Orthopaedic Healthcare Atlas for Norway

Use of orthopaedic health services 2012–2016

December 2018

Helseatlas

HELSE FØRDE

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Foreword, Western Norway RHA

The Orthopaedic Healthcare Atlas for Norway is the first healthcare atlas to be produced by Western Norway Regional Health Authority. This healthcare atlas analyses the use and variations in the use of treatment for several important orthopaedic conditions.

In 2015, the Ministry of Health and Care Services tasked Western Norway RHA and Northern Norway RHA with developing a national healthcare atlas service in cooperation with the Norwegian Directorate of Health. Western Norway RHA gave the assignment to Helse Førde, since the health trust already had experience of analysing the use of health services from a population perspective from its work relating to the website *Samhandlingsbarometeret*. Responsibility for both the healthcare atlas service and the *Samhandlingsbarometeret* project has been assigned to Helse Førde's section for research and innovation.

Helse Førde health trust works closely with the Centre for Clinical Documentation and Evaluation (SKDE), which develops healthcare atlases on behalf of the Northern Norway RHA. SKDE has developed healthcare atlases for several fields of medicine, and it has generously shared its experience, from which Western Norway RHA has benefited greatly.

During the production of the Orthopaedic Healthcare Atlas for Norway, Helse Førde health trust has cooperated closely with the Norwegian Orthopaedic Association's Quality Committee, which, together with a user representative, has acted as a resource group during the work. The health trust has also been in dialogue with medical quality registers in the orthopaedic field and various other orthopaedic specialists. This cooperation with the specialist community has played an important role in the production of this orthopaedic healthcare atlas.

The Orthopaedic Healthcare Atlas for Norway presents analyses for the period 2012–2016. The atlas shows that patients from different parts of Norway did not receive surgical treatment to the same extent, and that the variation was high for several conditions.

Equitable access to health services regardless of where we live is an important goal of Norway's health policy. The healthcare atlases are a tool for comparing the use of health services in different geographical areas, regardless of where the patients actually receive treatment.

The information in this healthcare atlas about the unequal distribution of health services must be used to question our own practice, identify the causes of this variation and its consequences for the patients and the health service, and take action to reduce unwarranted variation. We are pleased to present Helse Førde health trust's first national healthcare atlas: the Orthopaedic Healthcare Atlas.

Stavanger, 20 November 2018

Baard-Christian Schem
Medical director
Western Norway Regional Health Authority

Foreword, the Norwegian Orthopaedic Association represented by the Quality Committee

The Norwegian Orthopaedic Association wants the Norwegian population to have equitable access to high-quality health services regardless of where they live. Norway's geography and the population's distribution are among the factors that make this a hard goal to achieve. It is paramount that the available resources are used in the best possible way to benefit the population of Norway as a whole. The board of the Norwegian Orthopaedic Association therefore received Helse Førde's initiative to produce an orthopaedic healthcare atlas with great interest. In order to ensure that the clinically relevant questions are answered, the board requested the Association's Quality Committee to play an active part in the work. In the board's view, it is important that the specialist community contributes to the work and can feel a sense of ownership to the results.

Although the quality of the coding on which the figures are based may vary, the orthopaedic healthcare atlas gives reason to ask why the variation is so high for some diagnoses. On the other hand, the atlas also shows that orthopaedic surgeons in Norway have more or less reached a consensus on some treatment options. Even though the Quality Committee consists of representatives of the four health regions in Norway, it has still been difficult to understand why the variation in different treatment options for certain diagnoses is as high as it is. However, the results from the Orthopaedic Healthcare Atlas for Norway can form a basis for discussing what is behind these differences. This could, in turn, lead to suggestions for how the health services offered in the different health regions can become more uniform.

The work on the Orthopaedic Healthcare Atlas has been an exciting process. The Quality Committee has participated enthusiastically in the work, and the Norwegian Orthopaedic Association is proud to be in on the launch of the Orthopaedic Healthcare Atlas. Its results will be useful both for managers and healthcare professionals, and should be of great interest to everyone with an interest in Norway's health policy.

Lærdal, 29 November 2018

Tobias Franke
Chair
Quality Committee, the Norwegian Orthopaedic Association

Abbreviations

CI: Confidence interval

CT: Computerised tomography

CV: Coefficient of variation

DRG: Diagnosis-related group

FT: Ratio

Helfo: The Norwegian Health Economic Administration

HOD:The Ministry of Health and Care Services

ICD-10: International Statistical Classification of Diseases and Related Health Problems.

ICPC-2: International Classification of Primary Care

KUHR: Control and payment of reimbursements to health service providers

MRI: Magnetic resonance imaging

NCMP: The Norwegian Classification of Medical Procedures

NCRP: The Norwegian Classification of Radiological Procedures

NCSP: The NOMESCO Classification of Surgical Procedures

NHS: The National Health Service in England

NOMESCO: The Nordic Medico-Statistical Committee

NPR: The Norwegian Patient Registry

RCT: Randomised controlled study

RHA: Regional health authority

SCV: Systematic component of variation

SKDE: The Centre for Clinical Documentation and Evaluation

SSB: Statistics Norway

Important terms and definitions

Arthroscopy: Keyhole surgical procedure on a joint

Case mix: Includes patient characteristics such as sex, age and morbidity. Is a component of systematic variation that is described as desirable, explainable or well founded ('warranted').

Conservative treatment: Treatment without surgery, such as physiotherapy or lifestyle changes.

CT: Computerised tomography. Radiology examination method that produces cross-sectional images using X-rays.

Degenerative joint disease: A collective term for joint diseases caused by changes brought on by age or wear and tear, injuries, strain, overweight or genetic factors.

Demography: Describes and explains the size, age and sex distribution, geographical distribution, fertility, mortality and migration of the population.

Effective care: Treatment generally considered to be effective and where the benefits outweigh the risks.

Elective treatment: Treatment chosen by the patient him/herself in consultation with a doctor. Such treatment can be planned and carried out at a predetermined time. Total prosthetic replacement to treat arthrosis of the hip is one example.

Emergency care: Healthcare provided within a short time, often hours.

Free choice of treatment centre ('Fritt behandlingsval'): Under this scheme, which was introduced with effect from November 2015, patients can choose where they want to be treated, and they can choose either a public or an approved private healthcare provider. Helfo is responsible for approving private enterprises as healthcare providers under this scheme.

Gender and age adjustment: The composition of the population is taken into consideration by adjusting or standardising rates. This enables the use of the population of one area to be compared with that of another area even when the population sizes and age and gender composition are different.

Helfo: The Norwegian Health Economic Administration. Helfo is a separate agency under the Norwegian Directorate of Health. It administers payments to treatment providers, suppliers and service providers, as well as individual reimbursements to private persons who have incurred medical and dental expenses abroad.

High-energy injury: Injuries caused by an incident where a part of the body is impacted by considerable energy causing injury. Ankle fractures resulting from road traffic accidents are one example.

Hospital referral area: The municipalities and city districts that comprises a health trust's catchment area. The areas used in this atlas roughly correspond to the health trusts' catchment areas. The use of health services by the population in the different areas is compared in order to determine whether people have equitable access to health services regardless of where they live. The analyses are based on the patients' addresses.

ICD-10: International Statistical Classification of Diseases and Related Health Problems. This international classification system for diseases and other health problems is published and maintained by the World Health Organization, WHO.

ICPC-2: International Classification of Primary Care. International classification system for primary healthcare used to document reasons for encounter, health problems and diagnoses.

Incidence: Number of new episodes of illness or deaths over a period of time divided by the number of persons in the population during the same period.

Lifetime risk: The risk of developing a disease during one's lifetime. Synonymous with risk of disease.

Low-energy injury: Injuries caused by an incident where the energy impact on a part of the body is small, but nevertheless causes injury. Hip fractures resulting from a fall from the patient's own height are an example of such injuries.

Low value procedure: Procedures where knowledge about the effect of treatment is uncertain.

Medical coding in the specialist health service: Coding is used to document the reason for contact and the examinations and treatment carried out when a person comes into contact with the specialist health service. The main reason for contact is coded as the primary diagnosis, while other conditions that have a bearing on the treatment are coded as secondary diagnoses. Procedures (operations) are coded using procedure codes. The coding system also forms the basis for calculating part of the income of institutions in the specialist health service (activity-based funding). Examples of classification systems in use include ICD-10, NCSP, NCMP and NCRP. See the website of the Norwegian Directorate for e-health (https://ehelse.no/) for information about coding and coding systems.

Meta-analysis: The use of statistical methods to collate the results of several independent studies on the same topic. The purpose of meta-analysis is to find better indications of what research results are reliable, valid and robust than the individual studies can provide when considered separately.

Morbidity: Morbidity or morbidity rate is a less precise term for the prevalence or incidence of a disease.

Mortality: Number of deaths in a limited section of the population in a given period, for example deaths per 1,000 population per year. Describes the number of deaths from all causes (total mortality) or from specific causes (cause-specific mortality).

MRI: Magnetic resonance imaging. Advanced radiological imaging of the inner organs and structures of the body. Images are produced using a strong magnet, low-energy radio waves and a computer that processes the signals from the body. Unlike X-ray or CT examinations, MRI does not use X-rays.

NCMP: The Norwegian Classification of Medical Procedures. Developed in Norway, this system is primarily used for non-surgical procedures.

NCRP: The Norwegian Classification of Radiological Procedures. Developed in Norway for diagnostic imaging, image-guided interventions and nuclear medicine procedures.

NCSP: The NOMESCO Classification of Surgical Procedures. Common Nordic coding system for surgical procedures. The Norwegian version of NCSP is used to classify surgical procedures in Norway.

