not explore the outcomes of care, it is impossible to draw any inferences about the appropriateness of the care provided to older people in their last two years of life. Hospital use was concentrated in the last months of life, and people died in hospital. These hospital admissions might be considered inappropriate, but the outcome of care is not always known when the decision about admission is made (Garber et al., 1999; Wolinsky et al., 1994). Effective hospital care should lengthen life and usually it does, except in the very last month of life (Felder et al., 2010). Health care is usually driven to promoting the individual's and the population's health. The scarce resources should be allocated to those areas and actions that most contribute to improving health. However in the case of older people living their last years of life, the only object is not to improve their health but also to provide good care and to alleviate pain.

It is not clear who makes the decisions about health and social service use at the end of life. Most older people will have their own preferences as to how they want to be treated, but some of them may be unable to express their hopes and wishes, or they are paid no attention. The older individual's next of kin will usually have their say as well (Dormont et al., 2006). A living will is an expression of the individual's will about future care in the event that he or she is unable to contribute to care decisions due to disease or frailty in old age. These wills may include the directive that life shall not be extended by aggressive procedures if there is no hope of recovery. Some commentators have suggested that these wills could help to achieve savings in end-of-life care. This is not an ethically acceptable viewpoint, nor is it necessarily even possible. In the USA it has been proposed that the more frequent use of advance directives (living will), hospice care and less aggressive care could help to save costs of care at the end of life, but Emanuel and Emanuel (1994) reported that the only way to achieve cost savings was by decreasing the number of days spent in hospital. When patients refuse life-sustaining interventions, they still need the same amount of medical care; it is only a different kind of care. High-quality palliative care requires skilled and costly personnel (Emanuel & Emanuel, 1994). Teno, Fisher, Hamel, Coppola and Dawson (2002) suggested that patients' preferences about palliative care could substantially lower the costs of care, but they are not always taken into account. In a recent study advance directives were not found to impact the costs of terminal hospital care for cancer patients (Tan & Jatoi, 2011). In the USA hospices including both home and institutional care have largely substituted the use of acute hospital care in the last six months of life, but this has not reduced Medicare expenditure (Garber et al., 1999).

Health and social services for older people should respond to different kinds of needs and be adjusted to suit different situations. Too often care facilities can only respond to certain types of needs, and when the older individual's needs change, they have to be moved to another facility. Not all care facilities, it seems, are able to care for older people at the very end of life. In this study the use of private long-term care decreased as death came closer (see Study I). It has been found that older people have to experience many transitions between care facilities and home in their last years of life (Aaltonen, Forma, Rissanen, Raitanen, & Jylhä, 2010). Indeed steps are needed to improve the planning and coordination of care and to streamline the municipal service pattern and financing arrangements.

This study has analysed health and social service use in the last two years of life as well as in earlier years for control persons. All decisions in health care are made under conditions of uncertainty. In retrospect it is easy to say when the last years of life began; but in real present-day life, neither the individuals themselves nor the professionals providing care can know this for sure (Scitovsky, 2005).

Special nature of last years of life

This study showed that the use of health and social services in the last years of life is different than in earlier phases of life. In addition to the finding of increased service use at the end of life, some of the results for the last two years of life contradicted those from studies with older people in general. Hemminki, Luoto and Gissler (2006) found that old women used hospitals more often than men, but in this study women living the last years of their life used hospitals less often than men. Dementia has also been found to increase hospital use in an earlier phase of life (Bynum et al., 2004), but to decrease in the last years of life (McCormick et al., 2001; Rosenwax et al., 2009). A detailed analysis is needed of the changing effects of these factors when death is approaching.

There is an abundance of official documents about services for older people: recommendations, plans and development projects. Most of these documents do not concern themselves with the group at the centre of interest in this study, i.e. those who are living their last years of life. Terminal care is mentioned in the National framework for high-quality services for older people (Ministry of Social Affairs and Health & Association of Finnish Local and Regional Authorities, 2008), and in 2010 a recommendation was published concerning good terminal care (Ministry of Social Affairs and Health, 2010). This recommendation is focused on care for dying people, on the planning and provision of care as well as on staff knowledge and skills. However terminal care does not of course extend to the last years of life, which require special consideration and possibly a separate set of guidelines.

Need and demand for services

Health and social service use among older people in the future will very much depend on the development of their health and functional ability and thus on need for the services. That need could be postponed by promoting the health and functional status of older people. In Finland it is projected that the number of severely disabled older people will more than double by 2030, assuming no change in the age-specific prevalence of severe disability (Lafortune et al., 2007). If the prevalence of disability among people aged 65–80 years continues to decline as reported earlier (Lafortune et al., 2007; Martelin et al., 2004), then the need for services will not increase at the same rate. However the number of the oldest-old will increase, and their functional ability has not been found to be improving (Sarkeala et al., 2011). Projections of the need for health and social services are not enough for purposes of projecting the future use of services. Service use is based not only on needs, but also on the supply of services. Valtonen (2000) found that the use of services for older people was not explained by need factors. As Bech, Christiansen, Khoman, Lauridsen and Weale (2011) assumed, ageing affects HCE directly through demand that is met. The ageing population's increasing needs are not the only driver of expenditure. Spending is also a result of political choices and solutions on the supply side of services (Getzen, 1992; Getzen, 2001).

7.2 Methodological considerations

One of the major strengths of this study is that it makes use of national comprehensive register data. The register sources used cover all people in Finland, regardless of whether they were living at home or in an institution. These registers made it possible to include in the study all people who died in 1998, 2002 and 2003 as well as a 40% random sample of those who died in 1999–2001 at the age of 70 years or older. The 40% sample was representative of the underlying study population. The data were examined in detail, and only few mistakes were identified and rectified. Finnish register data have been found to be highly accurate (Keskimäki & Aro, 1991; Sund, 2003).

Another important strength of the study is its using of a case-control design. Earlier studies into the effect of closeness of death on service use have not matched decedents and survivors one-to-one, but in this study decedent-survivor pairs were matched for age, gender and municipality of residence. This was to eliminate the effects of possible differences in these factors that would have undermined comparability at group level. The use of multilevel analyses suitable for hierarchical structured data also adds to the strength of the study. The interdependency of service use among old people living in the same municipality and municipalities in the same hospital district was taken into account. Analyses ignoring this dependency would have given lower standard errors and thus overestimated the effects of independent variables (Twisk, 2007). The random coefficient models were constructed when necessary, although in many studies only the slopes have been allowed to vary randomly.

It seems that the two-year time period was long enough to cover the effect of closeness of death on service use. It is possible that the use of long-term care begins to increase earlier than two years before death and therefore that a longer time period might have been needed in order to identify that starting point.

This study covered the most resource intensive services, i.e. hospital inpatient care, long-term institutional care and home care. Outpatient primary and secondary care visits and informal care could not be included because relevant data were not available. Primary care might have an important role in the continuity and quality of care at the end of life. Kronman, Ash, Freund, Hanchate and Emanuel (2008) found that more primary care visits in 18-6 months preceding death lowered the number of days in hospital and HCE in the last 6 months of life in the USA. Primary care physicians also have a gate-keeping role in relation to hospital care. Most of the care provided for older people consists of informal care, which has been found to be associated with the use of formal care. In France and Ireland a negative association was discovered (Gannon & Davin, 2010), but in the UK it was found that the two are not perfect substitutes (Pickard, Wittenberg, Comas-Herrera Adelina, Davies, & Darton, 2000). Informal care may also increase the use of formal care if informal caregivers help older people access formal services. More research is needed into the role of informal care in the last years of life.

Functional status, socioeconomic status and living conditions (alone or with a spouse) could have been crucial in helping to better understand the dynamics of health and social service use in the last two years of life, but again lack of data meant they could not be included. It remains unclear whether disability is a proxy for closeness of death or whether it exerts an impact in addition to closeness of death.

Register data do not provide information about the content of care, and it is possible that the information from different regions is not completely comparable. It has been found that the content of home care, for instance, varies between different parts of Finland, and it is not clear that being a client of regular home care is defined similarly in all areas (National Audit Office of Finland, 2010). The use of prescribed medicines was analysed in Study I. The decision was made to exclude this aspect from the other studies, because only data on medicines prescribed to outpatients were available. The lack of data on the use of medicines in hospitals and long-term care would have misrepresented the results between decedents and survivors and between people with and without dementia.

7.3 Future research

Following this detailed analysis of health and social service use in the last two years of life, it would be useful to proceed to examine the costs of care at the end of life. This analysis should also extend to differences between decedents and survivors and between municipalities.

This study was concerned to follow changes in service use over a six-year period. A longer time series needs to be built to see how the possible changes are associated with individual, municipal and regional level factors. It would be important also to examine differences in service use between decedents and survivors in a time series, to establish whether the period during which closeness of death affects service use has lengthened, shortened or remained unchanged.

It was not possible in this study to explain the municipal differences observed in health and social service use. It seems that these differences are rooted in care practices, but it would be important to know what exactly has led to them. However this is a question that requires a different kind of approach.

This study focused on analysing long-term as a whole. The composition of long-term care varies between municipalities and over time as residential care for older people, sheltered housing and health centre inpatient wards are given different emphasis. It would be important to study the development of long-term care over time.

More research is also needed to explore what is happening beyond the registers. How are end-of-life care decisions made, how do they affect the quality of care and quality of life? Qualitative approaches could help to complement the picture of service use at the end of life.

This study did not look into the need for and outcomes of service use or care in the last two years of life, even though age probably reflects need for care. Therefore no proper assessment could be given of the equity and appropriateness of service use, although these issues were discussed in the study. An in-depth knowledge of these aspects would be important when planning care for older people.

8 Conclusions

Closeness of death is an important determinant of health and social service use among older people. However, the effect of closeness of death varies with age and between different services. Age, too, has an impact on service use among older people at the end of life.

People today are older in their last years of life than they were before. This is reflected in service use, which differs by age. With no clear picture of how disability among the oldest-old (85–90 years or over) will develop in the future, it is difficult to assess how the need for services will change. It is clear that with all the changes that are happening, it is not enough simply to analyse the effect of closeness of death on service use.

This study revealed considerable differences between municipalities in the use of services at the end of life. However, those differences are difficult to explain. It is not known whether they are due to different needs for services in municipalities, or whether care delivery is more appropriate in some municipalities than in others, and whether access to care is unequal for older people living in different municipalities.

To gain a better understanding of the complex patterns of health and social services use at the end of life, it is necessary to apply the viewpoints and methods and approaches of different disciplines.

This study contributed to the international discussion on the effects of closeness of death and age on service use by analysing different services in detail with high quality data and a suitable case-control design.

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Author(s), year, country	Services included	Data source	Follow-up time	c	Age	Main results
Bickel 1998, Germany	Hospital Residential and nursing homes Ambulatory services	Administrative data and survey	1 year	2507	≥65	With increasing age at death use of residential or nursing homes rose but use of hospital decreased. 80% of decedents had been in hospital, 29% were cared in homes, and 40% were receiving care from home help. 9% of last year was spent in hospital and 21% in residential or nursing home.
Bird, Shugarman, Lynn 2002, USA	Hospital Outpatient visit Skilled nursing facility (SNF) Hospice Home health Physician visit	Medicare	1 year	6967	≥65	Total expenditure was lower for older. SNF expenditure was higher for women and older. Age was much more important than gender in explaining most of the variation in end-of-life care.
Brameld, Holman, Bass, Codde, Rouse 1998, Australia	Hospital	Record linkage	1 year	68 875	≥65	The chance of hospital admission decreased with age. Total inpatient resource use was lowest among the oldest (85+).
Brock, Foley, Salive 1996, USA	Hospital Nursing home	National Institute on Aging's Survey on the Last Days of Life (SLDOL)	3 months	1227	≥65	Hospital days decreased slightly with age, but nursing home days increased dramatically.
Brockmann 2002, Germany	Hospital costs	Hospital claim files, Germany's largest public health insurer (AOK)	1 year	2 583 820	≥20	Caring for patients in their last year of life made a large part of total HCE. Last year was less costly if patient died in advanced age. Oldest old received less costly treatment for same illness, especially women.

Felder, Meier, Schmitt 2000, Switzerland	HCE	Major Swiss sick fund	2 years	415	Majority ≥65	HCE increased with closeness of death. HCE decreased with age (for retired).
Garber, MaCurdy, McClellan 1999, USA	Acute hospital Non-acute hospital Outpatient hospital Hospice Home health	Medicare	2 years	Almost 300 000 for 8 years, altogether 2 271 475	65–99	The number of days in care rose sharply as the date of death neared.
Jakobsson, Bergh, Öhlén, Odén, Gaston- Johansson 2007, Sweden	Hospital inpatient care Hospital outpatient care General practitioner Residential care facility Home care	Government sources	3 months	229	≥18, mean 79.9	Use of health services near end of life was considerable and extensive. It was related to age, living arrangements, resident, functional and disease related characteristics. The number of hospital admissions decreased with advancing age. Probability to use hospital was lower among those who lived in residential homes than those who lived in private homes.
Klinkenberg, Visser, Broese, van Groenou, van der Wal, Deeg, Willmes 2005, Netherlands	Informal care (personal/ household) Formal care Institutional Hospital Residential/ nursing home	Longitudinal Aging Study Amsterdam (LASA)	3 months	342	55-85 at baseline 1992	Use of formal care increased in the last 3 months of life. Half of community-dwelling old people were moved to institutional care, in most cases to hospitals. Women were more dependent on institutional care than men.
Kronman, Ash, Freund, Hanchate, Emanuel 2008, USA	Primary care Hospital	Medicare data	Hospital use last 6 months, primary care preceding 12 months	78356	≥66	More primary care visits were associated with fewer hospital days and lower costs in the end of life.
Larsson, Kåreholt, Thorslund 2008, Sweden	Hospital Home help Institutional care	The Kungsholmen study and Registers	5 years	567 urban population	≥83	The number of days in care was 10-fold in institutional and home care than in hospital. Age increased use of home care but closeness of death use of hospital.

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Levinsky, Yu, Ash, Moskowitz, Gazelle , Saynina, Emanuel 2001, USA	Medicare expenditure	Medicare data	1 year	53 195	≥65	Medicare expenditures decreased with age. Decrease in the cost of hospital services accounted for approximately 80% of the decrease.
Liu, Wiener, Niefeld 2006, USA	Hospital Nursing home Hospice Home care Other	Multi-state Dually Eligible Data Files	1 year	152 019	≥65 Some younger disabled	Combined Medicare and Medicaid spending decreased with increasing age, primarily for Medicare services. Medicaid spending (nursing home care) increased with age. Costs varied considerably between 10 states. Medicare acute care costs rise dramatically in the last quarter of the year.
Long, Stevenson Marshall 2000, USA	Hospital (costs, intensity) Outpatient visits Emergency department Home care visits Durable medical equipment	Medicare Financial Performance Study	1 year The last month of life	All clients: 278 Decedents: 77	≥75	All clients: the oldest were treated less intensively. Decedents: the oldest were treated less intensively. For all age groups the intensity increased during the last month of life.
Lubitz, Riley 1993, USA	Medicare expenditures	Medicare data	1 year	5.5 millions	≥65	Payments were lower for older than younger. Payments for care in the last 2 months of life were about 52% of the payments in the last year.
Lubitz, Beebe, Baker 1995, USA	Medicare expenditures	Medicare data	Lifetime	129 166	≥65	The payments associated with an additional year of life decreased as the age at death increased.
Menec, Lix, Nowicki, Ekuma 2007, Canada	Hospital Long-term care Physician visits Prescription drugs	Administrative data files	1 month 3 months	7678	≥65	85+ had increased odds of being in long-term care and lower odds of being hospitalized.

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Scitovsky 1988, USA	Hospital Nursing home	Palo Alto Medical Clinic records, interviews	1 year	261	≥65	Young olds (65–79) received intensive hospital and physician services more than older old (80+), who received largely supportive care. Expenses for nursing home and home health care of older olds more than offset lower medical service expenses.
Seshamani, Gray 2004, UK	Hospital costs	The Oxford Record Linkage Study (ORLS)	24 years	90 929	≥65	Approaching death affected costs up to 15 years prior to death. The costs increased tenfold from 5 years prior to death to the last year, which overshadowed the 30% increase in costs from age 65 to 85.
Seshamani, Gray 2004, UK	Hospital costs	The Oxford Record Linkage Study (ORLS)	5 years	9366	≥65	The model Zweifel et al. 1999 used was criticized. Both age and proximity of death had a significant effect on hospital costs. The effect of age was smaller. In the last 3 weeks of life hospital costs decreased.
Shugarman, Campbell, Bird, Gabel, Louis, Lynn 2004, USA	Medicare expenditure	Medicare	3 years	241 047	≥68	Older had higher HCE in 2 nd and 3 rd years before death but lower in the last year of death. Among the younger HCE were higher for women in all 3 years before death. Among the oldest HCE were higher for men.
Spillman, Lubitz 2005, USA	Acute and long-term care expenditure	Medicare, National Mortality Followback Survey, National Medical Expenditure Survey	From age 65 to death and 2 years	73 280	≥65	Total expenditure increased substantially with longevity, in part because of steep increase in nursing home expenditure for very old persons. Also spending in the last 2 years increased with longevity. The effect of longevity was different in acute and long-term care.
Stearns, Norton 2004, USA	Medicare expenditure	Medicare Current Beneficiary Survey	2 years	22 101	66-99	The probability of expenditures increased significantly with age up to 85 years. Expenditures decreased with increasing age.