Organisation of the Norwegian health service: The Norwegian health service is divided into two levels:

a) The municipal health services (primary healthcare or first-line services) cover everyone who lives or is staying in a municipality. These services are regulated by the Health and Care Services Act. The regular GP scheme and emergency primary healthcare services are both municipal health services. The doctors use the ICPC-2 coding system and tariff codes. The well-developed system of municipal health services is particular to Norway, and the regular GPs play a key role by referring patients to the specialist health service.

b) The specialist health service. The public specialist health service is divided into four regional health authorities (RHAs), which are responsible for providing specialist health services in and outside institutions to everyone residing or staying in their health region. The actual services (diagnosis and treatment) are provided by the health trusts. The RHAs can enter into funding contracts with private health service providers (specialists in private practice, hospitals, rehabilitation institutions, laboratories and providers of radiology services).

Preference-driven care: Services where more than one treatment option is available and the different options can be equally effective.

Prevalence: Number of persons with a certain disease in a certain population at a given time or during a given period of time.

Private service providers in the specialist health service: Institutions under public funding contracts not subject to competitive tendering, specialists in private practice under public funding contracts and institutions under public funding contracts subject to competitive tendering and/or renegotiation. Institutions (hospitals) under public funding contracts not subject to competitive tendering have long-term contracts with an RHA, and some of them even have their own hospital referral areas. In healthcare atlases and some other contexts, activities performed at such hospitals are therefore placed in the same category as activities performed by public hospitals. The activities of specialists in private practice under public funding contracts and institutions under contracts subject to competitive tendering and/or renegotiation, on the other hand, are deemed to be private services. Treatment provided by wholly commercial institutions or specialists in private practice without public funding contracts and treatment abroad are not reported to NPR and are thus not included in the healthcare atlas. These treatments are privately funded by e.g. insurance schemes.

Rate: Specifies the number of events (admissions, conditions, treatments or other) per 100,000 population during a period of time or at a point in time. For example: surgery rate: number of operations per 100 000 population per year.

Referral period: The time from a referral for a complaint or condition until assessment, treatment, rehabilitation and follow-up have been completed.

Supply-sensitive care: Health services whose use is determined by capacity.

Surgical treatment: Treatment in the form of an operation.

Tariff code: Codes that specialists in private practice under public funding contracts and regular GPs use when sending claims for settlement to Helfo. The codes refer to the measures implemented and agreed payment for the measure in question.

The Norwegian Patient Registry: This national register contains information about all patients who are waiting for or have received treatment in the specialist health service. All public institutions, private non-profit institutions, private institutions under contract with the public authorities and specialists in private practice under public funding contracts are all obliged to report data to NPR. This information will form the basis for the administration, management and quality assurance of specialist health services.

Undesirable or unwarranted variation: Variation in the use of health services that is not due to chance, differences in the composition of the patient group or patients' treatment preferences. The terms undesirable, unjustified, unwarranted and unfair variation are used synonymously.

Summary

Background
In order to learn more about variation in the use of health services, the Ministry of Health and Care Services charged Western Norway RHA and Northern Norway RHA with developing a national healthcare atlas service. Helse Førde health trust is carrying out this assignment on behalf of the Western Norway Regional Health Authority. The *Orthopaedic Healthcare Atlas for Norway* is the first healthcare atlas to be produced by Helse Førde.

What was investigated
When preparing the orthopaedic healthcare atlas, we investigated the use of health services by groups of patients typically treated at orthopaedic departments. The analyses are based on data from the Norwegian Patient Registry for the period 2012–2016. The use of health services was analysed on the basis of hospital referral areas, i.e. where the patients lived rather than where they received treatment. For degenerative joint disease, we investigated osteoarthritis of the hip, knee and thumb for variations in surgery rates between hospital referral areas. The surgery rate is the number of operations per 100 000 population. For osteoarthritis of the knee and meniscal degeneration, we also looked at variation in the use of arthroscopy. Correspondingly, surgery rates for fractures (wrist, ankle, hip, shoulder and clavicular fractures), lower back complaints (prolapse and spinal stenosis) and anterior cruciate ligament injuries were also analysed. For other lower back pain and concussion, we investigated admission rates (number of admissions per 100,000 population).

Assessment of variation
There is no standard method that can easily be used to analyse variations in the use of health services between geographical areas. We therefore used several methods. All the rates for hospital referral areas were adjusted for age and gender in order to make areas with different gender and age compositions more comparable.

Results
The analyses show that the variation in the use of health services was particularly high for arthroscopy as treatment for degenerative knee disease (osteoarthritis and meniscal injuries). This procedure is known to have little effect on patients aged 50 years and older, and we found that the number of arthroscopies was halved during the period. However, the high variation between hospital referral areas shows that no professional consensus existed on the indications for this procedure.

We found considerable variation in surgical treatment of wrist fractures, lumbar disc herniation, lumbar spinal stenosis and anterior cruciate ligament injuries. Private treatment providers (institutions under contracts subject to competitive tendering and/or renegotiation and specialists in private practice under public funding agreements) were used for operations for back complaints, anterior cruciate ligament injuries and arthroscopies for degenerative knee complaints in particular. The extent to which patients with lower back pain and concussion were admitted to hospital varied greatly. There is no known corresponding variation in the incidence of these conditions, and the variation was therefore deemed

to be unwarranted.

The variation in surgery rates for osteoarthritis of the knee and ankle fractures was moderate, while the variation was relatively low for osteoarthritis of the hip. Hip fracture was the diagnosis that showed the least variation between hospital referral areas. The observed variation reflects the incidence of hip fractures and is thus desirable. The average number of bed days per episode of care, on the other hand, varied considerably for hip fracture patients.

The number of operations for shoulder fractures, osteoarthritis of the thumb and clavicular fractures performed during the period was relatively low. The variation between hospital referral areas might seem high at first glance, but it was characterised as moderate because the surgery rates may have a large element of random variation.

Assessments
The results in this healthcare atlas provide a basis for reflection on central areas of orthopaedics. The atlas can also form the basis for further investigation with a view to understanding the variations and their consequences for patients and for the health service. Cooperation between health personnel, patients, managers and the health authorities will be important in change work aimed at providing more equitable services to patients regardless of where they live.

Conclusion
Systematic variations have been identified in the orthopaedic treatment received by people living in different parts of Norway during the period from 2012 to 2016.

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Chapter 1

Introduction

1.1 The remit

In order to learn more about variation in the use of health services, the Ministry of Health and Care Services (HOD) assigned the task of developing a national healthcare atlas service to Northern Norway Regional Health Authority and Western Norway Regional Health Authority at the enterprise general meeting held in January 2015. The two regional health authorities will cooperate with the Norwegian Directorate of Health in this work, which is intended to shed light on and analyse the use of and variation in services.

Subsequent assignment documents from HOD have emphasised that information about variation in the use of health services is to be used to make improvements. This improvement work can reduce unwarranted variation. Variation in the use of health services that cannot be explained by differences in treatment preferences or morbidity between patients in different parts of Norway can be characterised as unwarranted variation (Wennberg, 2010). Great variation between hospital referral areas indicates over- or underuse of health services, which could, in turn, have consequences both for patients and for the health services.

Helse Førde health trust is responsible for the Western Norway Regional Health Authority's work on healthcare atlases, while the Centre for Clinical Documentation and Evaluation (SKDE) performs this function on behalf of Northern Norway Regional Health Authority. SKDE got off to an early start and launched its first healthcare atlas *Day Surgery in Norway 2011–2013* in January 2015 (Balteskard et al., 2015), which is published at www.helseatlas.no together with subsequent healthcare atlases. This is Helse Førde health trust's first healthcare atlas, and it deals with important orthopaedic conditions.

1.2 The resource group

The resource group for the Orthopaedic Healthcare Atlas consisted of the Quality Committee of the Norwegian Orthopaedic Association and a user representative. The group has provided input on which conditions the healthcare atlas should cover and it has given us a deeper understanding of the discipline of orthopaedics and of how to produce a high-quality, relevant healthcare atlas.

It is important to involve doctors in the work of analysing variation in the use of health services. The Norwegian Medical Association considers it important to play an active role in the work on variation and over- and underuse of health services in order to maintain high professional and ethical standards in medical practice (Legeforeningen, 2016).

The resource group has also referred us to other experts and expert communities that we have contacted in connection with issues relating to various conditions or surgical procedures. It would not have been possible to produce an orthopaedic healthcare atlas without close cooperation with the resource group. The user representative on the resource group also provided useful input, especially concerning how to make the content understandable and accessible.

The members of the resource group are:
Tobias Franke
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Helse Førde health trust
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Åshild Steinde Helleset
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Chapter 2

About healthcare atlases and variation in the use of health services

There is a general consensus in Norway that the whole population should have equitable access to health services regardless of where they live, and that the treatment provided shall be appropriate to the patients' needs (Helse- og omsorgsdepartementet, 2016). It is therefore important to find out to what extent this goal is being achieved. In recent years, patients' use of health services has been compared for different patient groups, including through the preparation of healthcare atlases.[1] We have learnt that, in many areas, the use of health services varies between different parts of Norway.

Knowledge about variations in practice is an important prerequisite for studying the relationship between health policy goals and clinical decision-making in more detail. This knowledge raises questions about priorities and efficiency in the health service (Wennberg, 2011), and benefits patients, healthcare professionals and politicians.

Some countries have a longer tradition than Norway of studying variation in the use of health services between hospital referral areas, i.e. health service research focusing on what is known as *small area variation*. Such research started in the USA already in the 1970s, and John Wennberg of Dartmouth College in Vermont was a pioneer in the field. The use of health services, resource use and costs in different geographical population areas in the USA were mapped and the findings presented in maps etc. (*Atlas of variation*). This work uncovered considerable regional differences and attracted a great deal of attention locally.

Long before this, the English paediatrician James Alison Glover published a study documenting considerable local variations in the incidence of tonsillectomy in schoolchildren. His work received little attention when it was first published in 1938, but was re-published in 2008 (Glover, 2008). In 2010, the National Health Service (NHS) in England published its first healthcare atlas[2] inspired by the work carried out at Dartmouth College. Several other countries (including Spain, Australia and New Zealand) have since produced national healthcare atlases.

[1] Day surgery, COPD, the elderly, neonates and children
[2] http://fingertips.phe.org.uk/profile/atlas-of-variation

2.1 Various mechanisms and situations that can contribute to variation

Wennberg (2010) divided health services into three categories of care for the purpose of analysing and describing variations in their use.

Effective care

The category 'effective care' refers to services for which there is consensus that the treatment the patient receives is necessary and where its effect is well documented. There are unambiguous and generally accepted diagnostic and treatment criteria and little room for alternative treatment options. Surgery for hip fractures is one example of effective care. In practice, nearly all hip fracture patients will be treated by the specialist health service, and the frequency of operations will largely correspond to the incidence of the condition. Any variations between hospital referral areas for this category will be due to actual variation in incidence, or, alternatively, to undertreatment of patients.

Preference-sensitive care

In the category 'preference-sensitive care', there is more than one treatment option for the patients' condition, but no clear ranking of the available options. Both the indications for and benefits of the treatment may be unclear or debatable. Elective surgery, for example total prosthetic replacement to treat arthrosis of the hip, typically falls into this category.

Even though there has been more focus on the patients' right to informed decisions (*shared decision-making*) in recent years, the preferences of healthcare professionals and the advice they give will often be decisive in relation to which treatment method is chosen. The variation between hospital referral areas will normally be greater in this category than in the effective care category, and the variation cannot be explained by differences in demographics or morbidity.

Supply-sensitive care

In the 'supply-sensitive care' category, the supply of services influences their use. The number of specialists in an area and diagnostic imaging capacity are examples of health services where an increase in capacity can easily lead to an increase in activity without this necessarily resulting in better patient outcomes.

Wennberg (2010) emphasises supply-sensitive care as the most important reason for variation in the use of health services between hospital referral areas in the USA, and he believes that the greatest variation is found in this category. He also claims that up to 30 % of supply-sensitive care services represent overuse (i.e. overdiagnosis and overtreatment) and thereby do not deliver a health benefit, but are potentially harmful to the health of the patients in question and represent incorrect prioritisation of the health service's resources.

2.2 The concept of variation

The purpose of analysing variation in the use of health services is to determine whether patients are receiving equitable services regardless of where in Norway they live. Variations will always be found in the data on which the analyses are based. The objective of a healthcare atlas is to say something about systematic variation between hospital referral areas and about whether it is warranted or not. The terms *undesirable*, *unjustified*, *unwarranted* and *unfair* variation are used synonymously. In this chapter, we will describe different concepts of variation and how they relate to each other, while information about how the analyses of variation were conducted during the preparation of the orthopaedic healthcare atlas is provided in Chapter 4 Method.

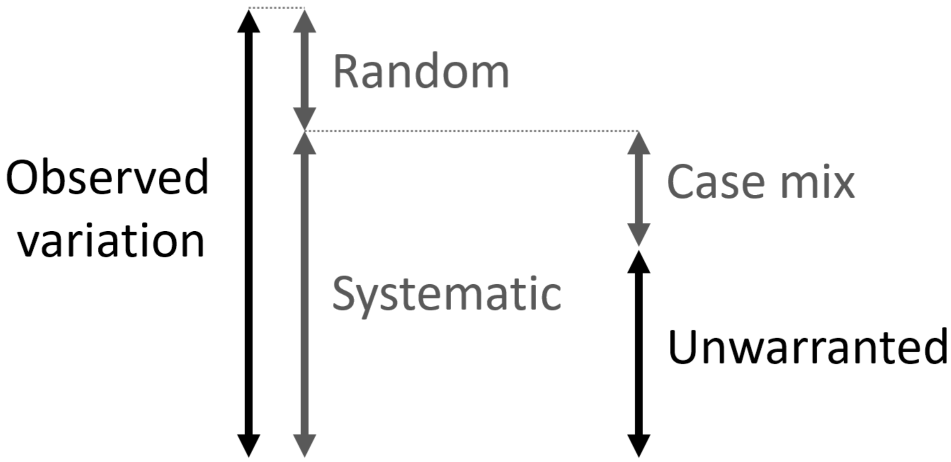

Figure 2.1: Illustration of the components of variation. (Used by permission from SKDE. From the Norwegian Neonatal Healthcare Atlas (Moen et al., 2016))

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Random and systematic variation

The observed variation can be divided into two main components: systematic and random variation (Figure 2.1). Random variation is most noticeable in connection with small samples of patients, procedures or other variables. When samples are small, figures can vary quite a lot from year to year within a geographical area. If the element of random variation is too great, we cannot draw any clear conclusions about the systematic variation. The analyses in the healthcare atlas will therefore be based on samples of a certain size. The size, for example the number of operations performed, will nevertheless vary between hospital referral areas, and this could have a bearing on the assessments and conclusions.

Patient composition

In a healthcare atlas, the use of health services is analysed on the basis of patients' home addresses, not where they received treatment. Analyses based on geographical affiliation will result in a more homogeneous patient composition than if the analyses were based on different hospitals. In Norway, we generally see little difference between geographical areas in terms of morbidity. However, information about different degrees of morbidity will form part of the basis for assessing the variation.

For many conditions, the prevalence varies between young and old people, while the prevalence of other conditions varies between the sexes. For example, postmenopausal women have a higher risk of fractures than men, as osteoporosis is more prevalent in women. For this reason, age and gender adjustment is necessary in the analyses of variation in the use of health services between different parts of the country.

Warranted and unwarranted variation

The systematic variation is partly warranted and partly unwarranted. Variation in the use of health services between hospital referral areas that is due to patient characteristics is considered to be warranted. Such characteristics can be the prevalence of diseases or patients' treatment preferences. Figure 2.1 uses the term *case mix* to describe this. When the population in the areas that have the highest morbidity also uses more health services, we consider this variation to be warranted.

Variation that cannot be explained by chance or patient characteristics is deemed to be unwarranted (see Figure 2.1). In order to be able to say something about the unwarranted variation, the analyses in healthcare atlases endeavour to reduce the element of random variation and variations relating to patient characteristics.

The purpose of a healthcare atlas is to shed light on and analyse variations. When assessing the results, it is easy to focus on values at the top or bottom of the scale, and to try to avoid these positions and assume that the national average is the correct level. However, analyses of the use of health services do not tell us what the correct level of use of health services is, and nor do we necessarily know what the correct level is.

A clearly unwarranted variation in the use of health services indicates that the service described is not equitably distributed in accordance with the responsibility to provide health services. The existence of unwarranted variation does not tell us whether a service is underused in one hospital referral area or overused in another.

Chapter 3

Orthopaedic healthcare atlas

3.1 The discipline of orthopaedics

The discipline of orthopaedics, also known as orthopaedic surgery, has developed from being concerned with correcting deformities using bandages, corsets and other devices to its current focus on treating both congenital and acquired injuries and diseases of the musculoskeletal system. The main focus is on surgical treatment, but conservative treatment methods are also used. In line with technical developments, orthopaedics has become a high-tech speciality in terms of both diagnostics and treatment. Orthopaedic surgeons can replace joints, treat compound fractures and use minimally invasive treatment methods. Orthopaedic surgery can reduce pain, help patients to function better at work and in leisure activities, and improve patients' quality of life.[3],[4]

Several national medical quality registers have been established for the discipline to ensure that orthopaedic treatment is as safe and effective as possible. These registers collect information about the content and outcomes of treatment provided at Norwegian treatment centres. They facilitate systematic quality assurance and efforts to improve treatment methods and patient services. The outcomes are published in annual reports by the registers, thus providing a knowledge base for choosing, e.g., between different types of joint prostheses. The Norwegian Arthroplasty Register was established by the Norwegian Orthopaedic Association in 1987. Since then, the Norwegian Cruciate Ligament Register, the Norwegian Hip Fracture Register and the Norwegian Paediatric Hip Register have been established. They are owned by the Norwegian Orthopaedic Association and administered by Helse Bergen health trust. The Norwegian Registry for Spine Surgery is administered by the University Hospital of Northern Norway.[5]

More than half of Norway's total burden of disease can be linked to non-fatal health loss (Years Lived with Disability, YLD). Musculoskeletal complaints, in particular lower back and neck pain, are among the diseases and injuries that often cause health loss in Norway – and this health loss increases with age. Fall-related injuries are also an important cause of health loss (Folkehelseinstituttet, 2015). In other words, living with musculoskeletal problems or fall-related injuries affect patients' state of health even though they are not fatal diseases.

The national prioritisation guide to treatment in the specialist health service lists a number of orthopaedic conditions.[6] An individual assessment in which a number of factors are taken into consid-

[3]http://legeforeningen.no/Fagmed/Norsk-ortopedisk-forening/om-foreningen/Utdanning/
[4]https://no.wikipedia.org/wiki/Ortopedi
[5]https://www.kvalitetsregistre.no/
[6]https://helsedirektoratet.no/retningslinjer/ortopedi

eration determines whether an orthopaedic surgeon deems a patient to be entitled to treatment by the specialist health service. Patients can receive conservative or surgical treatment for their problems. A patient's condition can change over time, and surgical treatment at a later time may be an option. The patient's suffering as a result of the condition (pain and impaired function) will be a factor in the assessment of the right to, and type of, healthcare provided by the specialist health service.

The four regional health authorities (RHAs) have a statutory responsibility to provide specialist health services to the population in their regions.[7] For patients who are entitled to healthcare, the help must be deemed to be beneficial and cost-efficient, and the condition must be deemed to be serious.