Stooker, van Acht, van Acute care Barneveld, van Vliet, Long-term van Hout, Hessing, (care) Busschbach 2001, Netherlands	Acute care (cure) Long-term care (care)	Dutch sickness fund	1 year	85 000	All	When life approached its end, HCE rose sharply, especially in the last months. Rise was higher for cure costs than for care costs.
Wilson, Truman 2002, Acute care Canada hospital	Acute care hospital	Hospital abstracts data	5 years	7429	All, mean 70.5	Hospital use varied, but was most often low. The last hospital stay was infrequently resource intensive. Age, gender and illness did not distinguish use. Most ultra-high users were rural residents.
Zweifel, Felder, Meiers HCE 1999, Switzerland	НСЕ	2 major Swiss sick 2 years funds (5 years	2 years (5 years)	570 + 348	≥65	No correlation between age and HCE for old people could be detected. HCE during the last quarter of life was 307% (218% in another sample) higher than in the 8^{th} last quarter. The last phase of life was costly independently of whether it occurs at age 60 or 90.

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Author(s), year, country	Services included	Data source	Follow-up time	Ľ	Age	Main results
Busse, Krauth, Schwartz 2002, Germany	Hospital	One sickness fund	1, 2 and 3 last years of life, lifelong hospital use	69 847 survivors 1385 in last year 1368 in 2 nd last 1333 in 3 rd last	All	The number of days in hospital and the ratio of days to survivors were lowest for the oldest (85+).
Experton, Ozminkowski, Branch, Li 1996, USA	Acute and long-term health care use and expenditures, total HCE	Interview, providers 1 year and Health Care Financing Administration	1 year	Frail old home care patients: 127 decedents 450 survivors	≥65	Decedents were 7 times as likely to have hospital admission, 4 times as likely to be admitted to skilled nursing facility, twice as likely to use home health service than survivors. Total HCE was 276% higher for decedents.
Hashimoto, Horiguchi, Matsuda 2010, Japan	Hospital outpatient Hospital inpatient Home care Institutional care	Public insurance claim data	1 year	50 857 decedents 364 484 survivors	≥65	Use and costs of hospital care were higher for decedents than survivors. They decreased with age for decedents, but increased for survivors. Use and costs of institutional care and home care increased with age. Decedents had higher probability to use them, but the expenditure was similar between decedents and survivors.
Hogan, Lunney, Gabel, Lynn 2001, USA	Medicare costs Nursing home and hospice use	Medicare	1 year	19500 decedents, N of survivors was not reported.	≥65 Some younger disabled	Costs for decedents were 6 times higher than for survivors, but when adjusting for severe illnesses and functional impairment, costs were only slightly higher for decedents than survivors.
Hoover, Crystal, Kumar, All medical Sambamoorthi, Cantor 2002, USA	All medical costs	Medicare Current Beneficiary Survey (MCBS), validated by claims records	1 year	49 505 decedents + non-terminal years	≥65	Medical costs for last year of life were 5-fold to non-terminal years. Mean did not vary greatly by age. Non-Medicare expenditures were higher and Medicare expenditures lower for older.

Appendix table 2. Studies on the use and costs of health and social services among decedents and survivors

HEALTH AND SOCIAL SERVICE USE AMONG OLDER PEOPLE

Häkkinen, Martikainen, Noro, Nihtilä, Peltola 2008, Finland	Somatic specialized care Health centre Psychiatric inpatient care Long-term care Prescribed medicines	Register data	6 years	285 317 N of decedents and survivors was not reported.	N 23	Total expenditure on health care and care for old people increased with age but the relationship was not as clear as is usually assumed. The expenditure of somatic care and prescribed drugs clearly decreased with age among decedents.
Lubitz, Prihoda 1984, USA	Hospital inpatient Skilled nursing facility Home health agency Physician Hospital outpatient	Continuous Medicare History Sample (CMHS)	2 years	1 141 580 decedents 18 342 040 survivors	≥67	Decedents comprised 5.9% of the study group but accounted for 28% of expenditures. The use of services became more intense as death approached: 30% of all expenditures in the last year of life were spent in the last month of life. Medicare expenditure decreased by age among decedents and increased among survivors. Older decedents used more nursing home. Much of the higher costs at older ages were due to higher mortality.
McCall 1984, USA	Hospital Skilled nursing facility Home health agency	Medicare	1 year	10 766 decedents 6170 survivors	≥65 Some younger disabled	Decedents costs in the last year were >6000\$, survivors <1000\$. 89% were for hospital care. More than 60% of the expenditures were in the last quarter.
Perls, Wood 1996, USA Acute care	Acute care hospital	Hospital discharge data	2 years	Discharges: 37 936 for decedents 636 963 for survivors	09≂	Age-related decrease in costs per hospitalization was especially notable among decedents. Average length of stay declined from 13.7 days (60–69 years) to 10.3 days (≥100). The difference in cost between survivors and decedents became less with increasing age.

Polder, Barendregt, van Oers 2006, Netherlands	Hospital Nursing home Home care GP Pharmaceuticals	Health insurance data	1 year	24 265 decedents 2.1 million survivors	ЯШ	HCE for decedent was 13.5 times higher than for survivor. Costs for the younger decedents were higher than for older. Most of the costs in the last year of life were related to hospital care (54%) and nursing home (19%). The cost ratio of decedents and survivors diminished strongly by age.
Pot, Portrait, Visser, Puts, van Groenou, Deeg 2009, Netherlands	Acute: medical spe- cialist hospital Long-term: informal care formal home care institu- tional care	Longitudinal study of ageing in Amsterdam (LASA)	1 year	262 decedents 2845 survivors	55–85 at baseline	Decedents used more care than survivors. Use of acute and home care were determined by health problems. Use of institutional care was determined by health problems and decedent status.
Rhee, Degenholtz, Muramatsu, Lau 2009, USA	Formal and informal care	Health and Retirement Study (HRS) 2002	2 years	19 668 N of decedents and survivors was not reported.	≥50	Probability of receiving and the amount of formal and informal care was higher for decedents and survivors.
Roos, Montgomery, Roos 1987, Canada	Acute and chronic hospitalization Nursing home Ambulatory physician contacts	Registry of provincial universal health insurance plan	4 years	4263 decedents Comparison: General popul. 52 394 Survivors 38 579	≥45	Hospital use doubled from 4 th to 2 nd last year for all but youngest. The most dramatic increase was during the last year of life. Use of nursing home increased regularly 4 years before death. Impending death reduced age differences. Among the oldest three was a shorter period of increased use prior to death. Deaths of the oldest (85+) resulted highest HCE, due to nursing home expenditure.
Serup-Hansen, Wickstrøm, Kristiansen 2002, Denmark	Hospital inpatient Primary health care	Prevention Register, Statistics Denmark	1 year	1 011 348	All	Costs for primary health care were slightly higher and hospital costs considerably higher for decedents than survivors. Difference in both services diminished with age.

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Temkin-Greener, Meiners, Petty,	Use and costs of Medicare and	Communitywide database	1 year	4349 decedents 87 312 survivors	≥65	Younger olds used 55% of resources to hospital care, whereas the oldest 26%, 67%
Szydlowski 1992, USA	Medicaid services					going for nursing home and home care. In the very last phase of life the oldest were less costly. Dying had a greater impact on use and costs among younger decedents; 285% more costs than for survivors, among the oldest 35%.
Werblow, Felder, Zweifel 2007, Switzerland	Total HCE Ambulatory Care Nursing home Home care Hospital inpatient Hospital outpatient Prescription drugs Other services	Major Swiss sickness fund	5 years	5075 decedents 57 085 survivors	30–95	HCE was five times higher for decedents than survivors 1 year before death, 2 times higher 4 years before death. 70+: Total HCE increased with age year before death. This was due to increase in long-term care use. Use of other components decreased with age. High costs of dying decreased in old age. Age had a positive effect on long-term care use, but also proximity of death. "Age has a negligible effect on HCE both for survivors and decedents." Proximity of death is strongly positively related to HCE.
Wolinsky, Culler, Callahan, Johnson 1994, USA	Hospital % hospitalized n of episodes LOS total charges	Medicare Longitudinal Study on Aging (LSOA): Interview Administrative records	7 years	2867 decedents 4660 survivors	≥70	Decedents consistently consumed more hospital resources than survivors. Among hospitalized: decedents had about 11.5 days longer total stays and their total charges were about 8398\$ greater than those of survivors.
Wolinsky, Stump, Johnson 1995, USA	Hospital	Medicare Longitudinal Study on Aging (LSOA)	7 years	2867 decedents 4660 survivors	≥70	The volume of hospital use was more than twice as great for decedents as for survivors. Younger decedents had higher number of hospital episodes.

ts ≥65 HCE increased with closeness of death.	ors Time to death was the main reason for higher	inpatient care expenditures, whereas aging	was the main reason for higher long-term care	expenditures.			
3 years 4394 decedents	19 932 survivors						
Medicare Current	2003, USA care Beneficiary Survey	Cost and Use					
Hospital inpatient	care	Nursing home	Home health care	Outpatient	Medical provider	Prescription drugs	Hospice
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Appendix table 3. Studies on municipal variation in the use and costs of health and social services at the end of life	udies on municip	al variation in the	use and costs of	health and social	l service	s at the end of life
Author(s), year, country	Services included	Data source	Follow-up time	۲	Age	Main results
Barnato, Herndon, Anthony, Gallagher, Skinner, Bynum, Fisher 2007, USA	End of life spending	Survey, Measure of local health care intensity	6 last months of life	2515 306 hospital referral regions	≥65	Differences in preferences are unlikely to explain regional variations in end of life spending.
Fisher, Wennberg, Stukel, Gottlieb, Lucas, Pinder 2003, USA	Medicare EOL spending	Medicare Current Beneficiary Survey	6 months (not last months of life)	987 515 306 hospital referral regions	65–99	Average baseline health status was similar across regions, but patients in higher- spending regions received approximately 60% more care. Quality of care and access to care was no better in higher-spending regions.
Fisher, Wennberg, Stukel, Gottlieb, Lucas, Pinder 2003, USA	Medicare EOL spending	Medicare Current Beneficiary Survey	6 months (not last months of life)	987 515 306 hospital referral regions	65–99	Patients in higher-spending regions received more care but did not have better health outcomes or satisfaction with care.
Fisher, Wennberg, Stukel, Skinner, Sharp, Freeman, Gittelsohn 2000, USA	Hospital	National small area analysis U.S. Census Medicare claims	Not reported	5.53 million 313 hospital referral regions	≥65	Residents of areas with more beds were up to 30 percent more likely to be hospitalized, controlling for socioeconomic characteristics and disease burden. Increased use provides no detectable mortality benefit.
Goins, Hobbes 2001, USA	Three home- and community based long-term care programs	Administrative files Medicaid data	1–8 months, differed between programs (not last months of life)	No individual data 100 counties	≥65	Great variability was found in number of elderly using services. Percent of persons ≥85 years and the ratio of institutionalized long-term care beds were negatively associated with use.

Häkkinen, Luoma 1995, Finland	Health care Care of the elderly	Earlier studies		No individual data		Income level of local population, level of state subsidy, allocative efficiency (mix of institutional and non-institutional care), productive efficiency of service providers and factors associated with need of services were most important determinants of HCE.
McConnel, Zetzman 1993, USA	Hospital Nursing home Physician service	National Center for Health Statistics Longitudinal Study of Aging+	2 years (not last years of life)	3750	≥70	Utilization pattern of hospital, nursing home and physician services was unrelated to either rural or urban residential location or the availability of health resources in those areas.
Mukamel, Bajorska, Temkin-Greener 2002, USA	Hospital Nursing home Primary care physician	DataPACE, the Program of All- inclusive Care for the Elderly	3 last years of life	2160 10 sites	≥65	Use of health services increased 7 months before death, with the largest increase in the last month. The increase was dominated by hospital use. During the last month before death variation across program sites explained twice as much of the variation in service use as did variation in individual characteristics.
Muramatsu, Campbell 2022, USA	State expenditure on home and community based services (HCBS) Formal and informal personal assistance	Assets and Health Dynamics among the Oldest Old (AHEAD) Survey	Not reported	3051 34 states	≥70	Persons residing in states with higher home and community-based services expenditures were more likely to use formal personal assistance, but not less likely to use informal assistance.
Pritchard, Fisher, Teno, Sharp, Reding, Knaus, Wennberg, Lynn 1998, USA	Place of death: hospital or non- hospital	SUPPORT Administrative databases		458 individuals 5 sites	≥65	Variation was not explained by sociodemographic, clinical characteristics or patient preferences. Risk of hospital death was increased for residents of regions with greater hospital bed availability and use, and decreased in regions with greater nursing home and hospice availability and use.

Skinner, Wennberg 1998, USA	Medicare expenditure Intensive care unit use	Medicare data	6 last months of life	306 hospital referral regions	"Elderly"	Spending differences were not due to variation in health levels. Survival rates were not better in higher spending areas.
Temkin-Greener, Bajorska, Mukamel 2008, USA	Hospital Nursing home Day center Therapy Home care	PACE, the Program of All- inclusive Care for the Elderly	3 years (not last years of life)	9853 individuals 29 programs	Mean 77.6	More hospital care was associated with worse functional outcomes. Sites providing more day center care and more therapy had significantly fewer hospital admissions.
Wennberg, Fisher, Stukel, Skinner, Sharp, Broneer 2004, USA	Hospital Physician visits Hospice	Medicare admission files	6 last months of life	115 089 individuals 77 highly respected hospitals	≥65	Extensive variation in days in hospital, days in intensive care units, n of physician visits and hospice enrolment existed.
Virnig, Kind, McBean, Fisher 2000, USA	Hospice	Medicare administrative data	"prior to death"	1 699 547 deaths Hospital Service Areas (HSA)	≥65	Individual characteristics explained less of the variation in hospice use than was explained by local market characteristics. Hospice use was lower in areas with high numbers of hospital beds per capita and high in-hospital death rates.

Original publications

Health and social service use among old people in the last 2 years of life

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Abstract

This study focuses on differences in health and social service use in the last 2 years of life among Finnish people aged 70–79, 80–89, and 90 or older and on the variation in service use in the various municipalities. The data set, derived from multiple national registers, consists of 75,578 people who died in 1998–2001. The services included hospitals and long-term-care facilities, use of regular home care, and prescribed medicines. General hospital and public long-term care were the services most commonly used: general hospitals for younger age groups and public long-term care for older groups. The number of inpatient days in hospital was lower with increasing age, but older age groups used long-term care more frequently. Men had more hospital inpatient days than women, but women used more long-term care. The number of hospital inpatient days increased rapidly in the last months of life, almost doubling in the final month. Days in public long-term care by municipality was remarkable. The results indicate that, among people aged 70 years and older, age is a major determinant of care in the last 2 years of life. The variation in the use of care by municipality and the differences between men and women deserve more detailed analysis in future.

Keywords: Last years of life, health and social care, use of care, ageing, older people, register study

Introduction

There is a general understanding that people use more health and social care services in the last months and years of their lives than earlier, and that old people use more care than the young and middle-aged. Results, however, vary from one study to another by the type of care, the length of the period considered before death, and the time of the study. Also, the use of and demand for care preceding death is changing with practices in health and social care, and with increasing longevity in various populations. In this study, we examine the use of health and social care among old people in the last 2 years of their life in Finland, using register data covering both institutional and outpatient health and social services for the whole population. In particular, the focus is on the differences between age groups in old age.

At the beginning of the Twenty-first century, about 70% of all deaths in Finland and 67% in the US occurred among persons aged 70 years or over (Statistics Finland 2006, personal notification; Kochanek et al. 2004). The proportion is expected to increase as a result of the population ageing and of the rapidly increasing life expectancy for those of both younger and older ages in particular. Several studies indicate that both age and closeness to death influence the need for care in older people. The likelihood of co-morbidity and functional decline increases with age, and, thus, need for services differs by age group. However, epidemiological studies indicate that old people who are dying experience a steeper decline in functional status than do same-age survivors (Guralnik et al. 1991; Wolinsky et al. 1996), and among older people, the oldest are more likely to experience a longer period of disability before death (Lunney et al. 2003). Also, functional decline before death differs by age, being greater with more advanced age at death (Guralnik et al. 1991).

A limited number of studies have concentrated on old people's use of services in their last years of life; most of these have focused on costs of services. The studies vary according to the services included in the analysis. Most studies have included hospitalisation (e.g. Brameld et al. 1998; Seshamani and Gray 2004; Wilson and Truman 2002), but many have considered physician's visits and home care also (e.g. Lubitz and Prihoda 1984; Bird et al. 2002; Hoover et al. 2002), and some have included support services (e.g. Mukamel et al. 2002). The results

indicate that the use and costs of acute health care are greater in younger old people than in the most elderly (Shugarman et al. 2004; Seshamani and Gray 2004), but these differences more or less disappear or are even reversed when long-term care as well is taken into account (Hoover et al. 2002; McGrail et al. 2000). The follow-up time in relevant studies has varied from the last 3 months to the last 24 years of life, but most often service utilisation has been followed for the last year. The results indicate that the effect of closeness to death appears mainly in the last 2 years of life. Health care expenditure has been reported to increase most rapidly in the last 6 or final 3 months of life (e.g. Yang et al. 2003; Zweifel et al. 1999). Mukamel et al. (2002) found that health care service use increased 7 months before death; the largest increase was in the final month.

Few of the previous studies have examined both hospital care and outpatient care. Also, most studies have been based on either administrative (e.g. Bickel 1998; Bird et al. 2002; Gaumer and Stavins 1991) or survey data (e.g. Brock et al. 1996), relying on self-reports or reports by the next of kin, which may be susceptible to recall problems. In Finland, one of the major advantages in health services research is the availability of comprehensive national registers that are based on provision of both health and social services, and are considered reliable.

In Finland, municipalities, 431 in number in the year 2006, are responsible for organising health and social services for their residents. The municipalities may provide services themselves or in co-operation with other municipalities, or they can purchase them from private providers or other municipalities. These services are funded mainly by taxes, but also partly by user fees. In addition to this public service provision, the private sector produces about one-fifth of all health and social services. The proportion of private services, however, varies according to the type of service, being largest for dentists and outpatient care physicians, and very small for hospital care (3.6% for all hospital days in Finland, according to Hein et al. 2005). National health insurance, which usually covers all people regularly living in Finland, provides partial reimbursement for the costs of private services, including prescribed medicines also. Medication is included in the user fees for institutional care.

Primary health care is provided by municipalities at health centres that also have hospital beds and provide both acute and long-term care. Specialised health care is produced by the municipalities via district and central hospitals owned by 20 hospital districts that are joint organisations. These districts form five university hospital districts, providing the most specialised health care. Municipalities and hospital districts have wide autonomy in organising the services, and there are differences between municipalities with regard to practices and also provision of care. Local service patterns influence social and health care usage and, to some extent, are also likely to affect the impact of age and time to death on service use.

In this study, the focus is on age differences in health and social service use in the last 2 years of life among people aged 70 years and older. The study is part of a more comprehensive project on 'Costs of Care Towards the End of Life' (COCTEL). The detailed research questions are:

- To what extent does use of different health and social services in the last 2 years of life differ between age groups 70–79, 80–89, and ≥90 years? Here, we are interested in both, the proportion of people who used different services and the service quantities they used.
- 2. How does the use of different health and social services vary with time to death (starting from 24 months preceding death), and how is age associated with this variation?
- 3. Are the possible age differences in social and health service use in the last 2 years of life maintained even if the variation in service organisations among municipalities is taken into account?

Methods

Data

The basic population of this study consists of all people who lived in Finland and died between 1998 and 2001 at the age of \geq 70 years. The sample was identified from the Central Population Register (Statistics Finland). The study population consisted of two subgroups:

1. all those who died at the age of 70 or older in the year 1998 and

2. a random sample (40%) of all people living in Finland who died in 1999–2001 at age 70 or older, taken on those who were alive at 31 December 1997.

The total sample consisted of 75,578 decedents. Their service use was studied for the time period of 2 years before death (not two calendar years but 730 or 731 days until death).

The data were combined from five registers, maintained by Statistics Finland, the National Research and Development Centre for Welfare and Health (STAKES), and the Social Insurance Institution of Finland (SII). All records in these registers contain the individual's unique social security number, which makes it possible to link records within the register and to information in the other registers. The same personal ID is used for all social and health care purposes. The registers are introduced in brief here, and Table 1 describes the information from each that is used in this study.

[Table 1 about here]

The Causes of Death Register of Statistics Finland contains basic demographic characteristics; dates and places of birth; and dates, causes, and circumstances of death.

The Care Register for Health Care of STAKES covers all hospitals in Finland. It contains data on the provider of hospital services and on the patient, admission, discharge, diagnoses, and care received. The Care Register for Social Welfare, also maintained by STAKES, registers the care episodes of residents in all long-term-care institutions in Finland, since 1996. The register contains data on the provider of service, client, admission, and discharge to care, as well as on the services and care received. These two registers also include census information for those care episodes that continue beyond the end of each calendar year. The Home Care Census has been conducted since 1995; it is performed 1 day every second year in November. It includes clients of regular municipal home care, and services they have received in the previous month. The register contains information on the provider of service, client, admission, and discharge to care, and on the services and care received.

The prescription database of the Social Insurance Institution covers prescribed medicines for which non-institutionalised people have claimed reimbursement from the SII. The database includes ATC code (Anatomical Therapeutic Chemical classification system), date of purchase, costs, and the SII reimbursement received. The prescription database covers 97% of all purchased prescribed outpatient medicines for which reimbursement has been provided (Klaukka 2004).

The ethics committee of the Pirkanmaa hospital district discussed the research plan and concluded that they did not object to the research being undertaken on ethical grounds.

Discrepancies were found for 0.2% of admissions; there were inpatient days after the date of death or the same admission was recorded twice. These admissions were removed from the data. Corrections were made to 0.15% of admissions. Most of them concerned admission dates that referred to the same admission but differed between the census and discharge data; in these cases, the admission date from the discharge data was replaced by the admission date from the census data.

Measures

In this study, the data include (1) inpatient days in hospital, (2) days in long-term care, (3) regular home care (at least once a week), and (4) use of prescribed medicines. Hospitals include university hospitals, general hospitals (including central, district, and private hospitals), and inpatient departments of health centres when the patient remains in care for less than 90 days. Long-term care includes care in residential homes, housing with 24-h assistance for older people, and inpatient departments of health centres in cases where the patient stays for 90 days or more. Long-term care is divided into public and private care; all three categories are included in public care, but only residential homes and housing with 24-h assistance for older people are provided privately also. Home care includes both home nursing and home help.

Service use was analysed for age groups 70–79, 80–89, and \geq 90 years (age at death), separately for men and women. Data were analysed also in 5-year age bands but are reported in 10-year

strata because the results were quite similar in the two classification schemes. We present, first, the proportion of subjects who had used various services and, second, the quantity of services used (care days or number of medicines), with the latter calculated for only those who had used the service in question. Use of medicines is reported as the number of different prescribed medicines (ATC codes to an accuracy of seven characters; pharmaceutical ingredient) purchased. Home care is described only as the proportion that received regular service; the number of home care visits in the last 2 years of life was not available. The service use was calculated for 24 months before death in each age group and for men and women separately. The months were calculated individually as 24 times 30 or 31 days before death. The last month was deemed to end on the day of death.

To study the influence of municipal differences, the services were analysed in two categories: hospital care and long-term care. One very small municipality had only one person in the data. In one municipality (184 persons in these data), services were organised differently from those in all other municipalities, definitions of hospital and long-term care were different, and there were considerably more hospital inpatient days than in other municipalities. These two municipalities were excluded from these analyses.

Analysis

To ensure that the sample is representative of the basic population, its age and gender distributions were compared to those for all deaths at the age of 70 and over in the study years 1998–2001 in Finland, using the data from Statistics Finland.

Chi-square tests were performed to test differences between age groups in the proportions of subjects who had used services. Since the distributions of all study variables were strongly skewed or bimodal, medians and upper and lower quartiles are presented instead of means and standard deviations. Kruskall–Wallis tests were performed to find out if there are differences between the three age groups in the quantity of services used, and Mann–Whitney U tests were done for analysing more exactly, which age groups differ in respect of the quantity of services used. All analyses were performed with the SPSS statistical software package (version 12.0.1).

Results

Descriptive

In the sample there were 30,786 (40.0%) men and 44,792 (60.0%) women. The average age at death was 82.1 years, 80.0 for men and 83.5 for women. Age distribution by gender is shown in Table 2. The age and gender distribution of the sample followed the distribution of all deaths in the age groups \geq 70 in Finland in those years, and the distribution did not vary according to the year when people had died. This was also true separately for those deaths occurring in the 40% sample of people in 1999–2001.

The proportion of service users in different age groups

Service use in the last 2 years of life varied considerably between different groups. Of all subjects, 4.7% (1.4–8.8% in different age and gender groups) did not use inpatient days at all in their last 2 years of life, while 13.9% spent at least their two final years of life in some institution. Thus, the minimum number of inpatient days was 0 and the maximum was 731. The most frequent place of care was a general hospital for men aged 70–89 and women 70–79 years old and was public long-term care for men aged \geq 90 and women aged \geq 80 years (see Table 3). Use of university and general hospitals was less frequent for older age groups, but long-term care increased with older age classification. Use of inpatient departments of health centres was slightly different from that of other hospitals or long-term care; age differences were quite small, and service use tended to be more common among 80 to 89-year olds than other age groups. The proportion of subjects spending any days in long-term care was minor. A greater proportion of men than women had spent inpatient days in hospital, whereas women had used more long-term care.

The proportion that did not use any hospital care was higher in older age groups. About 20.9% of men and 34.2% of women aged \geq 90 years did not have any hospital inpatient days in their last 2 years of life. The proportion that did not use long-term care was much lower in older age groups

- for men, it decreased from 73.9% in the age group 70–79 years to 35.9% in the age group \geq 90 years, and for women from 63.5 to 22.2%, respectively.

[Table 3 about here]

All told, 18.0% of subjects had received regular home care in their last 2 years of life. The proportion of home care clients tended to be higher in older age groups, but among women the use of these services was highest in the 80–89 age group. This could be due to the large proportion of institutionalised women in the oldest group. Those aged 90 or more constituted the only age group in which men received more regular home care than women.

Of all subjects, 80.4% (with a 60.0–89.8% spread among age and gender groups) had purchased at least one prescribed medicine in their last 2 years of life. The proportion was lower in older age groups, and the decrease by age group was steeper among women than men. The majority (62.5%) of those who had purchased no prescription medicines spent the last 2 years of life in some institution, and information about their medicine use was not available for this study.

The quantity of services used

The medians and quartiles of inpatient days and prescribed medicines for men and women in the three age groups are described in Table 4. Only those who had at least one inpatient day in the respective service type, or at least one medicine purchased in the last 2 years of life, are included. For all hospitals combined, and for university hospitals and general hospitals as groups, the number of inpatient days was lower for older age groups among both men and women. Differences between age groups for all service categories were statistically significant. For health centres, inpatient days increased from age group 70–79 to age group 80–89, but differences between age groups 80-89 and ≥ 90 were not statistically significant. Also, for long-term care there was a gradual increase in the days in care from the youngest to the oldest age group.

For those who had used long-term care, the number of days in care was usually high. It was higher in older age groups and much higher for women than men.

The number of medicines purchased was lower for older age groups. The numbers of separate medicines purchased were large: 54.4% of those who bought any prescription medicines bought ten or more different ones in the last 2 years of their life.

A quite small proportion of old people accumulated a large proportion of both hospital and longterm-care use; e.g. 10% of \geq 90-year olds accounted for 66% of hospital inpatient days in that age group. In the youngest age group considered (70–79 years), hospital inpatient days distributed most evenly, with 10% accounting for 46% of inpatient days. In the 80–89 group, 10% accounted for 56% of the inpatient days. Days in long-term care distributed most evenly in the oldest age group.

[Table 4 about here]

The median number of hospital and long-term-care admissions (analysis not shown) was quite small, ranging from 1 to 3 in different services. Still, over 40% of subjects in the two younger age groups and 33.6% in the \geq 90 group had at least five admissions for the combined group of services. The maximum number of admissions was 136. The number of admissions was lower for older age groups. Differences between age groups were statistically significant in hospital admissions.

Variation of service use with time to death

The next step in our analysis was to examine the use of services according to the time to death. In these analyses, the whole study group was included. Number of hospital inpatient days increased rapidly in the last months of life (see Fig. 1), and it almost doubled in the last month. In university hospitals, the number of inpatient days among the youngest age group started to increase approximately 1 year before death, and in the older groups for men 6 months and for women 4 months before death. In general hospitals, the increase occurred at an accelerated rate in the five or six final months. Use of inpatient departments of health centres peaked about 4

months before death for both in men and in women. There were no remarkable age differences in use of health centres, by month.

The number of days in public long-term care increased quite regularly over the 2 years, but the increase stopped in the last 2 months of life for all age groups (see Fig. 2). Also, it is quite likely that use of these services was rising already before the 2 years started, especially in the women of the oldest age group. For private long-term care, the number of days increased but then started to decrease towards the end of life - for men about half a year and for women 1 year before death.

The order of the age groups in terms of care use did not change in the 2 years prior to death; younger people used more hospital care and older ones used more long-term care the whole time. The differences between age groups remained similar for long-term care throughout the 2-year period, but in hospital use differences did see an increase towards the end of life.

Although service use was considerable in the last month of life, 10.5% of the whole study group did not spend any days in inpatient care in the last month of their lives.

[Figure 1 about here] [Figure 2 about here]

Service use by age group and municipality

There is some variation in the exact manner in which municipalities in Finland arrange health and social services for their residents. Therefore, we wanted to explore the possible effect of the municipalities' different practices on our results that indicate a lower number of hospital days but higher number of days in long-term care as age increases in the last 2 years of life. To do this, we calculated means, medians, and 5 and 95% percentiles of days in hospital and days in long-term care by age group for the 429 municipalities. In this analysis, the age-group-specific mean for each municipality served as a unit of observation. The results for men and women were combined (see Table 5). The results were essentially the same as for the analyses where individuals were used as observation units. The number of inpatient days in hospital was lower for older age groups and the number of days in long-term care much higher in older age groups. However, the variation in inpatient days between municipalities was quite high for hospital inpatient days and even higher for days in long-term care.

[Table 5 about here]

Discussion

The aim of this study was to assess differences between age groups in health and social service use in the last 2 years of life, and to describe the variation among municipalities. We found marked differences between the 70 to 79-year olds, 80 to 89-year olds, and \geq 90-year olds in both the proportion of people who had used services and the quantity of use. The results suggest that inpatient days in hospital decrease with age but days in long-term-care institutions increase. Similar results have been obtained in previous studies. Brock et al. (1996) studied days of care in the last 90 days of life among old people. The number of hospital days decreased slightly with age, but days in a nursing home increased dramatically. In a German study, Bickel (1998) found that, with increasing age at death, the use of residential homes and ambulatory services rose steeply, whereas the probability of hospital treatment decreased with advancing age. Also a recent Canadian study (Menec et al. 2007) showed that very old individuals (85+ years old) were more likely to be cared for in long-term care institutions and less likely to be hospitalised than younger olds.

The major differences in health and social service use between age groups once again indicate that neither in research nor in practice should old people be considered to be a single group; rather, even the population aged \geq 70 years includes many groups whose use of services is different. The same has been found earlier, such as by Long and Stevenson Marshall (2000), whose entire study population was 75 years or older and had a functional disability but where the older age groups were treated less intensively than the younger. There are several possible explanations for these differences. Causes of death differ somewhat from one age group to another, and some diseases are more associated with disability and also with need of services.

However, it is also possible that, regardless of need, older age groups may have fewer admissions to inpatient hospital care than younger ones because they are less lightly admitted and less intensive care is given for them (see e.g. Levinsky et al. 2001).

In this study, 80% of old people had bought prescribed medicines in their last 2 years of life. This result is quite similar to that of a Swedish study (Jörgensen et al. 2001), where 78% of community-dwelling people \geq 65 years old had at least one prescription item, although that study considered old people generally, not only those who were in their last years of life. In our study, 43.8% of the sample had bought \geq 10 medicines, which is many more than Jyrkkä et al. (2006) reported: 28% of old people had used this many medicines. However, unlike such earlier work our study included all different medicines in the last 2 years of life, and not all of these were necessarily used at the same time. The variation of medicine use by time to death could not be studied here.

In our study 11–22% of old people had used regular home care in their last 2 years of life. The proportion is quite similar to that in the study of Grabbe et al. (1995), where 19.5% of decedents had received formal home care. They found that among other characteristics, older age and being female were significantly associated with the use of formal home care. In our study the results were similar, except in the oldest age group (\geq 90 years), where a bigger proportion of men had received regular home care than women, and women had used less home care than women in age group 80–89 years. Less use of home health in the oldest age group (85+ years) has been reported also by Bird et al. (2002).

The change in service use towards the end of life varied between the service types. Hospital use tended to increase rapidly in the last months of life, the same has been found in previous studies (e.g. Mukamel et al. 2002; Klinkenberg et al. 2005; Menec et al. 2007). The number of hospital inpatient days began to rise earlier for the youngest age group than for older groups. Roos et al. (1987) also found that closeness to death influences health and social care service use among the oldest age groups over a shorter period. In our figures days in long-term care decreased in the last months of life. Some of the residents of long-term care have been moved elsewhere for the last period of their lives. The transitions between different care units and the pathways of care

will be analysed more in detail in future. The use of home care and prescribed medication could not been analysed by time to death like hospital and long-term services.

Average service use seems to be quite high in the last years of life, but there are also people who do not use the services at all. For example, Gaumer and Stavins (1991) reported that almost 10% of Medicare beneficiaries did not use Medicare services in the 90 days before death. McCall (1984) found that 26% of Medicare beneficiaries did not have any inpatient stays in the last year of life, which is a lot more than the corresponding figure in this study (4.7%). According to Diehr et al. (2002), the oldest are most likely not to be hospitalised, a finding echoed in this study.

Possible differences between municipalities in ways of organising the care of old people do not seem to remove the differences between age groups. Still, variation among municipalities was large in terms of both hospital and long-term care. The factors that have led to this variation could not be analysed in this study.