3.2 Data from the Norwegian Patient Registry

The information about activity in the specialist health service used in the Orthopaedic Healthcare Atlas is based on data from the Norwegian Patient Registry (NPR). The information includes data from both public and private service providers in the specialist health service. By public health services we mean health services provided by the health trusts or private institutions under public funding contracts not subject to competitive tendering.

By private service providers in the specialist health service we mean specialists in private practice under public funding contracts and private institutions under public funding contracts subject to competitive tendering and/or renegotiation. Both the public specialist health service and private service providers under public funding contracts are obliged to submit information about their treatment of patients to NPR. The healthcare atlas aims to provide an overview of the treatment provided by the public authorities through the funding scheme.

Patients in Norway also make use of health services that are fully privately funded or services performed abroad. Since such services are not reported to NPR, the healthcare atlas does not include information about the extent to which patients use them. These treatment activities could have a bearing on the variation in patients' overall use of orthopaedic services in the areas we have looked at, but we do not know how it would be affected. The updated healthcare atlas *Day Surgery in Norway 2013–2017*, points out that there was a strong increase in the number of people with private health insurance during the period 2003–2017, as well as in insurance payments to private individuals. The authors also note that it is a limiting factor that no comprehensive overview exists of the use of health services in Norway (Uleberg et al., 2018).

Medical coding in the specialist health service involves describing diseases or symptoms using codes developed and collected in diagnostic coding systems.[8] Coding based on ICD-10, which is an international classification of diseases, tells us why a patient was treated by the specialist health service. Correspondingly, codes from procedure coding systems are used to document the examinations and treatments a patient has undergone during a hospital stay – whether the patient was an inpatient, day patient or outpatient. In the Orthopaedic Healthcare Atlas for Norway, surgical procedure codes (NCSP) and tariff codes are used to describe which procedures are included in a sample. The tariff codes are used when specialists in private practice under public funding contracts report their activities.[9]

[7] The Act relating to Specialist Health Services etc. https://lovdata.no/dokument/NL/lov/1999-07-02-61

[8] www.finnkode.ehelse.no

[9] The Norwegian Medical Association's normal tariff for specialists in private practice under public funding contracts 2015-2016 http://normaltariffen.legeforeningen.no/pdf/Normaltariff_2015.pdf

Chapter 4

Method

4.1 Data sources

The Orthopaedic Healthcare Atlas is based on health data from NPR for the period 2012–2016. Helse Førde health trust has sole responsibility for the interpretation and presentation of the disclosed data. NPR has no responsibility for analyses or interpretations based on the disclosed data. Helse Førde health trust holds a licence from the Norwegian Data Protection Authority to process health data for the national healthcare atlas service from 2016. Since 20 July 2018, the basis for the processing of data has been the General Data Protection Regulation.

Age and gender adjustments and the calculation of rates are based on population data from Statistics Norway's tables 07459 and 10826.

Helfo has provided us with an overview of regular GPs and emergency primary healthcare services' treatment volumes for wrist and ankle fractures.[10] The information received from Helfo has not been linked with data from NPR, but was used as supplementary information about patient treatment in the municipal health service.

4.2 Sample

Helse Førde health trust has been granted access to data from NPR for the purpose of developing a healthcare atlas for important orthopaedic conditions. During the work on the Orthopaedic Healthcare Atlas, the data or selection from NPR's database was defined in such a way that all patients registered with one of the diagnosis, procedure or tariff codes listed in Appendix B.1 were included.

We used the available NPR data to obtain an overview for use in the process of determining which diagnoses and procedures to include in the healthcare atlas. We looked for the most commonly used diagnosis and procedure codes and focused on analysing conditions that many people receive treatment for. We also looked at procedures where the knowledge base concerning the effect of treatment is uncertain, based on responses[11] to the American *Choosing wisely* campaign.[12]

[10] The Norwegian Medical Association's normal tariff for regular GPs and emergency primary healthcare 2016–2017 http://normaltariffen.legeforeningen.no/pdf/Fastlegetariff_2016.pdf

[11] http://afpjournal.blogspot.com/2015/03/advise-patients-to-steer-clear-of-these.html

[12] http://www.choosingwisely.org/the-american-academy-of-orthopaedic-surgeons-aaos-releases-choosing-wisely-list/

In this healthcare atlas, we have looked at some of the activities in the discipline of orthopaedics. The day surgery atlas has served as a source of supplementary information about patients' use of orthopaedic health services that are usually performed as day surgery procedures (Uleberg et al., 2018).

Good and reliable information about activity in the specialist health service is contingent on the different diagnoses and procedures being correctly coded, and we have conducted a thorough investigation of which codes are used for the different conditions. In the data set, we identified which procedure codes were used for different conditions at treatment centres in Norway, and vice versa – which diagnosis codes were used in connection with different procedures. During our work, we have consulted orthopaedic surgeons, health trusts and analysis communities to verify and correct the code samples on which our analyses are based.

The codes that were finally used to identify each patient group and each surgical procedure are presented in the results section of the report and in the fact sheets (www.helseatlas.no). When a supplementary sub-category specifying the site is available for a diagnosis (ICD-10) or procedure code (NSCP), they are included in addition to the general codes presented for each sample.

4.3 Hospital referral areas

The healthcare atlas assesses variation in the use of health services between hospital referral areas. The analyses were based on which municipality or, for Oslo, which city district, the patients were resident in. The hospital referral areas used in the Orthopaedic Healthcare Atlas roughly correspond to the health trusts' catchment areas. Analysing the use of health services on the basis of hospital referral areas shows the population's use of health services regardless of where the treatment was provided, which can give the health authorities information about how the RHAs fulfil their responsibility to provide healthcare.

We used Samdata's hospital referral areas for the somatic sector of the specialist health service as our point of departure, but have made some adjustments (Helsedirektoratet, 2015). Residents of Oslo will usually belong to the hospital referral areas of Oslo University Hospital (OUS), Akershus University Hospital (Ahus), Lovisenberg Diaconal Hospital and Diakonhjemmet Hospital, depending on which city district they live in. In the Orthopaedic Healthcare Atlas, we have decided to include the city districts in Lovisenberg and Diakonhjemmet hospital referral areas in the OUS area. This was done because Lovisenberg has no orthopaedic emergency care or local hospital functions.

Information about the patient's municipality or city district of residence was missing for a small number of department stays in the data set received from NPR for the period 2012–2016. We distributed these patients as follows before continuing our analyses:

If we lacked information about the patient's municipality of residence (under 1 % of department stays) but a municipality was registered for other department stays, we assigned the patient to the municipality registered for the stay closest in time to the stay in question. If information about municipality of residence was missing for all the department stays, we assigned the information about the patient in question to the hospital referral area where he or she received treatment.

For some department stays, the patient's address was registered as 'abroad'. If a municipality was registered for other department stays, we assigned the patient to the municipality registered for the stay closest in time to the stay in question. If 'abroad' was registered as a patient's address for all his or her stays, the patient in question was excluded from our analyses.

Correspondingly, we identified department stays for patients resident in the City of Oslo for whom no city district had been registered (under 1% of department stays). If a city district was registered for other department stays, we assigned the patient to the district registered for the stay closest in time to the stay in question. If information about city district was missing for all the department stays, we assigned the information about the patient in question to OUS or Ahus hospital referral area, depending on the location of the institution where the patient had received treatment.

In the (very few) cases where we lacked information about both city district and treatment centre for patients from Oslo, the patients were randomly distributed with 17 % assigned to Ahus and 87 % to OUS hospital referral area. This proportion was chosen because approx. 17 % of the population of Oslo live in Ahus hospital referral area and 87 % in the OUS area.

Short versions of the names of the hospital referral areas are used in the report, in the fact sheets and in the atlas. Table 4.1 lists the hospital referral areas and the short names. Appendix C contains a complete overview of which municipalities and city districts belong to the different hospital referral areas as defined in the Orthopaedic Healthcare Atlas.

Table 4.1: Hospital referral areas with short names

Hospital referral area / catchment area for:	Short name, hospital referral area
Finnmark Hospital Trust	Finnmark
University Hospital of Northern Norway Trust	UNN
Nordland Hospital Trust	Nordlandsykehuset
Helgeland Hospital Trust	Helgelandsykehuset
Helse Nord-Trøndelag health trust	Nord-Trøndelag
St. Olavs Hospital Trust	St. Olavs
Helse Møre og Romsdal health trust	Møre og Romsdal
Helse Førde health trust	Førde
Helse Bergen health trust	Bergen
Helse Fonna health trust	Fonna
Helse Stavanger health trust	Stavanger
Østfold Hospital Trust	Østfold
Akershus University Hospital Trust	Ahus
Oslo University Hospital Trust	OUS
Innlandet Hospital Trust	Innlandet
Vestre Viken Hospital Trust	Vestre Viken
Vestfold Hospital Trust	Vestfold
Telemark Hospital Trust	Telemark
Sørlandet Hospital Trust	Sørlandet

4.4 Other definitions

In order to enable comparison of the use of health services between hospital referral areas, surgery rates, admission rates, lengths of stay and other rates and figures were calculated to provide support for the assessments. The terms are defined below.

Surgery rate

The surgery rate was defined as the number of operations per 100,000 population in a hospital referral area per year. The rate was calculated for all diagnoses for which surgery is an option. The number of operations was arrived at by means of procedure codes. The surgery rate for Norway as a whole – *the national rate* – is the number of operations per 100,000 population in Norway as a whole per year.

In order to show where the patients underwent surgery, we have divided the surgery rate into three categories for some diagnoses. *Public, own hospital referral area* is the category for operations performed at health trusts or hospitals under public funding contracts not subject to competitive tendering in the hospital referral area where the patient lived. *Public, other hospital referral area* is used for operations performed at health trusts or private hospitals under public funding contracts not subject to competitive tendering located outside the hospital referral area where the patient lived. *Private, publicly funded* covers operations performed at private institutions under contracts subject to competitive tendering and/or renegotiation or private practices under public funding contracts regardless of location.

For some conditions, we have also looked at the proportion of operations performed using different techniques.

Fracture rate and patient rate

The diagnosis a patient is given in the specialist health service is also referred to as the patient's condition. The rates for conditions have been calculated in two different ways.

For the conditions involving fractures, we have looked at the number of new *fractures* registered by the specialist health service. A patient may have suffered more than one fracture during the period from 2012 to 2016, in which case the patient will be counted more than once. The *fracture rate* is the number of fractures per 100,000 population per year.

For conditions other than fractures, we have looked at how many unique *patients* with the condition were in contact with the specialist health service during the period 2012–2016. In this group, each patient was only counted once during the period. The *patient rate* is the number of patients (first-time contact with the specialist health service during the period) who has the condition per 100,000 population per year.

The number of fractures and patients was determined on the basis of diagnosis codes. There is greater uncertainty about the rates for the conditions than the surgery rates. The reason for this is that there are more errors in the diagnosis codes reported to NPR than in the procedure codes.

Percentage operated on

The percentage of patients who were operated on was calculated in two different ways. For conditions involving fractures, we have calculated the proportion of the *fractures* fractures (registered by the specialist health service) that were operated on. For conditions other than fractures, we have calculated the proportion of *patients* (in contact with the specialist health service in connection with their condition) operated on. Since we divide by the number of fractures or number of patients with the condition, incorrect diagnosis codes will result in an incorrect percentage operated on. Incorrect procedure codes will also result in further errors. There is therefore greater uncertainty about the percentage operated on than about the surgery rates.

Admission rates

Our definition of *admission* is based on patients with one bed day or more.[13] Outpatient stays are not counted. The stay is counted as a day if the patient was admitted to a hospital past midnight. If a patient was admitted again more than 30 days after the end of his/her last admission, this was counted as a new admission for that patient.

[13] Based on the NPR variable Aktivitetskategori3 ('Activity category 3')

Length of stay

When calculating the length of hospital stays for patients who have undergone surgery for a hip fracture, we have added up the bed days from all a patient's department stays, from admission to discharge, which we define as an episode of care.[14] Patients with hip fractures can have stays in several departments. We have therefore added up bed days from department stays less than eight hours apart that we assume to be related to the first stay in order to arrive at the length of the episode of care for patients who were operated on for hip fractures (Hassani et al., 2015).

If the total length of an episode of care was 21 bed days or more, it was eliminated from the sample to allow us to calculate the length of normal stays for hip fracture patients (Seo, 2006). Since we have looked at normal stays, we have not included bed days from stays at private rehabilitation institutions.

For a more detailed description of the method used to calculate lengths of stay, see Appendix B.2.

Small numbers and protection of privacy

Due to privacy considerations we have not published figures and rates based on fewer than six patients. Rates calculated on the basis of a group of fewer than 40 patients are labelled as uncertain.

4.5 Gender and age adjustment

People's use of specialist health services varies with age and gender. Typically, use increases with increasing age, but for some conditions, younger age groups may use more services. The population composition is taken into consideration when rates are standardised. This enables the use of the population of one area to be compared with that of another area even when the population sizes and age and gender composition are different (Statistisk sentralbyrå, 1997). The program R was used for the analyses (R Core Team, 2018).

We divided the patients into five age groups for age adjustment purposes. The age groups are defined so that there are about the same number of operations or admissions in each age group. For this reason, different age groups were used for the different conditions.

Rates per 100,000 population

This healthcare atlas uses direct standardisation using the population of Norway on 1 January 2016 as the standard population (Rothman et al., 2008, s. 188-192). The gender-adjusted and age-adjusted rates for a hospital referral area thus show what the rate would have been if the gender and age distribution of the area's population were identical to that of Norway as a whole as of 1 January 2016 (Appendix B.3).

Percentage operated on

The percentage operated on was also gender-adjusted and age-adjusted using direct standardisation. In this case, the adjustment was based on the patient population with the same condition in Norway during the period 2012–2016. The adjusted percentage shows what the percentage operated on would have been in the hospital referral area if the gender and age distribution of the area's patient population were identical to the patient population of Norway as a whole.

[14] The term used in the Norwegian report is 'sykehusepisode'.

Length of stay
The average number of bed days was adjusted for gender, age and comorbidity (Quan et al., 2005). Analysis of covariance was used for this (Pourhoseingholi et al., 2012; Lenth, 2018; Lenth et al., 2016). The comorbidity index was divided into five groups before adjustment. The adjusted length of stay shows what a hospital referral area's average length of stay would have been if the area's patient population were identical to the patient population of Norway as a whole in terms of gender and age composition, and comorbidity.

4.6 Assessment of variation

We have used several different methods to assess whether there is unwarranted variation in the use of health services, and figures with confidence intervals have been emphasised (see sub-chapter 4.6.1). The different methods can tell us whether the variation is greater than can be expected based on chance and how great the variation is.

It is the systematic variation that is of interest when discussing variation in the use of health services. The presentations in this healthcare atlas emphasise that the variations we describe are not due to chance alone. The number of patients (n) on which the analyses are based is important when assessing variation. The smaller the figure n is, the greater the element of random variation will be. In this Orthopaedic Healthcare Atlas, we have added up data from several years to have sufficiently large numbers to form a sound basis for drawing conclusions about variation.

4.6.1 Confidence intervals

The Confidence Interval (CI) indicates how much random variation can be expected. We have calculated confidence intervals for the rate, as well as the percentage operated on and length of stay, for each hospital referral area. In the following, we discuss rates, but the same also applies to the percentage operated on and length of stay. The rates for hospital referral areas with a large population and a high number of patients will not be affected much by random variation, so the confidence interval of such rates will be quite narrow. The rates for areas with a smaller population and fewer patients will be more susceptible to chance, and will therefore have a wider confidence interval.

The confidence interval describes the uncertainty that stems from natural variation in the surrounding world, for example that it is determined by chance which individuals injure themselves and sustain fractures during the period in question. Confidence intervals do not take account of other sources of uncertainty, such as registration errors, differences in coding practices, missing data etc. (Washington State Department of Health, 2012).

Interpreting confidence intervals
In some figures, we have included the confidence interval for the rate for each hospital referral area. In such cases, the rate for Norway as a whole (the national rate) is indicated by a vertical line to make it easier to compare hospital referral areas and assess variation. This must not be interpreted to mean that the national rate is the correct level and that it is wrong to be significantly above or below it. The national rate is only used as an aid to assessing the magnitude of the variation and whether it is greater than we would expect based on chance.

If a hospital referral area's whole confidence interval is above the national rate, then the area's rate is significantly higher than the national rate. If the whole confidence interval is below the national rate, then the area's rate is significantly lower than the national rate. If the confidence interval overlaps with the national rate, we can conclude that the rate does not differ significantly from the national rate and that the variation indicated by these rates could be random.

Based on random variation, a 95 % confidence interval will be completely above or below the national rate in 5 % of cases, even if the underlying rate is in fact identical to the national rate. With 19 hospital referral areas, an average of one 95 % confidence interval will not overlap with the national rate even if the variation is entirely random. Since we have tested significance for 19 hospital referral areas at the same time, we have therefore used a 99.8 % confidence interval.

If at least one of the 99.8 % confidence intervals does not overlap with the national rate, we can say that the rate for that hospital referral area differs significantly from the national rate and that the variation between hospital referral areas is significantly greater than we would expect based on chance. The overall test is significant at below the 5 % level.

Calculating confidence intervals

In this healthcare atlas, we have used different methods to calculate confidence intervals for different situations. The program R has been used (R Core Team, 2018).

We would expect to see a Poisson distribution when counting events that are rare in the population and independent of each other. In these case, the gamma method proposed by Fay & Feuer (1997) was used to calculate the confidence intervals for directly standardised rates (Ng et al., 2008; Nelson, 2017).

In cases where events are less rare, but are still independent of each other, we will instead assume a binomial distribution. One such example is when we counted how many of all patients with the condition in question who were in contact with the specialist health service were operated on. The Wilson score method was used to calculate confidence intervals for the directly standardised percentages (Wilson, 1927; Newcombe, 1998; Brown et al., 2001; Dorai-Raj, 2014).

For the average length of stay, we calculated 95 % and 99.8 % confidence intervals around the adjusted value of the average number of bed days. These calculations were made using the 'emmeans' package in R (Lenth, 2018).

When events are not independent, for example in the case of several operations, fractures or admissions per patient, we will normally see greater random variation than when events are independent. In such cases, confidence intervals calculated using the above-mentioned methods will be too narrow. In the cases we have looked at, it was relatively rare for patients to have several operations, fractures or admissions during the period. It turned out that the error resulting from assuming that the events were independent did not have any significant impact on the results. We have therefore used the above-mentioned methods even when some of the events are not independent.

4.6.2 Ratios

By ratio is meant the relationship between the highest and lowest rates, i.e.

$$\text{Ratio} = \frac{\text{highest rate}}{\text{lowest rate}}$$

The ratio shows how many times higher the use is in the hospital referral area with the highest usage rate compared with the area with the lowest usage rate. Ratios have been calculated between the highest and lowest rates (FT), between the second highest and second lowest rates (FT_2) and between the third highest and third lowest rates (FT_3).

The ratio provides a picture of how much variation there is between hospital referral areas, with the emphasis on areas that stand out because of particularly high or low rates. At the same time, it is important to be aware that the ratio varies considerably depending on the size of the patient sample (Ibáñez et al., 2009; Diehr et al., 1990). If the patient sample is small (low n), chance alone can generate considerable variation and a high ratio. If the patient sample is big (high n), on the other hand, the element of random variation alone will result in a much lower ratio. The same ratio can therefore be interpreted in very different ways. If a ratio is considered high with a high n the same ratio can be considered low if n is low. The ratio must therefore be seen in relation to n.