Our sample included 100% of those who died in Finland at the age of \geq 70 in 1998 and 40% of those of this age who died in 1999–2001. The sample represents well all Finnish people who died at this age. The data had some discrepancies, and 0.2% of the admissions had to be removed as a consequence. That is a very small proportion, however, and does not cause remarkable underestimation in the results. Keskimäki and Aro (1991) studied the accuracy of the Finnish hospital discharge register (now the Care Register for Health Care) by comparing register data to corresponding medical records. The accuracy of dates of admission and discharge was 96%. The data used in this study were based mainly on these dates of admission and discharge, and can be considered reliable. A clear weakness in our study is that not all services available to old people were included. In particular, lack of data about primary care and the limited register for home care prevent drawing a comprehensive picture of health and social service use. Also, informal care, an important addition to formal care, could not be included in this study.

It seems that the 2-year period is long enough for determining how the use of health and social services changes towards the end of life. It is possible, though, that use of some services, such as

public long-term care, begins to rise earlier than 2 years before death. However, most of the change is visible in this study.

Differences in service use between men and women were not a research question in this study, but some interesting results were found in this area nonetheless. Older women spent more time in long-term institutions than men of the same age. This may be explained in part by the higher proportion of women who live alone; perhaps they do not receive as much informal care as men do. On the other hand, elderly women often have multiple disabilities (e.g. Lunney et al. 2003), creating a need for long-term care. Also, Lentzner et al. (1992) found that a larger proportion of women than men were severely restricted in all age groups in their last year of life. The difference between men and women in hospital inpatient days is also interesting, and is more difficult to explain.

In conclusion, the use of hospitals in the last 2 years of life decreased and the use of long-term care increased from the age group of 70–79 years to the age group \geq 90 years. The differences between age groups were remarkable. Also, the types of hospitals differed for the different age groups. The older the person, the more likely he or she is to be cared for in public long-term care, and the less likely to receive care at a university hospital. The decline in days in long-term-care institutions suggests that these facilities have not been planned to take care of the residents until the end of their lives. Both the variation in the use of care by municipality and the differences between men and women deserve more detailed analysis in future.

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Legends of the figures.

Fig. 1

Average monthly use of hospital care by time to death in different age groups. (Hospital types are on different scales.)

Fig. 2

Average monthly use of long-term care by time to death in different age groups. (Public and private care are on different scales.)

Table 1. Registers and variables used

Register	Variables	
Statistics Finland		
Causes of Death Register	Age	Age of death
_	Gender	1 = man, 2 = woman
	Date of death	
STAKES		
Care Register for Health Care	Type of hospital	University hospital
-		Central hospital
		District hospital
		Private hospital
		Health centre (inpatient dep.)
	Date of arrival	
	Date of discharge	
Care Register for Social Welfare	Type of institution	Residential home
-		Housing with 24-hour assistance
		for older people
	Date of arrival	
	Date of discharge	
Home Care Census	Clients of regular home care	
Social Insurance Institution	2	
Prescription database	Medicines by prescription	ATC code
-		Date of medicine purchase

	Study sample						All deceased 1998–2001					
	Men			men	M	en	Wor	Women				
Age groups	n	%	n	%	n	%	n	%				
70–79	15,591	50.6	13,398	29.9	28,345	50.6	24,118	29.5				
80-89	12,348	40.1	22,242	49.7	22,389	40.0	40,591	49.7				
≥90	2,847	9.3	9,152	20.4	5,286	9.4	16,982	20.8				
Total	30,786	100.0	44,792	100.0	56,020	100.0	81,691	100.0				

Table 2. Sample characteristics (n = 75,578)

	Men			Women		
	70–79	80-89	≥ 90	70-79	80-89	≥90
Hospital inpatient care	86.5	85.9	79.1	85.7	78.8	65.8
University hospital	32.1	23.9	16.9	32.2	21.9	13.7
General hospital	65.1	62.7	51.7	62.4	54.2	39.5
Health centre ^a	46.9	53.5	53.5	47.5	48.4	43.1
Long-term care	26.1	46.0	64.1	36.5	60.1	77.8
Public long-term care	23.6	40.8	57.0	33.8	54.8	70.7
Private long-term care	4.0	8.3	10.6	5.0	9.2	11.7
Home care	11.2	18.9	21.8	16.7	22.2	18.6
Medicines	89.8	84.7	75.0	86.8	76.6	60.0

Table 3. Any use of services and medicines, by age and gender, in the last 24 months of life

All results as percentages

Results of χ^2 tests: Among both men and women the differences between age groups for each service type were statistically significant (p ≤ 0.001). The only exceptions were hospital inpatient care, where the difference between men of 70–79 and 80–89 years of age was not statistically significant, and health centres, where there was not a statistically significant difference between men 80–89 and \geq 90 years old or women 70–79 and 80–89 years old. ^a <90-day stay in an inpatient department of a health centre.

Age group	70–79 years	80–89 years	≥90 years
	Median (quart.)	Median (quart.)	Median (quart.)
Men			
Hospital inpatient care	32 (13, 61)	30 (13, 59)	27 (10, 52)
University hospital	13 (5, 27)	9 (3, 19)	5 (2, 14)
General hospital	18 (7, 37)	14 (6, 29)	11 (5, 22)
Health centre ^a	19 (8, 40)	24 (10, 47)	25 (11, 47)
Long-term care	253 (110, 576)	324 (120, 651)	415 (150, 703)
Public long-term care	235 (111, 560)	279 (115, 635)	387 (135, 704)
Private long-term care	153 (23, 399)	223 (34, 487)	322 (96, 565)
Medicines	10 (6, 16)	10 (6, 14)	8 (5, 12)
Women			
Hospital inpatient care	34 (13, 65)	28 (11, 57)	23 (8, 49)
University hospital	13 (5, 28)	8 (3, 17)	6 (2, 12)
General hospital	18 (7, 37)	12 (5, 26)	9 (4, 19)
Health centre ^a	23 (9, 45)	28 (12, 51)	27 (12, 50)
Long-term care	353 (134, 686)	444 (166, 717)	621 (277, 730)
Public long-term care	321 (129, 683)	402 (151, 718)	601 (229, 730)
Private long-term care	263 (52, 481)	326 (77, 585)	374 (142, 647)
Medicines	11 (7, 17)	10 (7, 15)	9 (6, 13)

Table 4. Inpatient days and number of medicines, by age and gender, in the last 24 months of life. Median, lower, and upper quartiles of those who had at least once used the service type

Results of Mann–Whitney U tests: In both men and women, the differences between age groups for each service type were statistically significant ($p \le 0.001$). The only exceptions were private long-term care, where the difference between men of 80–89 and \ge 90 years of age was statistically significant ($p \le 0.01$), and health centres, where there were no statistically significant differences between those aged 80–89 or \ge 90, among either men or women. ^a <90-day stay in an inpatient department of a health centre.

	Median	Range
Hospitals ^a		
70–79 years	37.6	0.0, 99.0
80–89 years	31.6	5.9, 91.9
≥90 years	21.3	0.0, 79.0
Long-term care ^b		
70–79 years	104.4	0.0, 354.3
80–89 years	216.1	0.0, 435.5
≥90 years	357.0	0.0, 728.0

Table 5. Municipalities' average number of inpatient days in hospitals and long-term care by age (n = 429).

^a Inpatient days at a university hospital, general hospital, and health centre for those who had <90 inpatient days at a health centre in the last two years of life.

^b Days at a residential home, in housing with 24-hour assistance for older people, and at a health centre for those who spent \geq 90 inpatient days in a health centre in the last two years of life.

University hospital, men

University hospital, women

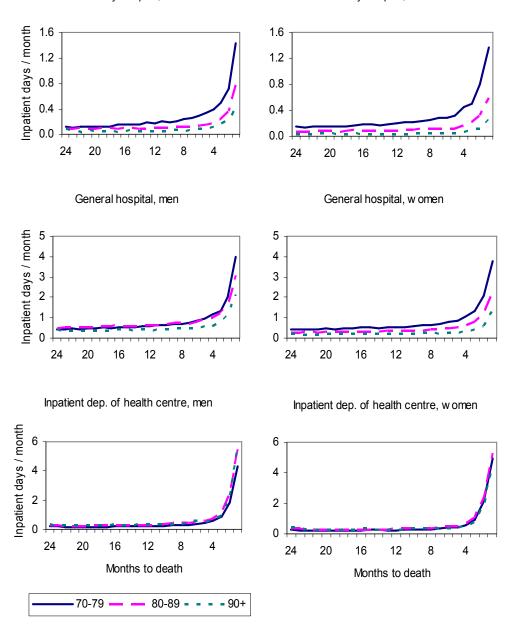
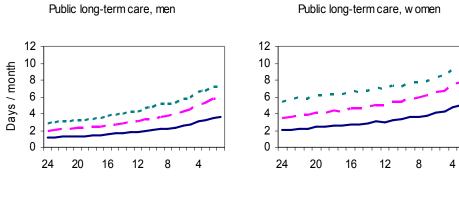
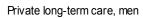


Figure 1.





Private long-term care, w omen

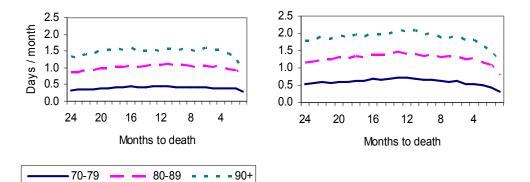


Figure 2.

Age and closeness of death as determinants of health and social care utilization: a case-control study

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Background: We used case-control design to compare utilization of health and social services between older decedents and survivors, and to identify the respective impact of age and closeness of death on the utilization of services. **Methods:** Data were derived from multiple national registers. The sample consisted of 56 001 persons, who died during years 1998–2000 at the age of \geq 70, and their pairs matched on age, gender and municipality of residence, who were alive at least 2 years after their counterpart's death. Data include use of hospitals, long-term care and home care. Decedents' utilization within 2 years before death and survivors' utilization in the same period of time was assessed in three age groups (70–79, 80–89 and \geq 90 years) and by gender. **Results:** Decedents used hospital and long-term care more than their surviving counterparts, but the time patterns were different. In hospital care the differences between decedents and survivors rose in the last months of the study period, whereas in long-term care there were clear differences during the whole 2-year period. The differences were smaller in the oldest age group than in younger age groups. **Conclusion:** Closeness of death is an important predictor of health and social service use in old age, but its influence varies between age groups. Not only the changing age structure, but also the higher average age at death affects the future need for services.

Keywords: aged, case-control studies, health services, long-term care, utilization.

Introduction

With population ageing, the demand for health and social services is expected to increase. Several studies have focused on 'red herring' effect; whether health care expenditure depends more on remaining lifetime than on calendar age. The costs in the last year or last months of life have been found to be many times higher than the costs in the earlier phases of life.¹⁻⁷ Only a limited number of studies have concentrated on health service utilization, showing that decedents utilized more hospital services^{8,9} and somewhat more nursing home and home care³ than survivors in the same age groups. However, both for costs and service use, this relationship is strongly dependent on age. With increasing age people use less hospital care and more long-term care in the last year of life, and the differences between those close to death and other diminish towards the oldest old.^{3,10,11}

In earlier studies, comparisons between the last years of life with others have mainly been done on a group level, between those who died and those who survived in a given age group. However, in old age groups decedents are also older than survivors, mortality is higher among men than women, and local care practices vary, and these factors may impair the comparability between decedents and survivors. To control these factors, we used a case-control design to compare the use of health services between decedents and survivors that were matched for age, gender and municipality of residence.

Both acute hospital care and long-term care were included. In some earlier studies, data have been limited due to sources such as insurance registers. In Finland, one of the major advantages in health services research is the availability of comprehensive national registers that are based on the provision of both health and social services and are considered reliable. $^{\rm 12,13}$

This study focuses on the respective effects of age and closeness of death on health and social service utilization in people aged \geq 70 years by comparing service utilization of decedents in the last 2 years of life, and that of survivors in the same period of time. The detailed research questions were:

- (1) To what extent does utilization of different health and social services differ between decedents and survivors in age groups 70–79, 80–89 and \geq 90 years, and to what extent is the difference modified by age? Both the proportions of those who used these services and the quantity of services used were studied.
- (2) How does utilization of different health and social services vary over time for 2 years before death among decedents and in the same period among survivors? How is age associated with this variation?

Methods

Data

A sample of people resident in Finland and dying in the period 1998–2000 at the age of \geq 70 years and their surviving matched pairs were drawn from the Causes of Death Register and the Central Population Register (Statistics Finland). The decedents consisted of two subgroups:

(i) All those who died at the age of \geq 70 years in 1998 and (ii) those who belonged to a 40% random sample of all \geq 65year-old people resident in Finland and dying between 1999 and 2000 at the age \geq 70 years. This sample was drawn from the Central Population Register of those alive on 31 December 1997.

The survivors were picked from the 40% random sample of \geq 65-year-old people. One-to-one matched pairs were constructed of decedents and survivors who were alive at least 2 years after their counterpart's death. The pairs were matched for age, gender and municipality of residence. The purpose was

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to ensure similar age and gender distribution in decedents and survivors, and to eliminate the effects of municipal service structures on service utilization.

An attempt was made to find an identical match for every combination of variables. Age was considered equal when the difference was ± 2 years. Using this limitation, for 90.5% of the decedents a counterpart was found. In Finland almost half of the municipalities have population under 5000, and therefore, it was impossible to find a suitable counterpart for all those living in small municipalities. If a similar counterpart was not found, the decedent was excluded from the analyses.

The data of health and social service utilization were derived from the Care Register for Health Care, the Care Register for Social Welfare and the Home Care Census (National Research and Development Centre for Welfare and Health, STAKES). These national registers were linked using a unique personal identification number. The use of these registers in this study and their linking together has been described elsewhere.¹⁴

The data include (i) inpatient days in hospitals, (ii) days in long-term care and (iii) regular home care (at least once a week). Hospitals include university hospitals, general hospitals (including central, district and private hospitals) and the inpatient departments of health centres if the patient stayed in care <90 days. Long-term care includes residential homes, housing with 24-h assistance for older people and inpatient departments of health centres, if the patient stayed 90 days or more. The 90-day limit between hospital and long-term care is administrative. Long-term care is provided by the public and private sectors. Since the use of private long-term care is minor, public and private care are analysed together. Home care includes both home nursing and home help.

The Ethics Committee of the Pirkanmaa Hospital District discussed the research plan and concluded that they did not object to the research being undertaken on ethical grounds.

Analyses

To ensure that the sample was representative of the basic population, its age and gender distribution was compared with all deaths at the age \geq 70 in the study period 1998–2000 in Finland, using the data from Statistics Finland.

Service utilization was analysed in age groups 70–79, 80–89 and \geq 90 years old separately for women and men. For decedents age at death was used and for survivors age on the day of their counterpart's death. In the analyses, survivors were placed in to the same 10-year age group with their deceased counterparts, although their possible ±2 year's age difference.

We present first the proportion of subjects who utilized different services, and second the quantity of services used. Home care is described only as the proportion of those receiving regular service; the number of home care visits was not available.

Conditional binomial logistic regression analyses were used to compare the likelihood of any hospital or long-term care use, or being a client of regular home care between the one-toone matched case-control pairs.^{15,16} Survival status was used as the independent variable.

The extent of services used is presented first for the entire sample by both the number of stays in care and days per stay; for each individual a ratio of days in care per stays in care was calculated. The figures indicate means and medians of these ratios, which both are presented, since these variables do not follow the normal distribution. In the denominator, also the non-users are included. Wilcoxon's matched pair tests were performed to test for differences in the quantity of services used between decedents and survivors in all age and gender groups. Second, the ratios of the days in care per the stays in care are calculated not for individuals but for the age and gender groups as a whole.

Finally, the average monthly days in hospitals and long-term care were calculated for 24 months before decedents' death and for the same time for survivors in each age group, separately for women and men. The time before death in months was calculated individually for each decedent and the same calendar days were used for the matched survivor.

Descriptive analyses and Wilcoxon's matched pair tests were performed with SPSS (14.0) statistical software package. Conditional logistic regression analyses were performed with Stata (8.2).

Results

Descriptives

The data consisted of 56 001 decedents and their surviving matched pairs, in total 112 002 persons, of whom 66 466 were women (59.3%) and 45 536 men (40.7%). The mean age was 81.1 years, 82.5 for women and 79.1 for men.

The age distribution in the sample differed from that of all of those who died in Finland in those years, with an overrepresentation of the age group 70–79 (42.4% vs. 38.2% in general population), and underrepresentation of those aged \geq 90 (9.0% vs. 15.8%). This is mainly because it was harder to find matched pairs for older people, and those who did not get a counterpart (5878 decedents), had to be excluded from the data. However, this is not likely to affect the reliability of our results, because analyses were done separately in three age groups.

Any use of services

The proportion of those using health and social services at least once during the 2-year-study period and the odds ratios with 95% confidence intervals from conditional regression analyses, comparing decedents with their matched surviving pairs, are shown in table 1.

The general finding was that a larger proportion of decedents used care services in the last 2 years of their lives than did survivors in the same period of time. This was true for men and women and for all three age groups. The only exception was that in the age group \geq 90 years, survivors received home care more often than decedents. The conditional logistic regression analyses confirmed that in each group, the decedents had a much higher probability to use hospital and long-term care services than their matched survived pairs. In home care, there was no statistically significant difference between decedents and survivors among women aged 80–89 and men \geq 90 years. Among women survivors aged \geq 90 years had a higher probability of using home care than their matched deceased pairs.