4.6.3 Coefficient of variation

We have also measured variation between hospital referral areas by calculating the coefficient of variation (CV),

$$\mathrm{CV} = \frac{\text{standard deviation}}{\text{average}}$$

Unlike ratios, the CV takes account of the rates for all the hospital referral areas. CV says something about the size of the variation between hospital referral areas in relation to the average. Like the ratio, CV is influenced by the size of the patient sample.

4.6.4 Systematic component of variation

The systematic component of variation (SCV), developed by McPherson et al. (1982), was also calculated. Once the rates have been adjusted for age and gender, the rate for each hospital referral area can be multiplied by a factor. If this factor is the same for all areas, gender and age adjustment will be sufficient to explain variation between areas. If the factor varies between areas with a positive variance σ^2, however, there is an unexplained difference between the areas. SCV is an estimate of the variance σ^2. Like ratios and CV, SCV can vary depending on the size of the patient sample (Diehr & Grembowski, 1990).

4.6.5 Annual rates

The calculation of annual rates illustrates stability of use over time. If the usage rates are stable over several years, the variation is less likely to be random. This only applies if it is not largely the same patients who recur from year to year. In this Orthopaedic Healthcare Atlas, we have calculated both annual rates and an average rate for all years in the period 2012–2016.

4.6.6 Overall assessment of variation – a brief summary

Confidence interval

In figures that show confidence intervals, the outer pair of lines indicates the 99.8 % confidence interval, while the inner pair of lines indicates the 95 % confidence interval. In order to assess variation we have checked whether the 99.8 % confidence intervals overlaps with the national rate.

- If at least one confidence interval does not overlap with the national rate, the variation is significantly higher than can be explained by chance. This means that some of the variation observed is systematic.

- The more confidence intervals we have that do not overlap with the national rate, the greater we can assume the systematic variation to be.
- For confidence intervals that do not overlap with the national rate: The further removed from the national rate the confidence intervals are, the greater we can assume the systematic variation to be, since the proportion of the variation we find that can be explained by chance is smaller.

Ratios, CV, SCV and N

When interpreting ratios, CV and SCV, we have to take into account the number of operations or admissions (N) – or patients (n) – included in the sample. For conditions with roughly the same number of patients, it is to a certain extent possible to compare the ratio, CV and SCV to assess the magnitude of the systematic variation.

- When N is low, a high ratio, CV and SCV can largely be due to chance, and systematic variation may be quite low.
- When N is a medium high figure, a high ratio, CV and SCV can to a certain extent be due to chance, and systematic variation may be moderate.
- When N is high, a high ratio, CV and SCV means that the systematic variation is high.

Professional judgement

A clinical assessment of the observed variation and of the underlying morbidity also formed part of the assessment of variation. This clinical assessment was based on both the available literature and professional judgement. It is not possible to provide a complete picture of possible variation in morbidity for relevant conditions or of demographic factors that may have a bearing on the results.

This assessment is therefore intended to provide guidance and serve as a basis for further assessment of the need for measures to reduce variation.

Chapter 5

Results

5.1 Degenerative joint disease

By degenerative joint disease we mean osteoarthritis (‘wear-and-tear arthritis’) and other age-related changes, such as meniscus injuries, that cause pain and impaired joint function. Osteoarthritis of the hip is most common, and more than 50 % of people over the age of 65 have symptoms caused by osteoarthritis of the hip joint (NEL, 2016c). Correspondingly, more than 30 % of people over 65 years of age suffer from osteoarthritis of the knee, while 25 % of people over the age of 50 have symptoms caused by degenerative changes in the knee joint (Siemieniuk et al., 2017). Approx. 10 % of people over 30 years of age have osteoarthritis of the thumb, but not all show symptoms of the condition (Haara et al., 2004). The prevalence of degenerative joint disease is expected to increase in the years ahead because of the increase in life expectancy and obesity (NEL, 2016d).

Wear and tear of articular cartilages and meniscuses and other joint changes due to wear and tear, cause pain, stiffness and loss of function. The symptoms usually develop gradually over time, sometimes following an injury to the joint. The development of the condition may be uneven. An X-ray examination can be used to confirm the diagnosis.

Factors that predispose people to degenerative joint disease are high age, gender (more women), being overweight, previous joint injury or disease, strain resulting from work or sports, and genetic factors (Best Practice, 2017a; NEL, 2017a). It seems that genetic factors contribute more to the risk of osteoarthritis of the hip than of the knee (Leddregisteret, 2017).

The goal of treatment is to relieve pain, improve function, prevent further development of the disease and improve quality of life (Best Practice, 2017a; Deveza & Bennell, 2018). The primary treatment options are conservative treatment and, if relevant, analgesics. The national programme Active Living with OsteoArthritis (ActiveOA)[15] offers evidence-based conservative treatment to patients with mild to moderate osteoarthritis of the hip or knee (see Chapter 6.3.1). Surgery may be an option for patients who experience significant pain, reduced mobility, sleep problems, significantly limited ability to perform activities of daily living or are at risk of becoming incapacitated for work.

Patients with degenerative joint disease make up the biggest group of patients in our data. The analyses are based on diagnosis codes and procedure codes. In our experience, procedure codes are more reliable, so they are emphasised most in the assessment of our findings.

[15] http://aktivmedartrose.no/

5.1.1 Osteoarthritis of the hip

Every year, about 7,000 patients with osteoarthritis of the hip undergo hip replacement surgery (prosthetic replacement) (Leddregisteret, 2017). Hip replacement is the standard treatment for people over the age of 50 years who suffer from debilitating osteoarthritis of the hip, while arthroscopy of the hip joint is very rarely performed. Ten years after surgery, 70 % of patients report that the outcome was good or excellent. The risk of reoperation due to problems with the prosthesis is approx. 1 % per year (NEL, 2016c). Patients are entitled to exercise free choice of treatment centre (formerly free hospital choice) when choosing where to be operated for osteoarthritis of the hip. In the analyses, this will be reflected as patients operated at private hospitals under contracts subject to competitive tendering and/or renegotiation, or at public or private hospitals in areas other than where the patient lives.

Sample

Osteoarthritis of the hip is defined by a primary or secondary diagnosis of ICD-10 code M16. Patients with osteoarthritis of the hip who also suffered a hip fracture (ICD-10 codes S72.0, S72.1, S72.2) during the referral period have been excluded.

Surgical treatment is defined by diagnosed osteoarthritis of the hip in combination with one or more of the NCSP procedure codes[16] for primary partial prosthetic replacement (NFB01, NFB02, NFB03, NFB11, NFB12, NFB13), primary total prosthetic replacement (NFB20, NFB30, NFB40), other primary prosthetic replacement (NFB99) or arthroscopic operations on the hip joint (NFF11, NFF31, NFF91). The biggest group, total prosthetic replacement, is broken down by three different fixation methods, namely: not using cement (NFB20), using hybrid technique (NFB30) or using cement (NFB40).

In our analyses, we count patients with osteoarthritis of the hip, meaning that only one registered case of osteoarthritis of the hip is counted per patient. Up to two primary (first-time) total prosthetic replacements per patient are counted. In order to arrive at as correct a number of operations as possible, it is a requirement that operations must be at least one day apart to count as separate procedures.

Patients aged 18 years and older are included in the sample, except in the figures that show the gender and age distribution of patients with osteoarthritis of the hip (Figure 5.1) and the gender and age distribution of patients who have been operated for osteoarthritis of the hip (Figure 5.2).

The surgery and patient rates have been adjusted for gender and age.

Findings

During the period 2012–2016, an average of 7,460 operations to treat osteoarthritis of the hip in persons aged 18 years and older were registered per year (Table 5.1). Most of them were total prosthetic replacements. Partial prosthetic replacement was registered for 0.5 % and arthroscopy in less than 0.5 % of these operations. Most of the patients operated on were between 60 and 80 years of age, and the majority were women (Figure 5.2).

The average number of operations per 100,000 population was highest in Nord-Trøndelag at 228, and lowest in Finnmark at 158 operations per year (Table 5.1 and Figure 5.3). The surgery rate for Norway as a whole was 191. The variation in surgery rates between hospital referral areas exceeded what can be explained by chance.

[16]For codes for the period 2012–2016, see: https://ehelse.no/Documents/Helsefaglig 20kodeverk/NCMP-NCSP 20- 20NCRP 202016.pdf

The greatest changes in surgery rates per year were found in the hospital referral areas of Førde and UNN, but, for the country as a whole, the rate remained relatively stable during the period (Figure 5.4).

The vast majority of patients were operated on for osteoarthritis of the hip in the public sector (Figure 5.5). However, there were differences between hospital referral areas in how many were operated at public hospitals in their own hospital referral area or at public hospitals in another hospital referral area than where the patient lived. Patients resident in the Ahus area were most often (in nearly 70 % of cases) operated in another hospital referral area. A high percentage of patients resident in the hospital referral areas of Østfold and Telemark (more than 40 %) were also operated in another area. In Bergen hospital referral area, the majority of patients (97 %) had their operations in their own area.

The use of different surgical techniques for total prosthetic replacements (cemented, partially cemented or uncemented) varied between patients from different hospital referral areas (Figure 5.6). For Norway as a whole, the three techniques were more or less equally common. Uncemented total prosthetic replacement was the most common method in the hospital referral areas of Østfold, Førde and Finnmark, among others, the hybrid (partially cemented) technique is most common e.g. in the Sørlandet, Stavanger and Innlandet areas, while cemented total prosthetic replacement is the most used technique in the Helgeland Hospital, Fonna and Bergen areas, among others. The hybrid hip replacement technique was the most common procedure throughout the period, and, as for cemented total prosthetic replacement, the number of operations remained relatively stable. The number of uncemented total prosthetic replacements increased from 2012 to 2016 until it was almost as widely used as the hybrid technique (Figure 5.7).

More women than men diagnosed with osteoarthritis of the hip were in contact with the specialist health service during the period, and the difference is particularly pronounced in the age group 60 years and older (Figure 5.1). For the country as a whole, an average of 344 patients per 100,000 population per year were in contact with the specialist health service (Figure 5.8 and Table 5.1). Half of these patients had surgery (Figure 5.9).

Comments

The surgery rate for osteoarthritis of the hip does not vary much between hospital referral areas (see Chapter 5.5). The variation nevertheless exceeded what can be explained by chance alone, and we deem the variation in surgery rates to be unwarranted. The basis for this assessment is that there is no known corresponding geographical variation in the prevalence of osteoarthritis of the hip in Norway.

However, there were relatively pronounced differences between hospital referral areas in the choice of total prosthetic replacement methods. For Norway as a whole, the hybrid technique was most common throughout the period 2012–2016, although there was a clear increase in uncemented total prosthetic replacements, and by 2016 this technique had almost caught up with the hybrid technique. There is a possibility that this change reflects a period of transition in recent decades where better implants have led to an increase in the use of uncemented cups (Personal communication with the Norwegian Arthroplasty Register, April 2018).

The number of patients diagnosed with osteoarthritis of the hip who were in contact with the specialist health service and the percentage of such patients who were operated on also varied during the period. This could be an indication of differences in referral practices and capacity, and it may account for part of the variation we found in the use of surgical treatment of osteoarthritis of the hip.

There are no national guidelines for the treatment of osteoarthritis of the hip, but the Norwegian Arthroplasty Register[17] registers several different outcome measures for surgical treatment.

[17] https://www.kvalitetsregistre.no/registers/nasjonalt-register-leddproteser

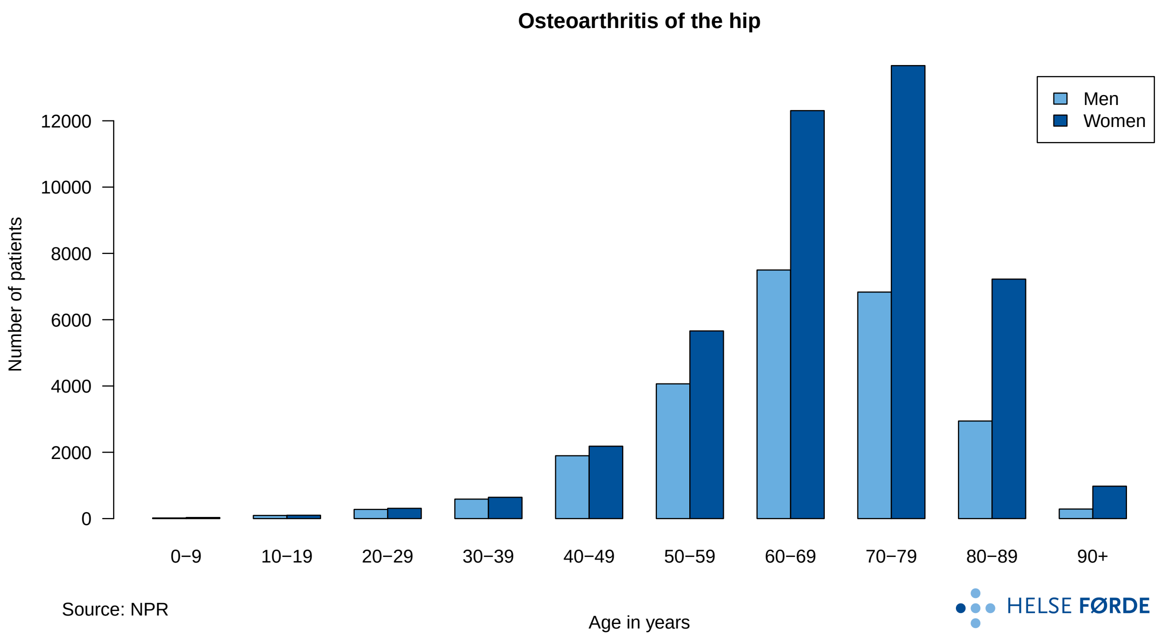


Figure 5.1: Total number of patients with osteoarthritis of the hip who were in contact with the specialist health service during the period 2012–2016, for Norway as a whole. The patients have been broken down by gender and age group.

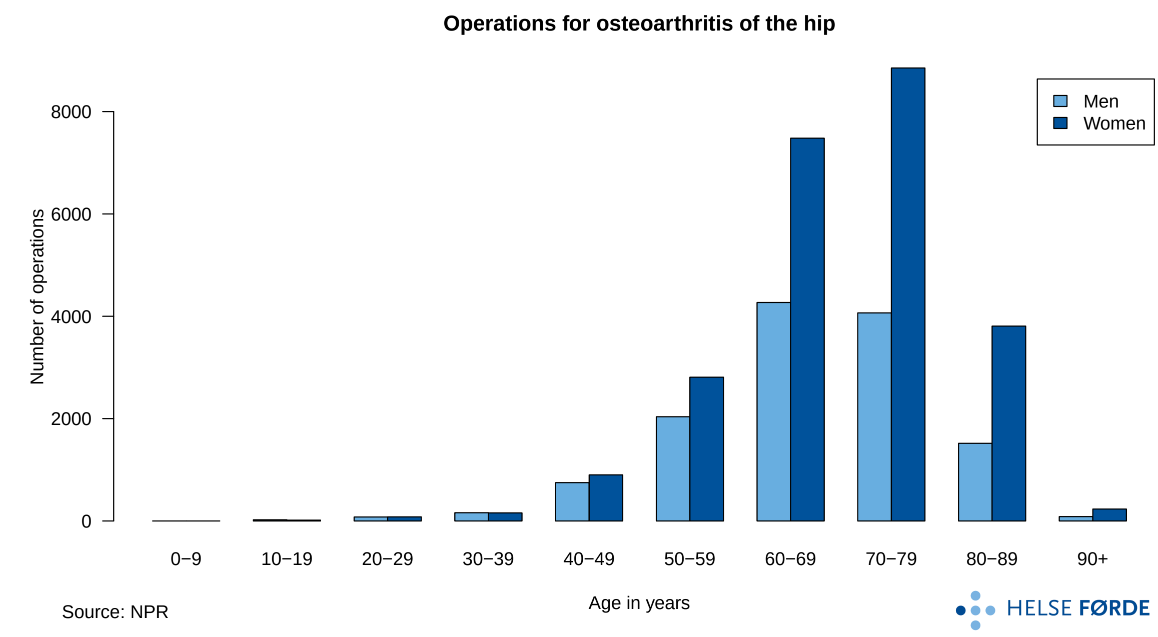


Figure 5.2: Total number of operations for osteoarthritis of the hip during the period 2012–2016, for Norway as a whole. The patients have been broken down by gender and age group.

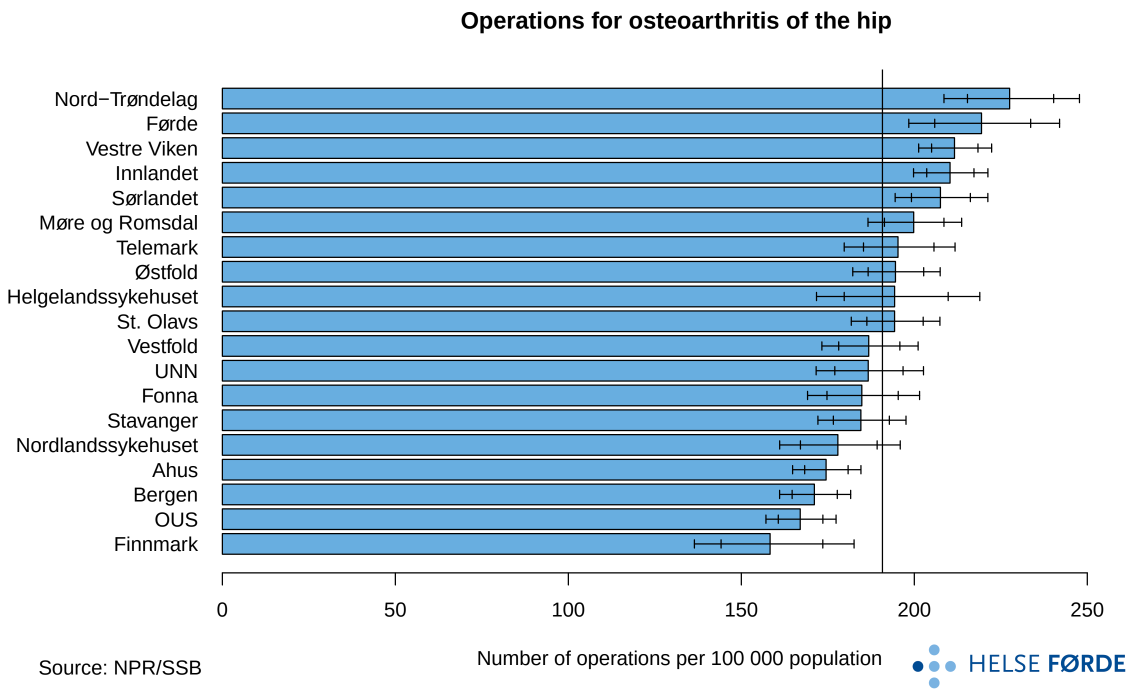


Figure 5.3: Surgery rate: Number of operations for osteoarthritis of the hip per 100,000 population (18 years and older), broken down by hospital referral area. The bars show the average value per year for the period 2012–2016, with pertaining 95 % and 99.8 % confidence intervals. The vertical line indicates the average for Norway as a whole. The rates have been adjusted for gender and age.