The age patterns differed between the services. In total hospital use, the difference between decedents and survivors was smallest in the oldest group, because use decreased with age in decedents but increased in survivors. In all, the proportion of hospital users was highest among 70- to 79-years-old decedents and lowest among survivors aged 70–79 and \geq 90 years. The use of long-term care was much more frequent in older than younger age groups, being most common among decedents aged \geq 90 years, and least common among survivors aged 70–79 years. Regular home care also increased with age; it was most frequent among \geq 90-year-old survivors and least common among 70- to 79-year-old survivors.

	70–79 yea	ars		80–89 yea	ars		≥90 years			
	Users (%)			Users (%)			Users (%)			
	D	s	OR (95% CI)	D	s	OR (95% CI)	D	s	OR (95% CI)	
Women (n)	11 052	11052		18014	18014		4167	4167		
Hospital inpatient care	85.7	46.2	6.85 (6.34–7.39)	78.4	56.9	2.75 (2.62–2.89)	68.1	55.8	1.71 (1.56–1.88)	
University hospital	31.4	12.3	4.70 (4.30–5.15)	21.2	12.5	2.26 (2.11–2.41)	14.8	10.3	1.66 (1.43–1.92)	
General hospital	63.3	29.3	5.24 (4.88–5.63)	54.4	32.1	2.96 (2.81–3.11)	43.0	29.2	2.03 (1.84–2.25)	
Health centre	47.3	19.3	4.03 (3.79–4.35)	48.3	33.2	1.92 (1.83–2.00)	43.6	36.6	1.35 (1.24–1.48)	
Long-term care	35.8	9.2	5.70 (5.24–6.21)	60.0	25.7	4.62 (4.39–4.87)	75.7	44.5	4.02 (3.61-4.46)	
Home care	17.0	9.0	2.12 (1.95–2.30)	22.3	21.6	1.05 (1.00–1.10)	18.6	27.9	0.57 (0.52-0.64)	
Men (<i>n</i>)	12 716	12 716		9200	9200		852	852		
Hospital inpatient care	86.5	47.0	7.53 (6.98–8.11)	85.9	56.9	4.70 (4.33–5.09)	80.3	59.0	2.68 (2.15–3.34)	
University hospital	31.5	12.9	4.46 (4.11–4.85)	23.6	13.1	2.62 (2.38–2.87)	17.5	10.3	2.09 (1.52–2.87)	
General hospital	65.7	32.6	5.26 (4.91–5.63)	62.9	37.1	3.57 (3.32–3.84)	50.7	34.6	2.04 (1.66–2.51)	
Health centre	46.8	16.4	5.16 (4.81–5.53)	53.8	28.3	3.10 (2.90–3.32)	54.7	35.3	2.29 (1.86–2.82)	
Long-term care	25.8	6.4	5.13 (4.70–5.60)	44.9	15.0	4.90 (4.52–5.31)	60.7	26.6	4.22 (3.36–5.31)	
Home care	11.4	5.4	2.25 (2.05-2.48)	18.7	14.6	1.37 (1.26–1.48)	21.1	24.6	0.82 (0.65-1.03)	

Table 1 Any use of services by age and gender during the 2-year study-period (in percentages) and conditional logistic regression analyses; odds ratios and 95% confidence intervals for matched pairs of decedents (D) vs. survivors (S)

Extent of service use

In each age and gender group, decedents had statistically significantly more stays and days per stay in hospitals and long-term care than their matched surviving counterparts. Since most of the services were used by only a minority in each group (especially among survivors), the medians of many services were 0 (table 2).

Next, the ratio of total days of care per total number of stays was calculated for survivors and decedents in each group. For hospital use the results were similar to the results of the analyses of individual-based figures (table 3). In long-term care, however, survivors had higher number of days per stay than decedents. A large proportion of those who used long-term care (19.3% for all; 18.8% for decedents and 19.7% for survivors) were living in an institution for the whole 2-year-study period, or longer (analyses not shown).

Variation of service use over time

Among survivors, hospital utilization remained very similar during the 2-year-study period (figure 1). Initially decedents and survivors had approximately the same level of hospital use, but among the decedents, hospital utilization tended to increase in the last months of life. In the youngest age group, inpatient days in university hospital already increased about 1 year before death, but in older age groups only 4 months before death. Use of general hospital started to peak about 4 months before death. Utilization of inpatient care in a health centre also started to increase 4 months before death, and, in contrast to other hospital types, there were no noticeable differences between age groups.

Days in long-term care increased during the 2-year-study period in every age group, most clearly among decedents and slightly among survivors. In the very last months, however, decedents' utilization no longer increased but rather decreased. During the whole 2-year period, both hospital and long-term care utilization was higher among decedents than survivors in every age group.

Discussion

Our findings confirm the results of earlier studies that decedents use health and social services much more than survivors in the same age. Age influences the use of care both in decedents and survivors, but differently in different services. People dying at different ages are cared in different facilities and for different periods of time. Younger decedents were cared for in hospitals more often and longer periods than older ones, and older decedents were cared for in long-term facilities more often than the younger decedents. Among survivors the age differences were not so great, but both their use of hospital and long-term care increased somewhat towards older age groups. The differences in hospital stays and days per stay between decedents and survivors were greatest in the age group 70–79 years and smallest in the oldest age group (\geq 90 years). The decedents were not only more likely to use hospital care, but also needed more days of care. Decedents also used longterm care more often than survivors, but survivors had more days per stay than decedents. Possibly the decedents' long-term care episodes are often interrupted by visits or transitions to hospitals or other care facilities.

Use of home care was more frequent among decedents than survivors, except in the oldest age group, where more survivors had used home care. This was mainly because a large proportion of decedents in the oldest age group lived in some institution, and thus did not need home care.

To the best of our knowledge, this is the first study to compare the health and social service use of decedents and survivors using a one-to-one matched case-control study design. Earlier studies comparing groups of decedents and survivors have not been able to reliably control for factors such as age, gender and municipality of residence, which are likely to be associated with service use, thereby impairing the comparability of the two groups. In our study these possible confounders were standardized. There are, however, other important factors, such as socioeconomic status, that we were not able to control for. Differences in service use between women and men were not a research question in this study, but analyses were done separately for them. There are certain differences, such as the more frequent use of long-term care in women than in men. However, differences between decedents and survivors seem quite similar among both women and men.

Because use of health and social services among decedents and survivors has not been much studied, here we also compare our results with those of studies focusing on the costs of these services. Our results are consistent with the studies reporting that decedents use health and social care resources much more than survivors,^{1,5,8} and that the differences Table 2 Stays and days per stay in hospitals and long-term care by age group and gender during the 2-year study period

	70–79 y	ears			80–89 years				≥90 years				
	Decedents		Survivors		Decede	Decedents		Survivors		Decedents		Survivors	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Mediar	
Women (<i>n</i>)	11	052	11	052	18	8014	18	3014	4	167	4	167	
Hospital inpatien	t care												
Stays	4.5	3	1.2	0	3.2	2	1.5	1	2.2	1	1.4	1	
Days per stay	8.7	6.5	3.2	0	8.6	6	4.8	1	8.2	4.8	5.5	1	
University hospita	al												
Stays	1.0	0	0.2	0	0.5	0	0.2	0	0.3	0	0.2	0	
Days per stay	2.5	0	0.7	0	1.4	0	0.6	0	0.8	0	0.5	0	
General hospital													
Stays	2.2	1	0.6	0	1.4	1	0.6	0	0.9	0	0.5	0	
Days per stay	6.2	3	2.0	0	5.0	1	2.4	0	4.1	0	2.2	0	
Health centre													
Stays	1.2	0	0.4	0	1.3	0	0.7	0	1.0	0	0.7	0	
Days per stay	6.3	0	1.8	0	7.0	0	3.6	0	6.9	0	4.8	0	
Long-term care													
Stays	1.6	0	0.3	0	2.4	1	0.8	0	2.5	1	1.3	0	
Days per stay	67.4	0	20.6	0	138.5	22	61.3	0	223.3	104.3	125.1	0	
Men (<i>n</i>)	12	2716	12	2716	9	200	9	200	8	352	:	852	
Hospital inpatien	t care												
Stays	4.6	3	1.3	0	4.0	3	1.6	1	3.1	2	1.6	1	
Days per stay	8.3	6	3.5	0	11.0	6.4	4.4	1	12.2	6	4.6	2	
University hospita	al												
Stays	1.0	0	0.3	0	0.6	0	0.2	0	0.4	0	0.2	0	
Days per stay	2.3	0	0.7	0	1.6	0	0.6	0	1.9	0	0.4	0	
General hospital													
Stays	2.4	1	0.7	0	1.9	1	0.8	0	1.3	1	0.7	0	
Days per stay	6.2	3.5	2.6	0	8.0	3	3.0	0	7.3	1	2.4	0	
Health centre													
Stays	1.2	0	0.3	0	1.5	1	0.6	0	1.5	1	0.7	0	
Days per stay	5.5	0	1.3	0	7.1	2.5	2.6	0	7.5	3	3.6	0	
Long-term care		-		-				-		-		-	
Stays	1.3	0	0.3	0	2.1	0	0.6	0	2.5	1	0.9	0	
Days per stay	38.5	0	11.1	0	74.8	0	26.8	0	126.0	19	55.3	0	

The ratios of days in care per stays in care were calculated for each individual. The means and medians of these are presented. According to Wilcoxon's matched pair tests there are statistically significant differences in the use of every services between decedents and survivors in each age and gender group.

Table 3 Days per stay for each age and gender group during the 2-year study period

	70–79 years		80–89 years		\geq 90 years		
	Decedents	Survivors	Decedents	Survivors	Decedents	Survivors	
Women							
Hospital inpatient care	9.0	7.2	9.8	8.2	10.7	9.4	
University hospital	7.0	5.5	6.9	4.9	5.7	4.8	
General hospital	8.7	6.8	8.4	7.1	8.7	7.3	
Health centre	11.2	8.8	12.3	10.0	13.6	11.8	
Long-term care	83.7	109.0	107.2	127.8	148.4	157.5	
Men							
Hospital inpatient care	8.5	7.4	10.0	7.7	11.6	8.5	
University hospital	6.7	5.4	6.4	4.7	8.7	4.6	
General hospital	8.5	8.0	10.4	8.1	12.3	8.0	
Health centre	10.0	7.8	11.0	8.5	11.6	9.8	
Long-term care	64.7	80.4	75.1	92.1	103.3	118.4	

The ratios of total days in care per total stays in care were calculated for each group.

between them vary by age.^{10,11} There is a consensus that closeness of death is the most important reason for high hospital expenditure,^{6,17} but its role in the use of long-term care resources varies. In our study survival status had an important effect also on the use of long-term care. Focusing on

health care expenditure, Hoover *et al.*¹⁸ and Werblow *et al.*⁷ have concluded that age has no or weak effect when closeness to death is taken into account; focusing on the use of services we found that both age and closeness to death are important factors.

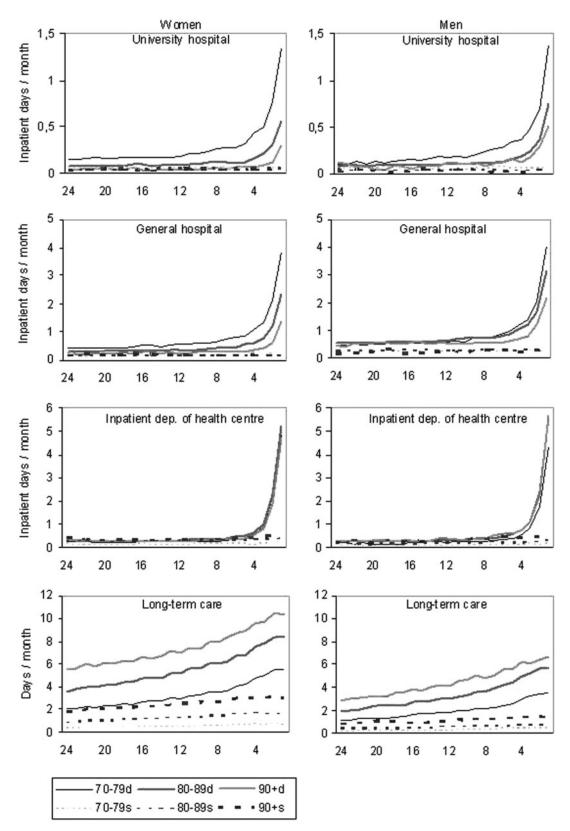


Figure 1 Average monthly utilization of days in hospitals and long-term care in the 2-year-study period, whole sample (d = decedents, s = survivors). Hospital types and long-term care are on different scales.

Finland is one of the few countries where service information from several sources can be linked by using a personal identification number to create a comprehensive, extensive and reliable dataset. The registers include data on most of the essential health and social services for older people. Nevertheless, important services such as outpatient primary health care, or informal caregiving, an important addition to formal care, are not included in these registers. These are clear limitations of this study.

The data cover all decedents aged \geq 70 years for 1 year and 40% of them for 2 years, but the sample is fairly representative of the underlying study population.¹⁴ Altogether

5878 decedents had to be excluded from the data, because it was impossible to find a matched surviving counterpart for them. Most of them were aged \geq 85 years, and resident in small municipalities. We do not believe that this impaired our results, since the number of observations after the exclusion was still more than 5000 in the oldest age group.

The future use of old age services is also determined by many other factors than demography, such as the general life circumstances of older people and changing medical practices. However, our results suggest that the impact of demographic changes alone is complex; it is not only the number of people in the old age groups that influences the demand for services, but also the remaining average life expectancy in each of these age groups. Thus, population ageing alone may not lead to such a sharp rise in use of services as is often assumed, at least if the average age of death in old age groups continues to rise.

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Conflict of interest: None declared.

Key points

- We compared the health and social service use of old decedents and survivors using a one-to-one matched case-control study design.
- Decedents used hospital and long-term care services more than their surviving counterparts. Use of hospital concentrated to the very last months of life.
- Age influences the use of care both in decedents and survivors, but differently in different services.
- The future use of old age services is determined by many other factors in addition to demography.

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ORIGINAL ARTICLE



Municipal variation in health and social service use in the last 2 years of life among old people

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Abstract

Aims: To describe and analyse municipal differences in health and social service use among old people in the last 2 years of life. *Methods:* The data were derived from national registers. All those who died in 2002 or 2003 at the age of \geq 70 years were included except those who lived in very small municipalities. The services included were different types of hospitals, longterm care, and home care. The variation in service use was described by coefficients of variation (CV). To analyse local differences, three-level (individual, municipal, and regional) binary logistic and Poisson regression analyses were performed. *Results:* A total of 67,027 decedents from 315 municipalities in 20 hospital districts were included. There was considerable variation in service use between residents of different municipalities, especially in the types of hospital used. Of the individual-level variables age and use of other services were associated (p < 0.05) with use of all services. Of the municipal-level variables, indicators describing the services. The presence of a university hospital in the hospital district increased the probability of using university and general hospitals, but among the users increased days in university hospital and decreased days in general hospital. *Conclusions:* Considerable differences between municipalities exist, but these cannot be exhaustively explained. Behind the differences are probably factors which are difficult to describe and quantify, such as historical developments and political realities.

Key Words: Aged, end-of-life, health services, long-term care, multilevel analyses, municipalities, register studies

Background

Individual characteristics such as age, disability, morbidity, and closeness of death have been found to determine health and social service use in old age [1–3]. However, supply side factors like available resources and local service structures also play a role [e.g. 4–6]. The local care system may be an even more important factor explaining service use than individual characteristics [7,8], and the variation explained by managed care programme sites was found to increase as death approached [7]. The regional variation in service use despite similar needs raises questions about equity and allocative efficiency. In Finland the municipalities are responsible for organising social and health services for their residents, and in this they have considerable autonomy. Thus, the service structures in municipalities differ, likewise the ways in which they respond to the population's needs. There are differences, for example, in how municipalities have organised primary and secondary health care or inpatient and outpatient care [9]. Twenty hospital districts owned by the municipalities organise secondary health care and own general hospitals. Hospital districts constitute five university hospital districts. University hospitals organise tertiary health care, but also secondary care if there is no general hospital in their hospital district.

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Extensive variation in health service use has also been found between hospital districts [e.g. 10,11].

Regional variations in the use of health services are well known, and numerous differences have also been found in services for old people [e.g. 12-15]. However, the factors underlying these variations are not clear. In the USA differences were not due to variation in health levels [12,15], neither did patient preferences explain regional variation in end-of-life care [8,16]. Greater hospital capacity has been found to be associated with increased use of hospital care in the USA, even after controlling for socioeconomic characteristics and illness burden [4]. Variations in the number of hospital beds and in the local supply of specialists' services have explained about half of the regional variations in Medicare spending [5]. Virnig et al. [6] found that the level of hospice use was higher in wealthier and urban areas in the USA, while in a study by McConnel and Zetzman [17], use of hospital, nursing home, and physician services was unrelated to rural or urban residential location.

The aim of this study is to describe and explain differences between Finnish municipalities in old people's health and social service use in the last 2 years of life. The study is a part of more comprehensive project entitled "Costs Of Care Towards the End of Life" (COCTEL). The detailed study questions in this paper are:

- (1) To what extent does the use of different health and social services in the last 2 years of life differ between municipalities? Both the proportion of users and number of days in care among the users are analysed.
- (2) How is health and social service use in the last 2 years of life associated with individual, municipal, and regional factors?

Materials and methods

Data

The study population consists of all people resident in Finland who died in 2002 or 2003 at the age of \geq 70 years. The sample was identified from the Causes of Death Register (Statistics Finland). Service use was studied for 730 days before the day of death.

The data on health and social service use were derived from national registers: the Care Register for Health Care, the Care Register for Social Welfare and the Home Care Census (National Institute for Health and Welfare). The information in registers was linked using a unique personal identification number. The collating of data was done in principle as in our earlier data [18]. The services included are: (1) hospital care (2) long-term care, and (3) regular home care (at least once a week). Hospitals include university hospitals, general hospitals (central and district) and the inpatient departments of health centres if the length of stay (LOS) was <90 days. Long-term care includes care in residential homes, housing with 24-hour assistance for older people and inpatient departments of health centres if LOS was \geq 90 days. Public and private long-term care are analysed together because the use of private care is minor. Home care includes both home nursing and home help.

In the study years, there were 448 (2002) and 446 (2003) municipalities in Finland, but in 2007 there were 416 left due to mergers of municipalities. We used the municipality numbers valid at the beginning of 2007, thus individuals who died in municipalities which were later merged were coded as residents of the new municipality. The Åland Islands (16 municipalities) and municipalities with <2500 inhabitants (85) were excluded from the analyses, because in very small municipalities only a few inhabitants die annually and thus service use may vary randomly. In addition there was a risk that individual subjects from small municipalities could be identified from the data.

The ethics committee of the Pirkanmaa hospital district discussed the research plan and concluded that they did not object on ethical grounds to the research being undertaken.

Statistical design and indicators

It is assumed that service use of individuals residing in the same municipality does not vary independently, and thus, the data of this study have a hierarchical structure. Individuals (level one) are living in municipalities (level two), which belong to hospital districts (level three). Due to this data structure we constructed multilevel models making it possible also to include municipal and regional variables in the analyses [19].

We used a two-stage approach, first analysing individual use (yes/no) of each of the five services, and then among the users, the number of days in care in each of the four services (for home care, the number of visits was not available).

Independent variables in the models are on three levels and were chosen on the basis of earlier studies. Individual variables are age, gender, and use of other services (than that analysed in the model). The municipal factors concern the year 2003 and describe population (number of inhabitants, average age of decedents, the proportion of those >65 years old in the population, and the proportion of old people living alone), economic conditions (annual contribution margin, tax revenue, health and social expenditure, and urbanity), and service pattern (support for informal care, outpatient care orientation, proportion of service users, and days in care per user). The regional level indicator is the existence of a university hospital in the hospital district. "Outpatient care orientation" (opco), one of the indicators of service pattern, was built on the basis of the SOTKAnet database (National Institute for Health and Welfare) [20,21]. It contains indicators describing, for example, municipalities' new care practices, the relation of inpatient and outpatient care, and supported living at home. The value of opco varies between 1 and 20; a small value indicates that the municipality has emphasised outpatient care. Some continuous variables were classified because of their wide range or abnormal distribution. Table I provides a descriptions and sources of all variables.

Analyses

Variation in service use between municipalities was assessed by coefficients of variation (CV = standard deviation/mean × 100) and by the variances of the intercepts, which are reported on the municipality level and on the hospital district level in empty (null) models.

Three-level analyses were performed to examine the effect of each level variables on service use after controlling for the effects of variables on other levels. The random intercept model allows the intercepts to vary across municipalities. The random coefficient model also allows regression coefficients to vary across municipalities. Random intercept (and random coefficient) models were used, when the variance of the intercept (and that of the coefficient) was more than two times higher than its own standard error [22], otherwise naïve models, which consider all individuals to be independent, are reported.

To analyse the probability of using services we performed three-level binary logistic regression analyses for each service type [19,22]. The number of days in care among the users was analysed by threelevel Poisson regression analyses. We ran four logistic and four Poisson regression models for each of the services:

- (I) individual level independent variables
- (II) I+variables describing population and economic conditions of the municipality

- (III) II+variables describing service pattern in municipality
- (IV) III + regional level variable.

In general, results of models I–III did not vary considerably, thus we report here only the results of the final (IV) models.

Descriptive analyses were performed by the SPSS (16.0), and the MLwiN (2.10) was used for multilevel analyses.

Results

Descriptives

The sample included 67,027 individuals living in 315 municipalities belonging to 20 hospital districts. The average age was 82.5 (84.2 for women and 80.2 for men), and the proportion of women was 59.5% (Table I). Although the smallest municipalities were excluded, 33.7% of municipalities still only had 2500–5000 inhabitants. The average age of decedents ranged from 79.6 to 85.5 years between municipalities and the proportion of people \geq 65 years old of all residents from 22.4 to 54.7%.

Variation in service use

For Figure 1 we organised the municipalities in ascending order according to the proportion of general hospital users. In all municipalities hospital care was the most frequently used service at least once in the last 2 years of life (on average 81% used it). The use of long-term care was second most common (54%), while the use of home care was least common (18%). Among the users, the average number of days in care was manifold in long-term care compared to hospital care. The proportion of users of different services varied extensively between municipalities. There was especially considerable variation in the types of hospital used; in municipalities, where use of university hospital was common, use of general hospital was low, and vice versa. The most varying proportion of users was for university hospital, but number of days in care varied most in general hospital (CV in Table II). The variances of intercepts were statistically significant on the hospital district level only for university hospital.

Factors associated with service use

Any use of services The probability of using a university hospital was higher among younger users, men, and users of other hospitals and home care, but lower among the users of long-term care (Table III).

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Table I. Description and sources of individual level $(n = 67,027)$, municipal level $(n = 315)$ and regional level $(n = 20)$ variables	s.

Level	Indicators	Mean or %	Range	Source of data
Individual				
	Age	82.5	70-107	Registers ^a
	Proportion of women (%)	59.5		Registers ^a
	Proportion of users (%)			Registers ^a
	University hospital	27.7		
	General hospital	49.3		
	Health centre	48.4		
	Long-term care	54.7		
	Home care	18.1		
	Days in care (if user)			Registers ^a
	University hospital	16.7	1-730	
	General hospital	21.3	1-730	
	Health centre	30.8	1-89	
	Long-term care	421.9	1-730	
Municipal				
Population	Number of inhabitants (%)			SOTKAnet ^b
•	2500-4999	33.7		
	5000-9999	34.0		
	10,000-600,000	32.4		
	Average age of decedents	82.4	79.6-85.5	Registers ^a
	Prop. of 65 years old (%)		6.0-29.7	SOTKAnet ^b
	Prop. of living alone (%) ^c		22.4-54.7	SOTKAnet ^b
Economic conditions	Annual contribution margin, €/capita			SOTKanet ^b
Leononne conditions	<0	11.1		50 T Railet
	≥0	88.9		
	≥0 Tax revenue, €/capita	00.9		SOTKAnet ^b
	<2000	41.9		SOTRAILE
	2000–3000	56.2		
	>3000	1.9		
	Total operating health and social	1.9		SOTKAnet ^b
	expenditure, €/capita			SOTRAILE
		48.3		
	$<2400 \ge 2400$	48.5 51.7		
	Urbanity	51.7		Statistics Finland
	Urban	10.7		Statistics Finland
	Semi-urban	19.7 23.5		
	Rural	23.3 56.8		
		50.8		
Service pattern	Support for informal care (%) ^d		0.1-6.9	SOTKAnet ^b
	Outpatient care orientation	10.4	1-19	Created on the
				base of SOTKAnet
	Proportion of users (%)			Registers ^a
	University hospital	21.8	0.0-91.1	
	General hospital	57.6	0.0-91.8	
	Health centre	50.1	0.0 - 77.8	
	Long-term care	54.0	15.1-90.0	
	Home care	18.7	1.6 - 41.7	
	Days per user (if users in municipality)			Registers ^a
	University hospital	12.6	1.0-37.8	
	General hospital	18.1	1.0-37.5	
	Health centre	30.1	1.7 - 51.0	
	Long-term care	414.9	66.3-565.8	
Regional				
	University hospital in the hospital district (%)			Statistics Finland
	0 = no	75.0		
	1 = yes	25.0		

^aCauses of Death Register (Statistics Finland), Care Register for Health Care, the Care Register for Social Welfare and the Home Care Census (National Institute for Health and Welfare).

^bSOTKAnet indicator bank contains extensive statistical information on the Finnish municipalities (National Institute for Health and welfare).

^cLiving alone, population aged 75 and over, as % of total population of same age.

^dSupport for informal care, clients aged 65 and over, during year, as % of total population of same age.

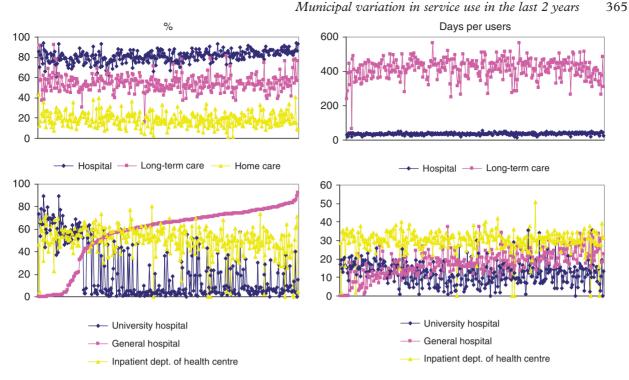


Figure 1. Proportions of service users and days per user in municipalities (adjusted to correspond to the age and gender distribution among all Finnish old people dying in 2002 and 2003. n = 315, for home care 309^a). The order of municipalities is ascending according to the proportion of general hospital users. ^aSix municipalities have not reported their home care clients properly, and they were excluded from the analyses of home care.

	Pr	oportion of the	users	Days	in care among t	he users
	CV for municipalities	Variance of intercept			Variance	e of intercept
		Municipality	Hospital district	CV for municipalities	Municipality	Hospital district
Hospital	7.0	0.03	NS	15.3	0.03	NS
University hospital	109.2	0.44	2.84	46.8	0.07	0.15
General hospital	43.2	2.46	NS	71.8	0.50	NS
Inpatient dept. of health centre	26.7	0.23	NS	16.3	0.01	NS
Long-term care	16.5	0.06	NS	14.2	0.03	NS
Home care	38.6	0.07	NS	NA	NA	NA

Table II. Coefficient of variation (CV) and the variance of the intercept on the municipality level and on the hospital district level in empty (null) binary logistic and Poisson regression models.

NA, not available; NS, not statistically significant (p > 0.05).

A higher proportion of university hospital users in the municipality and existence of a university hospital in the hospital district increased an individual's likelihood of using university hospital.

Use of general hospital was higher among younger users, men, users of other hospitals and home care, and in municipalities where the proportion of general hospital users was higher and belonged to a hospital district with a university hospital, but lower among the users of long-term care (Table III).

Use of the inpatient department of a health centre was higher among older users, users of other hospitals and home care, and in municipalities where the proportions of health centre and long-term care users were higher, but lower among users of long-term care (Table III).

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Table III.	Any use of services:	three-level binary	logistic regression mode	els $(n = 67,027, \text{ for home})$	e care $n = 66.551$).

	University hospital ^a		General hospital ^b		Inpatient dept. of health centre ^a		Long-term care ^a		Home care ^a	
Level	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Individual										
Age	0.93	0.93-0.94	0.96	0.95-0.96	1.04	1.04 - 1.04	1.11	1.10-1.11	1.04	1.03-1.04
Gender $(0 = man, 1 = woman)$	0.89	0.85-0.93	0.80	0.77 - 0.84	1.02	0.99-1.06	1.47	1.42-1.53	1.36	1.30-1.42
User of university hospital			1.95	1.81-2.11	1.62	1.55-1.70	0.65	0.62-0.68	1.21	1.14-1.28
User of general hospital	2.06	1.91-2.22			2.03	1.94-2.12	0.66	0.63-0.69	1.77	1.67-1.87
User of health centre	1.63	1.56-1.71	2.04	1.91-2.18			0.27	0.26-0.28	1.70	1.62-1.78
User of long-term care	0.63	0.60-0.66	0.69	0.64-0.73	0.27	0.26-0.28			0.90	0.86-0.94
User of home care	1.21	1.14 - 1.28	1.78	1.67 - 1.91	1.69	1.61 - 1.76	0.87	0.83-0.91		
Municipal No. of inhabitants 0 = <5000, 1 = 5000-9999				0.98–1.19		0.93–1.07		0.92-1.07		
0 = <5000, 1 = >10,000				0.94-1.22		0.93-1.12		0.91-1.10		
Average age of decedents				1.00 - 1.07				0.89-0.93		
65 years (%)				1.00-1.03		0.99-1.01		0.99–1.01		
Living alone (%)				0.98-1.00		1.00 - 1.01		0.99-1.00		
Annual contribution margin, $0 = <0, 1 = >0$	0.95	0.87-1.04	0.97	0.88-1.07	1.01	0.95-1.08	1.02	0.97-1.06	1.00	0.93-1.08
Tax revenue 0 = <2000, 1 = 2000-2999 0 = <2000, 1 = >3000 Expenditure, $0 = <2400, 1 = >2400$	0.96	0.84-1.10	0.82	0.93–1.10 0.66–1.01 0.90–1.04	1.00	0.93–1.05 0.91–1.10 0.97–1.06	0.96	0.93–1.05 0.86–1.06 0.97–1.06	0.99	0.88-1.12
Urbanity										
0 = rural, 1 = urban	1.06	0.02 1.22	0.05	0.84-1.08	1.02	0.93-1.07	0.08	0.90-1.07	1.02	0.01 1.14
0 = rural, 1 = urban 0 = rural, 1 = semi-urban				0.90-1.10		0.93 - 1.07 0.92 - 1.07		0.90-1.07		
Support for informal care (%)				0.90-1.10		0.92 - 1.07 0.98 - 1.02		0.92-1.07		
Outpatient care orientation				0.99–1.01		0.99-1.02		1.00-1.01		
Proportion of service users	1.00	0.99-1.00	1.00	0.99-1.01	1.00	0.99-1.01	1.00	1.00-1.01	1.00	0.99-1.00
University hospital	1.06	1.05 - 1.06	0.99	0.99–0.99	1.00	0.99–1.00	1.00	1.00 - 1.01	1.00	1.00 - 1.00
General hospital				1.06 - 1.07		0.99 - 1.00		1.00 - 1.01		
Health centre				0.99-1.00		1.05 - 1.05		1.01 - 1.02		
Long-term care				1.00 - 1.01		1.01 - 1.01		1.05 - 1.06		
Home care	1.00	1.00 - 1.01	0.99	0.99-1.00	1.00	0.99-1.00	1.00	1.00 - 1.01	1.07	1.07 - 1.07
Regional University hospital in the district $0 = no$, $1 = yes$ Model statistics	2.55	2.29–2.84	1.19	1.03–1.37	0.99	0.91-1.08	1.01	0.93–1.10	1.03	0.93–1.13
Variance of intercept (SE)	NA		0.04	(0.01)	NA		NA		NA	

Statistically significant (p < 0.05) odds ratios (OR) are on bold.

^aNaïve model.

^bRandom intercept model at the municipality level. Random coefficient for age, gender, use of inpatient department of health centre, use of long-term care, and use of home care.

NA, not available.

Long-term care use was higher among older users, women, in municipalities where the average age of decedents was lower, and in municipalities with higher proportions of health centre and long-term care users. However, use of long-term care was lower among the users of other services (Table III).

Home care was used more by older users, women, hospital users and those living in municipalities with lower average age of decedents and higher proportions of home care users, but lower among long-term care users (Table III). *Extent of service use among users* Number of days in university hospital was higher among younger users, users of other hospitals and long-term care, and in larger municipalities, but lower among users of home care and in municipalities with the highest tax revenue per capita (Table IV). Higher number of university hospital days per user in municipality and a university hospital in the hospital district were associated with individual's higher number of days in university hospital.

Number of days in general hospital was higher among younger users, among users of all other

Table IV. Days in care among the users: three-level Poisson regression analyses.

		ersity hospital ^a =18,546)		eral hospital ^b = 33,070)	1	nt dept. of health e^{c} (n = 32,435)		ong-term (n=36,653)
Level	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
Individual								
Age	0.96	0.96-0.96	0.97	0.97 - 0.97	1.01	1.01 - 1.01	1.01	1.01 - 1.01
Gender, $0 = man$, $1 = woman$	1.02	0.95 - 1.09	0.96	0.92 - 1.00	1.08	1.07 - 1.08	1.13	1.11-1.16
User of university hospital			1.18	1.17 - 1.19	1.12	1.11 - 1.12	0.65	0.65-0.65
User of general hospital	1.18	1.16-1.20			1.11	1.11 - 1.12	0.72	0.70 - 0.74
User of health centre	1.20	1.12 - 1.28	1.11	1.06 - 1.17			0.85	0.84-0.85
User of long-term care	1.08	1.08-1.09	1.06	1.01 - 1.11	1.14	1.14 - 1.14		
User of home care	0.91	0.84-0.99	1.07	1.07 - 1.08	1.21	1.20-1.21	0.44	0.44 - 0.45
Municipal								
No. of inhabitants								
0 = <5000, 1 = 5000 - 9999	1.12	1.05-1.20	0.95	0.88 - 1.04	1.01	1.01 - 1.02	1.01	0.98-1.03
0 = <5000, 1 = >10,000	1.20	1.09-1.31	0.99	0.88-1.12	1.01	1.00-1.02	1.02	0.98-1.06
Average age of decedents	1.00	0.97-1.02	1.07	1.03-1.11	0.99	0.99-0.99	0.99	0.98-1.00
65 years (%)	1.00	0.99-1.01	1.00	0.99-1.01	1.00	1.00-1.00	1.00	0.99-1.00
Living alone (%)	1.00	1.00-1.01	1.00	0.99-1.01	1.00	1.00-1.00	1.00	1.00-1.00
Annual contribution, $0 = <0, 1 = >0$	1.01	0.94-1.08	1.04	0.94-1.15	1.02	1.01-1.02	1.00	0.96-1.03
Tax revenue								
0 = <2000, 1 = 2000 - 2999	0.95	0.89-1.01	1.06	0.98-1.15	0.99	0.99-1.00	1.02	0.99-1.04
0 = <2000, 1 = >3000	0.86	0.74-0.99	1.23	0.96-1.58	0.99	0.98-1.00	1.00	0.92-1.08
Expenditure, $0 = <2400 - 1 = >2400$	1.01	0.96-1.07	0.94	0.87-1.02	1.01	1.00-1.01	1.02	0.99-1.04
Stat. grouping of municipality								
0 = rural, 1 = urban	0.95	0.86-1.04	1.03	0.90-1.19	0.99	0.98-1.00	0.98	0.93-1.02
0 = rural, 1 = semi-urban	0.94	0.87-1.01	0.97	0.88-1.08	1.00	1.00-1.01	0.98	0.95-1.02
Informal care	0.99	0.97-1.01	0.94	0.91-0.97	1.00	1.00-1.00	1.00	0.99-1.01
Орсо	1.00	0.99-1.00	1.02	1.01–1.03	1.00	1.00-1.00	1.00	1.00-1.01
Davs per user								
University hospital	1.08	1.07 - 1.08	0.99	0.99-1.00	1.00	1.00-1.00	1.00	1.00-1.00
General hospital	1.00	1.00-1.00	1.01	1.01 - 1.02	1.00	1.00-1.00	1.00	1.00-1.00 1.00-1.00
Health centre	1.00	1.00-1.00	1.00	0.99–1.00	1.00 1.04	1.00-1.00 1.04-1.04	1.00	1.00 - 1.00 1.00 - 1.00
Long-term care	1.00	1.00-1.01 1.00-1.00	1.00	1.00 - 1.00	1.00	1.00-1.00	1.00	1.00 - 1.00 1.00 - 1.00
Home care (%)	1.00	1.00-1.00	1.00	0.99-1.00	1.00	1.00-1.00	1.00	1.00 - 1.00 1.00 - 1.01
	1.00	1.00 1.00	1.00	0.99 1.00	1.00	1.00 1.00	1.00	1.00 1.01
Regional University hospital in the	1.40	1.34-1.47	0.76	0.71-0.82	0.98	0.98-0.99	1.03	1.01-1.06
district $0 = no, 1 = yes$	1.40	1.54-1.47	0./6	0.71-0.82	0.98	0.98-0.99	1.03	1.01-1.06
Model statistics								
Variance of intercept (SE)	0.18	(0.02)	0.18	(0.02)	NA		0.04	(0.003)

Statistically significant rate ratios (RR) are in bold face.

^aRandom intercept model at the municipality level. Random coefficient for gender, use of inpatient department of health centre, and use of home care.

^bRandom intercept model at the municipality level. Random coefficient for gender, use of inpatient department of health centre, and use of long-term care.

^cNaive model.

^dRandom intercept model at the municipality level. Random coefficient for gender and use of general hospital.

NA, not available; SE, standard error.

services analysed in this study, in municipalities where decedents were older, in municipalities with low proportions of people receiving support for informal care, with higher outpatient care orientation (i.e. emphasising more institutional care), and with higher general hospital days per user (Table IV). There were fewer days in general hospital in hospital districts with a university hospital. Number of days in inpatient department of health centre was higher among older users, women, users of all other services analysed in this study, in middlesized municipalities (as opposed to the smallest municipalities), in municipalities with positive annual contribution margin, and higher number of health centre days per user (Table IV). Number of days in health centre was lower in municipalities with

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older decedents and in hospital districts with a university hospital.

Number of days in long-term care was higher among older users, women, in municipalities with higher numbers of long-term care days per user, and in hospital districts with a university hospital, but lower among the users of all other services analysed in this study (Table IV).

Of individual level factors age and use of other services were associated (p < 0.05) with any use and extent of use of all services. Of the municipal level indicators the proportion of service users in a municipality was most important factor associated with service use. When this variable was added to the model, the variance of intercept fell to zero in all other services except general hospital. It stratified the service use in such a way, that the random intercept model allowing the intercept to vary across municipalities was not needed. Days per user in a municipality was also an important variable, but it did not have such an impact on the variance of the intercept as the proportion of users. The regional level indicator, university hospital in the hospital district, was associated with the probability of using university and general hospital, and with the number of days in care in all services.

Discussion

We found considerable variation between Finnish municipalities in health and social service use in the last 2 years of life among old people. There were differences in all services studied, but the widest variation was in use of different types of hospital, especially university hospital. However, a large amount of the observed variation was between individuals. We found that younger old people and men were more likely to use hospital care, while older old people and women were more likely to use long-term care in their last 2 years of life. These results confirm earlier findings by other researchers, [3,23] and ourselves [1,18].

The variation between municipalities was considerable, but disappeared when variables describing the municipal service pattern (indicated by proportion of service users and days per user) and availability of a university hospital were added to the models. There was no variation between hospital districts in any other services than university hospitals.

Some other important characteristics at individual, municipal, and regional levels could have been included in the analyses: at municipal level, e.g. distance to the nearest hospital, service capacity, and resources available, which have been included in many previous studies [4,5,17], but these were not available to our study. Yet underlying the municipal differences are probably factors that are difficult to describe and quantify, by exact quantitative indicators, such as care practices, which are consequences of municipalities' traditions and politics [24,25]

At municipal level there was a substitution between university and general hospital indicating that availability of hospital type determines use, but hospital care, long-term care, and home care seemed not to substitute each other. At individual level there was a negative association of use of long-term care and all other services studied. Of the users of long-term care, 17.3% stayed there the whole study period, 730 days, thus not having used other services.

The use of registers, which are considered reliable [26,27], and multilevel analyses necessary for hierarchical structured data are the strengths of this study. However, it was difficult to assess the fit of the models, because good tests do not exist and there are no -2 log likelihood test available for logistic and Poisson multilevel regression analyses. We included in the data all decedents in the years 2002 and 2003 (except those living in small municipalities, 4.3%) and were thus able to draw a picture of a whole older population living their last 2 years of life.

The service providers are heterogeneous, e.g. hospitals belonging to the category of general hospital may differ in respect to the content of care. The hospitals were categorised according to the "code of service producer" in the Care Register for Health Care. During the study period, there have been some organisational changes, like regional hospitals have been affiliated to university hospitals, and the codes may not be updated in all cases. We also performed logistic analyses without the municipalities where there is some confusion with the codes, but the results did not essentially change, and we decided to use the codes as such.

On the basis of this study, the consequences of the differences in service use between the municipalities cannot be identified. The fact that services are used differently does not imply that the service provision and use was more appropriate in some municipalities than in others [5,28]. Earlier studies indicate that health outcomes and satisfaction with care are not necessarily better in the areas where use of services is higher [12,15,29]. However, the cost consequences of services differ considerably; the costs of an inpatient day in university hospital are much higher than, for example, an inpatient day in a health centre [30]. One consequence of variations in service use is that the equity of access between residents in different regions may be compromised.

At present, remarkable changes are going on in the field of Finnish municipalities, the number of municipalities is decreasing and services are being restructured. It is not yet known how these changes will affect differences between municipalities. The service patterns and practices in different municipalities have been formulated in a historical process; they have been modified by need for services, e.g. morbidity and age structure, but also by political power blocs, preferences, and other local conditions and habits. Further research, also using qualitative and historical approaches, is needed to better understand the differences between municipalities in service use.

Conclusions

Our results showed that there is considerable variation between municipalities in the use of health and social services in the last 2 years of life, but the underlying factors are not clear. Our results indicate that the use of services is not equal, but more analysis is needed to assess if it is equitable.

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Conflicts of interest

None declared.

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RESEARCH ARTICLE



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Dementia as a determinant of social and health service use in the last two years of life 1996-2003

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Abstract

Background: Dementia is one of the most common causes of death among old people in Finland and other countries with high life expectancies. Dementing illnesses are the most important disease group behind the need for long-term care and therefore place a considerable burden on the health and social care system. The aim of this study was to assess the effects of dementia and year of death (1998-2003) on health and social service use in the last two years of life among old people.

Methods: The data were derived from multiple national registers in Finland and comprise all those who died in 1998, 2002 or 2003 and 40% of those who died in 1999-2001 at the age of 70 or over (n = 145 944). We studied the use of hospitals, long-term care and home care in the last two years of life. Statistics were performed using binary logistic regression analyses and negative binomial regression analyses, adjusting for age, gender and comorbidity.

Results: The proportion of study participants with a dementia diagnosis was 23.5%. People with dementia diagnosis used long-term care more often (OR 9.30, 95% CI 8.60, 10.06) but hospital (OR 0.33, 95% CI 0.31, 0.35) and home care (OR 0.50, 95% CI 0.46, 0.54) less often than people without dementia. The likelihood of using university hospital and long-term care increased during the eight-year study period, while the number of days spent in university and general hospital among the users decreased. Differences in service use between people with and without dementia decreased during the study period.

Conclusions: Old people with dementia used long-term care to a much greater extent and hospital and home care to a lesser extent than those without dementia. This difference persisted even when controlling for age, gender and comorbidity. It is important that greater attention is paid to ensuring that old people with dementia have equitable access to care.

Background

Dementia is one of the most common causes of death among old people. In 2007 it was the second most common cause of death among people aged 65 and over in Finland, and in 2009 it accounted for almost half of all deaths in the age group 80 or over [1,2]. In the past two decades the number of deaths caused by dementia has doubled [2], and continues to account for a growing proportion of health and social service use [3].

There is evidence of marked differences in health and social service use between old people with and without dementia. Dementing illnesses are the most important predictor of long-term care among old people [4-8]. In a

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six-year follow up-study in Finland, 70% of women with dementia and 55% of men with dementia were institutionalized [9]. The research evidence on hospital use is contradictory: some studies indicate that people with dementia are more likely [10] and others that they are less likely [11,12] to be hospitalized than those without the disease. Hospital stays tend to be longer for people with dementia [13,14].

The differences in service use observed between old people with and without dementia are not necessarily due to dementia, but other factors may be at play. It seems that the effect of comorbid conditions varies between different service types. In one study, people with Alzheimer's disease or other dementia used more medical inpatient and outpatient services than those without these diseases because they were physically more ill [15].



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Their increased risk of nursing home placement, on the other hand, was not explained by comorbid conditions [16]. However, it is difficult to assess the effect of comorbidity on service use because it is possible that other diseases of dementia sufferers' remain underdiagnosed [17] and thus undertreated.

Studies from different countries have shown that the proportion of old people treated in hospitals in their last year of life has increased over time, but there has been a trend towards shorter hospital stays, for instance in Australia in 1985-1994 [18], in the UK in 1976-1985 [19] and in the USA in 1985-1999 [20].

In Finland, the Ministry of Social Affairs and Health gives preference in its recommendations [21] to home care and sheltered housing over institutional care. The proportion of old people living in sheltered housing increased clearly from 1995 to 2005, while at the same time the proportion of old people in institutional care and home care decreased [3].

In this study, we compared the use of hospital care, long-term care and home care in the last two years of life among people with and without dementia diagnosis from 1996 to 2003. The main focus in earlier studies has been on either acute hospital or long-term care. Our study is population-based, including both people living in their own homes and in long-term care facilities. We hypothesized that old people with dementia use less hospital care and more long-term care in their last two years of life than people without dementia. We also hypothesized that service use among people with and without dementia has changed in line with Ministry of Social Affairs and Health recommendations [21]. The research was conducted as part of the project entitled "Costs of Care Towards the End of Life" (COCTEL). Our research questions were as follows:

1. How does health and social service use in the last two years of life differ between old people with and without dementia?

2. How did health and social service use in the last two years of life among old people with and without dementia change between the years from 1996 to 2003?

To answer these questions we analysed the proportion of service users and the number of days in care among those who used services.

Methods

Sample

The sample was drawn from the Causes of Death Register (Statistics Finland). All individuals in the study population were resident in Finland and had died at the age of 70 or over in 1998-2003. The sample consisted of: 1. all those who died at the age of 70 or over in 1998 2. those who belonged to a 40% random sample and died between 1999 and 2001 at the age of 70 or over and

3. all those who died at the age of 70 or over in 2002 or 2003.

For technical reasons it was not possible to include in the sample all deaths for the years 1999-2001. The random sample, representative of the underlying study population [22], was drawn from the Central Population Register of the total Finnish population aged 65 or over, alive on 31 December 1997.

Service use was examined for two years before death (i.e. 730 or 731 days before the day of death). Thus the data include decedents for six years and service use for eight years (since 1996).

Data sources

The data on health and social service use were derived from the following national registers: Care Register for Health Care, Care Register for Social Welfare and Home Care Census (National Institute for Health and Welfare, THL). The information from these registers was linked using unique personal identification number. A more detailed description of data collection has been given earlier [22]. Days in care were calculated for each individual on the basis of dates of admission to and discharge from care.

Permission to access the register data was obtained from each register controller. The data are not publicly available. The research plan was approved by the Pirkanmaa hospital district ethics committee.

Services

The services analysed were (1) hospital inpatient care (2) long-term care and (3) regular home care (at least once a week). Hospital use was analysed overall and separately for three types of hospitals representing different levels of care: university hospital, general hospital (central, district and private) and inpatient ward of health centre if the length of stay (LOS) was less than 90 days. Long-term care included residential home, sheltered housing with 24-hour assistance and inpatient ward of health centre (if LOS \geq 90 days). Home care included both home nursing and home help. Two outcome measures were used, i.e. (1) any use of individual services during the follow-up, and (2) total number of days in care over potential multiple visits during the follow-up.

Dementia diagnosis

The dementia diagnoses were identified from the Causes of Death Register, Care Register for Health Care, Care Register for Social Welfare and Home Care Census. A person was categorized as suffering from dementia if in any of the registers they had an ICD-10 code for dementia (F00-F03) or Alzheimer's disease (G30). All aetiologies of dementia were thus included. In addition to the ICD-10 codes, dementia was identified on the basis of class 25 for dementia in a separate 54-grade cause of death classification [23]. We included contributing, immediate, intermediate, and underlying causes of death, and both main and secondary diagnoses in Care Registers.

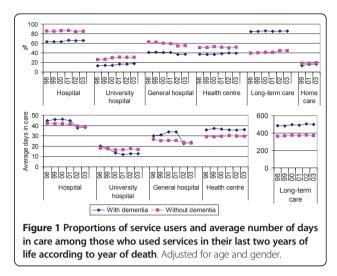
Comorbidity

To take into account comorbidity, we identified ten major diagnoses or diagnostic groups from the Causes of Death Register and the Care Registers. These diagnoses were cancer (ICD10-codes C00-C97), diabetes (E10-E14), psychosis, depressive symptoms or other mental health disorders (F04-F99), Parkinson's disease or other neurological diseases (G00-G99 excluding G30, Alzheimer's disease, which is included in the dementia category), chronic asthma and COPD or other respiratory diseases (J00-J99), arthritis or osteoarthritis (M05-M06, M15-M19), hip fracture (S72), stroke (I60-I69), ischemic and other heart diseases excluding rheumatic and alcoholic heart diseases (I20-I25, I30-I425, I427-I52), and other diseases of the circulatory system (I00-I15, I26-I28, I70-I99). From these diagnostic groups we created (1) individual dummy variables for each of the 10 diagnostic categories and (2) a comorbidity variable, indicating the number of other diagnoses except for dementia.

Analyses

Comparisons of dichotomous variables were based on chisquare tests, for comparisons of continuous variables we used independent samples t-tests and one-way analysis of variance. The distribution of number of days in care was skewed, and therefore Mann-Whitney U-tests were used to analyse differences in them. Age and gender distributions were different in people with and without dementia. Therefore, for Figure 1, the proportion of services users and number of days in care were adjusted for the age and gender distribution of the whole sample separately for people with and without dementia and for different years of death.

Binary logistic regression models were used to study the likelihood of using different services. The number of days in care was studied for those who used the services at least once during the study period. Data were not available on the number of home care visits. Since days in care variables only yield positive integer values and therefore follow the count data distribution, negative binomial regression models were employed. The independent variables were age, gender, dementia, year of death, an interaction variable of dementia and year of



death (dementia*year of death) and dummies for 10 diagnostic categories. If the coefficient of the interaction variable differed from zero (p < .05), additional analyses were performed separately for different years to examine how the effect of dementia differed between the years.

Descriptive analyses and binary logistic analyses were performed with SPSS (15.0) and negative binomial regression analyses were performed with Stata (8.2).

Results

Descriptives

The total number of decedents in 1998-2003 was 145,944, of whom 34,232 (23.5%) had a dementia diagnosis (Table 1). On average, people with dementia were 3.5 years older than people without dementia. The proportion of women was higher among dementia sufferers (69.6%) than among non-sufferers (56.2%).

Among dementia sufferers, 32.4% had Alzheimer's disease, 24.7% vascular dementia, 1.9% dementia related to some other disease and 66.0% unspecified dementia. The proportion with more than one dementia diagnosis was 21.6%. In the whole sample the proportion of people with a dementia diagnosis increased annually during the study period (p < .001). The average age at death of both people with and without dementia also increased (p < .001).

The number of other diagnoses was higher among individuals without dementia than among those with dementia (Table 1). Mental, neurological and respiratory diseases and hip fracture were more common among people with dementia, while other diseases were more common among people without dementia.

Use of different services

A higher proportion of people with dementia used longterm care during the last two years of life than people without dementia (Table 1). People without dementia

Table 1 Descriptive characteristics of old people with (D +) and without (D-) dementia

	D+	D-	
N for all years	34 232 (23.5%)	111 712	
N by year of death			
1998	7 408 (21.7%)	26 708	
1999*	3 085 (22.2%)	10 811	
2000*	3 124 (22.6%)	10 725	
2001*	3 178 (23.2%)	10 539	
2002	8 700 (24.3%)	27 121	
2003	8 737 (25.3%)	25 808	
	Mean (SD)	Mean (SD)	p (t-test)
Average age	85.0 (6.4)	81.5 (7.0)	<.001
Sum of diagnoses	2.0 (1.20)	2.3 (1.16)	<.001
	%	%	p (Chi square -test)
Proportion of women	69.6	56.2	<.001
Diagnoses			
Cancer	12.4	26.9	<.001
Diabetes	13.0	15.1	<.001
Mental	8.2	6.8	<.001
Neurological	11.2	10.1	<.001
Respiratory	51.9	43.1	<.001
Arthritis	4.6	6.1	<.001
Hip fracture	10.0	6.8	<.001
Stroke	20.0	23.5	<.001
Heart diseases	46.5	59.7	<.001
Other circulatory	24.6	31.6	<.001
Proportion of users			
Hospital	64.3	85.9	<.001
University hospital	15.1	29.5	<.001
General hospital	38.3	59.1	<.001
Health centre	38.5	51.4	<.001
Long-term care	87.1	40.3	<.001
Home care	14.5	19.2	<.001
Days in care among the (median)		Mean (median)	p (M-W U-test)
Hospital	41 (25)	41 (30)	<.001
University hospital	14 (7)	18 (10)	<.001
General hospital	27 (10)	25 (15)	<.001
Health centre	36 (32)	29 (23)	<.001
Long-term care	500 (608)	367 (325)	<.001

N = 145 944.

*The sample includes 40% of decedents in this year.

used all types of hospitals and were clients of regular home care more often than people with dementia.

Among service users, people without dementia had more hospital days overall and in university hospital than those with dementia (Table 1). The number of days in general hospital, health centres and long-term care was higher among people with dementia than among those without it.

Annual differences over the study period

The proportion of hospital users increased during the follow-up among people with dementia and remained unchanged among people without dementia (Figure 1). The proportions of those who used university hospital or health centre increased, while the proportion of those who used general hospital decreased. These trends were seen both among people with and without dementia, although the changes were different in magnitude. The use of long-term care increased among people without dementia, but remained unchanged among people with dementia. The use of home care increased among people with dementia but no changes were seen among those without dementia.

Among service users, the mean number of days in hospital overall and in university hospital and general hospital decreased over time both among people with and without dementia (Figure 1), but more so among people with dementia. The mean number of days in health centres remained unchanged. Days in long-term care remained unchanged among people without dementia, but increased slightly among people with dementia.

Multivariate analyses

In models including all independent variables, people with dementia were clearly more likely (OR 9.30, 95%CI 8.60, 10.06) to use long-term care than those without dementia. On the other hand, their likelihood of using all types of hospitals or home care was lower (Table 2).

Most diagnoses increased the likelihood of using different services (Table 2). Cancer and heart diseases increased the likelihood of hospital use, but decreased the likelihood of long-term care use. Diagnoses of mental disorders decreased the likelihood of university hospital use, but had no effect on the use of other hospitals (p > .05). Most diagnoses also increased the number of days in care (Table 3). We also ran the models using the number of other diagnoses instead of diagnosisdummies, but the main results remained unchanged.

The likelihood of hospital use, general hospital use and home care use decreased during our follow-up (Table 2). The likelihood of university hospital and long-term care use increased, while the use of health centres did not differ between the study years.

	Hospital							Long-	term care	Hor	ne care	
				versity spital	Genera	al hospital	Healt	h centre				
	OR	95%Cl	OR	95%CI	OR	95%Cl	OR	95%CI	OR	95%Cl	OR	95%Cl
Age	0.97	0.97,0.97	0.96	0.96,0.96	0.97	0.97,0.98	1.01	1.01,1.01	1.09	1.09,1.09	1.03	1.03,1.03
Gender (0 = man, 1 = woman)	0.81	0.78,0.83	1.02	1.00,1.05	0.82	0.80,0.84	0.95	0.93,0.97	1.50	1.46,1.54	1.29	1.26,1.33
Dementia (0 = no, 1 = yes)	0.33	0.31,0.35	0.48	0.44,0.52	0.46	0.44,0.49	0.58	0.55,0.62	9.30	8.60,10.06	0.50	0.46,0.54
Year of death	0.98	0.98,0.99	1.05	1.05,1.06	0.93	0.92,0.93	1.00	1.00,1.01	1.05	1.04,1.05	0.98	0.98,0.99
Interaction: Dementia * year of death	1.04	1.03,1.06	1.03	1.01,1.04	1.04	1.02,1.05	1.02	1.01,1.03	0.96	0.94,0.98	1.08	1.06, 1.10
Diagnoses (0 = no, 1 = yes)												
Cancer	3.64	3.49, 3.81	1.82	1.77, 1.87	1.98	1.93, 2.04	1.72	1.68, 1.77	0.82	0.80, 0.85	1.09	1.05, 1.13
Diabetes	1.37	1.31, 1.43	0.95	0.91, 0.98	1.27	1.23, 1.31	1.15	1.12, 1.19	1.41	1.36, 1.45	1.42	1.37, 1.48
Mental other than d	1.02	0.97, 1.08	0.91	0.86, 0.95	1.03	0.99, 1.08	1.04	1.00, 1.08	2.04	1.94, 2.14	1.26	1.20, 1.33
Neurological other than d	1.28	1.22, 1.35	1.14	1.09, 1.18	1.24	1.19, 1.28	1.01	0.98, 1.05	1.74	1.67, 1.81	1.20	1.15, 1.25
Respiratory	1.42	1.38, 1.46	1.08	1.06, 1.11	1.20	1.18, 1.23	1.21	1.18, 1.23	1.52	1.48, 1.55	1.13	1.10, 1.16
Arthritis	1.36	1.27, 1.45	0.98	0.93, 1.03	1.42	1.35, 1.49	1.01	0.97, 1.06	1.46	1.38, 1.53	1.36	1.29, 1.43
Hip fracture	3.45	3.22, 3.69	1.57	1.50, 1.64	2.15	2.06, 2.25	0.99	0.95, 1.03	1.68	1.61, 1.76	1.15	1.09, 1.21
Stroke	1.28	1.24, 1.33	1.08	1.04, 1.11	1.18	1.15, 1.22	1.04	1.01, 1.07	1.51	1.47, 1.56	1.07	1.04, 1.11
Heart diseases	1.57	1.52, 1.62	1.09	1.07, 1.12	1.35	1.32, 1.38	1.18	1.15, 1.20	0.84	0.82, 0.86	1.43	1.39, 1.47
Other circulatory	1.58	1.52, 1.63	1.24	1.21, 1.28	1.32	1.29, 1.36	1.12	1.10, 1.15	1.00	0.97, 1.02	1.19	1.16, 1.22
Model statistics												
Ν	145 944		145 944		145 944		145 944		145 944		62 158*	
Nagelkerke R ²	0.166		0.078		0.106		0.035		0.344		0.042	
-2 Log likelihood	126 682		159 658		189 194		198 231		158 708		134 320	

Table 2 Use of services (0 = no, 1 = yes) during last two years of life

Binary logistic regression models. Statistically significant (p < .05) odds ratios (OR) are in bold face. *Data on home care include only years 1999, 2001 and 2003.

We calculated the interaction term (dementia*year of death) to assess whether the effect of dementia on service use changed by year of death. In all services the effect of this interaction was statistically significant, and we ran additional analyses (not shown) separately for those who died in different years. The differences between people with and without dementia in the likelihood of using each of the services diminished during the follow-up from 1998 to 2003.

Among service users, people with dementia had a higher number of days in care in all types of hospitals and in long-term care than people without dementia (Table 3).

The number of days in hospital overall and in general hospital among services users decreased during the followup (Table 3). The number of days in health centres and in long-term care increased over time. The number of days in university hospital remained unchanged (p > .05).

The interaction variable of dementia and year of death was not associated (p > 0.05) with number of days in general hospital and long-term care; a similar trend was seen in both people with and without dementia. Dementia increased the number of days in hospital overall and in health centre less among those who died towards the end of the follow-up (analyses not shown). The diagnosis of dementia increased the number of days in university hospital in the early part of the study period, but decreased that number towards the end of it.

People with dementia were less likely to use hospital care and home care than people without dementia. This is likely due, in part, to their more frequent use of long-term

	Hosp	ital							Long-ter	m care
			University	hospital	General l	nospital	Health	centre		
N	117 9	974	38 1	23	79 1	35	70 5	95	74 797	
	β	р	β	р	β	р	β	р	β	р
Age	-0.009	<.001	-0.036	<.001	-0.019	<.001	0.009	<.001	0.015	<.001
Gender (0 = man, 1 = woman)	-0.007	0.384	0.024	0.094	-0.094	<.001	0.090	<.001	0.155	<.001
Dementia (0 = no, 1 = yes)	0.123	<.001	0.144	0.030	0.209	<.001	0.229	<.001	0.231	<.001
Year of death	-0.017	<.001	-0.004	0.205	-0.027	<.001	0.003	0.045	0.006	0.001
Interaction: Dementia * Year of death	-0.075	0.002	-0.308	<.001	-0.086	0.121	-0.041	0.003	0.016	0.067
Diagnoses (0 = no, 1 = yes)										
Cancer	0.283	<.001	0.265	<.001	0.191	<.001	0.124	<.001	-0.237	<.001
Diabetes	0.094	<.001	0.021	0.257	0.055	0.002	0.115	<.001	-0.028	<.001
Mental other than d	0.230	<.001	0.215	<.001	0.318	<.001	0.158	<.001	0.010	0.236
Neurological other than d	0.098	<.001	0.007	0.758	0.075	0.002	0.126	<.001	0.019	0.008
Respiratory	0.177	<.001	0.201	<.001	0.175	<.001	0.115	<.001	0.005	0.313
Arthritis	0.185	<.001	0.128	<.001	0.207	<.001	0.146	<.001	-0.113	<.001
Hip fracture	0.077	<.001	0.025	0.302	-0.004	0.861	0.207	<.001	-0.061	<.001
Stroke	-0.001	0.916	-0.124	<.001	-0.048	0.009	0.076	<.001	0.041	<.001
Heart disease	0.032	<.001	0.007	0.668	0.015	0.376	0.011	0.076	-0.133	<.001
Other circulatory	0.091	<.001	0.083	<.001	0.064	<.001	0.068	<.001	-0.105	<.001
Model statistics										
Alpha	0.923		0.983		1.145		0.703		0.769	
Log pseudo likelihood	-555016		-145652		-334300		-310208		-523140	

Negative binomial regression models. Statistically significant (p < .05) coefficients (β) are in bold face.

services. Therefore, we also analysed hospital and home care use separately among people with and without dementia who used no long-term care during their last two years of life (analyses not shown). In this sub-sample we found that the use of university and general hospital was less common among people with dementia than among those without dementia, but the use of health centre and home care was more common among those with dementia.

Discussion

Our aim was to compare the use of health and social services among people with and without a dementia diagnosis during their last two years of life in 1998-2003. We found that people with dementia were more likely to use long-term care but less likely to use hospital care and home care than people without dementia when age, gender, year of death and comorbidity were adjusted for. This was consistent with our hypothesis. Among service users, dementia sufferers spent more days in general hospital, health centre and long-term care than non-sufferers, but fewer days in university hospital.

Although the results describe the Finnish health and social care system and there may be differences between countries, they are broadly consistent with earlier findings from both Finland and elsewhere. It has been reported that dementia is a strong predictor of the use of long-term care e.g. [9,24] but the evidence on the effect of dementia on the use of hospital care is inconclusive. Studies that do not take account of the proximity of death have reported that dementia increases the use of hospital care [10,25,26]. However studies focusing on service use among people in their last years of life have found that dementia decreases hospital use [11,12]. This is supported by the results of the present study. Old people who are in long-term care are less likely to use hospital care, despite their comorbidity, especially those with dementia [27].

We started from the hypothesis that care practices and by the same token service use had changed during our study period from 1996 to 2003. In the case of hospital use the changes were dependent on the type of hospital: the probability of hospital use overall and general hospital use decreased, but the probability of university hospital use increased. In general there was a tendency towards shorter hospital stays, which has been a common trend in other countries over a longer time period [18-20]. Stays were shorter, particularly among people with dementia. Differences in service use between people with and without dementia decreased during the eight-year study period. The changes that were seen over time in service use among both groups may be due in part to organizational changes, or even to changes in the classification of hospitals. However, it is unlikely that such changes will have affected the differences between people with and without dementia.

The use of institutional long-term care increased during the study period. This is at sharp variance with current policy recommendations [21]. We analysed all types of long-term care together, including residential home, sheltered housing with 24-hour assistance and health centres (if length of stay \geq 90 days). Therefore, the potential shift from residential care to sheltered housing, which has been reported previously [3] and which is in line with policy recommendations, does not show up in our results.

We found that people without a dementia diagnosis had more other diagnoses than people with dementia. The evidence is conflicting, however: it has been reported both that dementia sufferers have more diagnoses [16,17,28], and the same number of other diagnoses than non-sufferers [29,30]. It has also been suggested that people with Alzheimer's disease are healthier than others [31]. Our data on comorbidity were derived from the Causes of Death Register and the Care Register for Health Care, which includes hospital diagnoses. Because hospital use was more common among people without dementia, their likelihood of having recorded diagnoses will obviously have been higher as well. It is also possible that the smaller number of other diagnoses among people with dementia is due to underdiagnosing [17]. Therefore, our comorbidity variables may underestimate the total level of comorbidity among people with dementia.

We did not have access to information on the time of diagnosis or the severity of dementia, which are important determinants of service use and thus health care costs [24,32,33], and important predictors of nursing home admission [34]. We also lumped Alzheimer's disease and other dementias together, even though there is some indication that service use may differ between them [35].

The proportion of people with a dementia diagnosis in the whole sample increased somewhat during our study period. We do not know whether this was due to improved diagnostic practices or more accurate registration of dementia diagnoses in hospital records, both of which are likely to have happened during our study period, or to decreased mortality among people with dementia. The diagnoses in the registers from which our data were drawn are closely in line with hospital records [36,37]. Still, despite better diagnostics, it is likely that not all cases of dementia in our sample were recorded appropriately in the hospital records [38]. This may be the case especially in the early and mild phase of dementia, and may lead to selection bias towards the most advanced and severe cases. The prevalence of dementia in our sample is closely consistent with the figures for all old people in Finland [39]. However, no data are available on the prevalence of dementia among those living their last years of life.

Our multivariate analyses showed that during their last two years of life, younger old people and men were more likely to use hospital care than older and women, who in turn were more likely to use long-term care. These results confirm earlier findings e.g. [19,40,41]. However, it is not clear whether the effect of age and gender on the use of all services is similar among people with and without dementia. Age has been found to increase the risk for nursing home placement both among people with and without dementia [8], while age and dementia to increase this risk in both genders [42]. It is important that detailed attention is given to possible age and gender differences between old people with and without dementia in service use towards the end of life. Most urgently, however, further research should clarify whether the lower use of hospital care among people with dementia is due to their different needs, or whether it reflects their poorer access to specialized health care.

Conclusions

In this study we compared service use among old people with and without dementia in the last two years of life in an extensive population sample of people living either in their own homes or in care facilities. We found that people with dementia clearly used more long-term care and less hospital and home care than people without dementia, even though age, gender and comorbidity were controlled for. The results suggest that dementia sufferers' other diseases may remain underdiagnosed and undertreated. It is important to make sure that old people who suffer from dementia have equitable access to care.

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Authors' contributions

LF: Conception and design of the study, acquisition of the data, analysis and interpretation of the data, drafting the manuscript, PR: Conception and design of the study, acquisition of the data, critical revision of manuscript, MA: Conception and design of the study, critical revision of manuscript, JR: acquisition of the data, analysis and interpretation of the data, critical revision of manuscript, MJ: Conception and design of the study, acquisition of the data, critical revision of manuscript. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

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