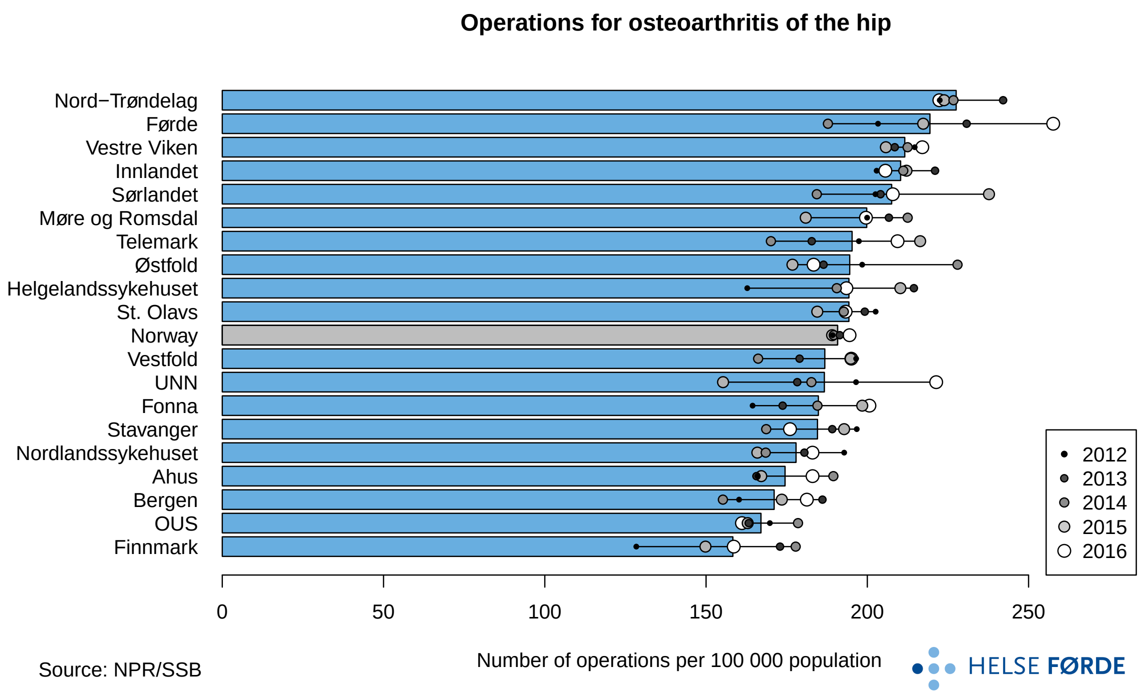


Figure 5.4: Surgery rate: Number of operations for osteoarthritis of the hip per 100,000 population (18 years and older), broken down by hospital referral area and for Norway as a whole. The bars show the average value per year during the period 2012–2016, and the dots represent the rates for each year. The rates have been adjusted for gender and age.

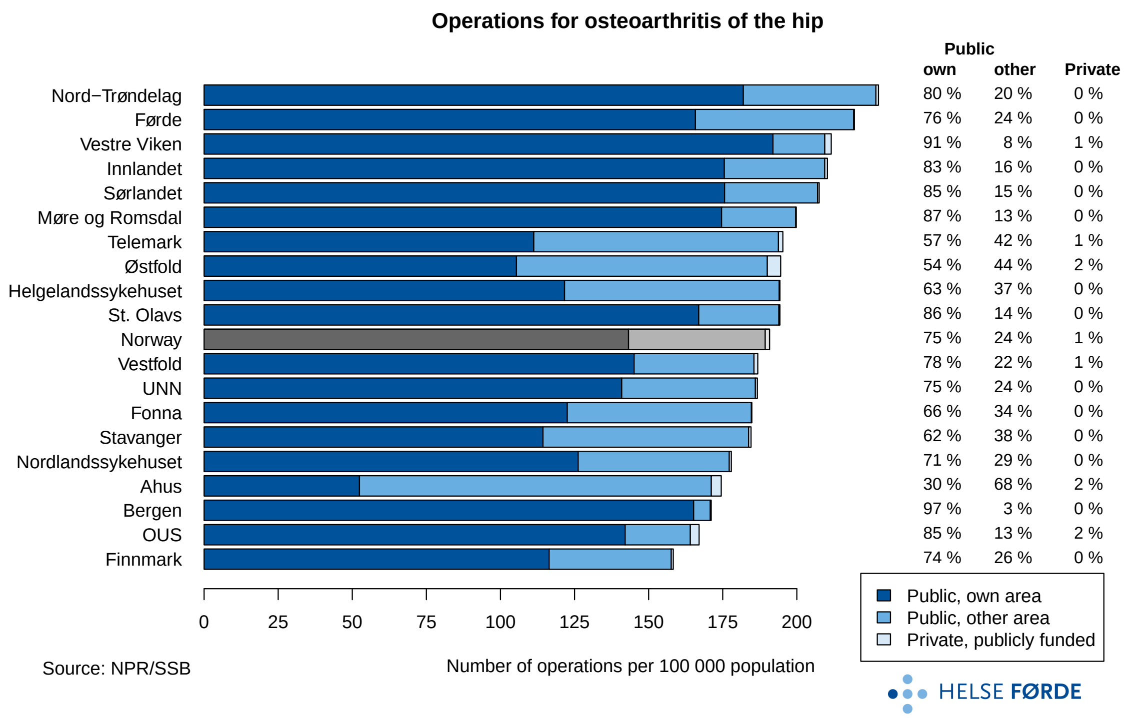


Figure 5.5: Surgery rate: Number of operations for osteoarthritis of the hip per 100,000 population (18 years and older), broken down by hospital referral area. Rates have been adjusted for gender and age. Bars show average value per year for the period 2012–2016, with the percentage distribution broken down by where the patients had surgery.

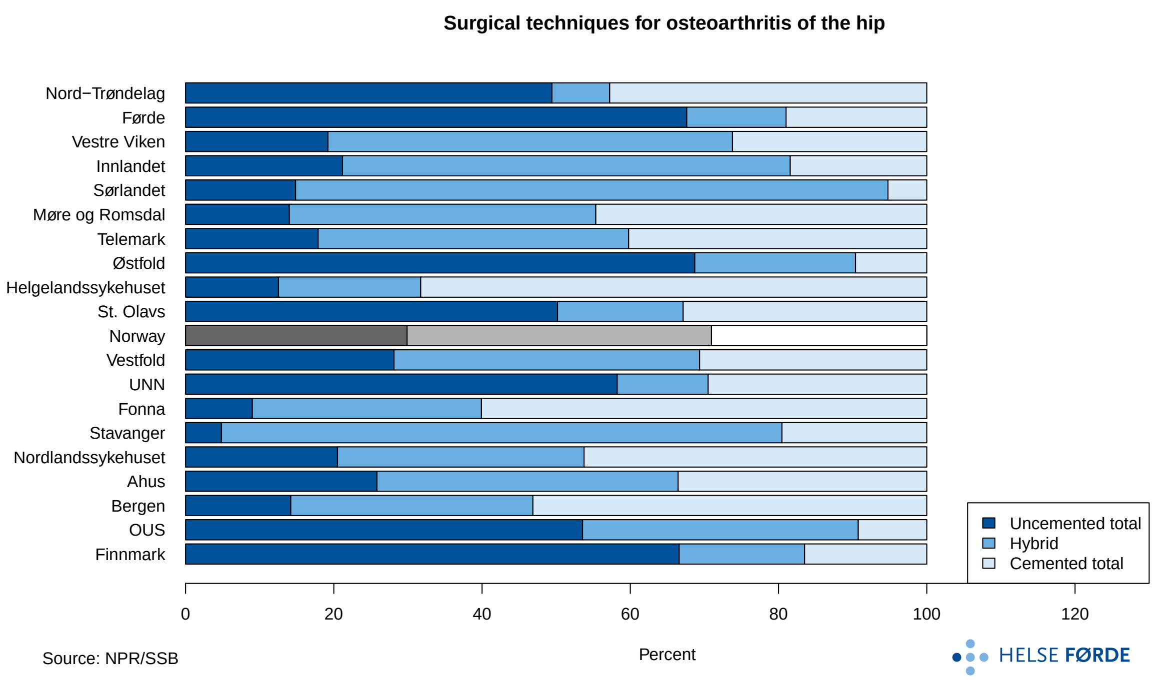


Figure 5.6: Surgical techniques for treating osteoarthritis of the hip, broken down by the most commonly used methods: primary total prosthetic replacement without cement, primary total prosthetic replacement using hybrid technique, and primary total prosthetic replacement using cement. Percentage distribution of surgical techniques, broken down by hospital referral area and for Norway as a whole, for the period 2012–2016 for patients aged 18 years and older.

Table 5.1: Osteoarthritis of the hip. Patient rate (number of patients per 100,000 population), number of patients, surgery rate (number of operations per 100,000 population), number of operations and the population broken down by hospital referral area and for Norway as a whole. The figures represent average values per year during the period 2012–2016 and apply to the population aged 18 years and older. The rates have been adjusted for gender and age.

Hospital referral area	Patient rate	Number of patients	Surgery rate	Number of operations	Population
Ahus	312.0	1,084	174.5	604	370,737
Helgelandssykehuset	356.0	239	194.3	133	61,456
Bergen	376.4	1,195	171.1	537	335,924
Finnmark	352.7	204	158.3	92	58,702
Fonna	340.5	468	184.8	253	135,469
Førde	437.6	394	219.4	199	84,077
Nord-Trøndelag	406.0	466	227.6	262	106,072
Møre og Romsdal	406.2	858	199.8	423	201,630
Stavanger	267.5	603	184.6	411	265,081
Innlandet	361.1	1,271	210.3	745	315,870
Nordlandssykehuset	360.3	409	177.9	202	106,963
Østfold	327.8	768	194.6	458	222,700
Sørlandet	363.0	811	207.6	463	224,372
St. Olavs	359.7	825	194.3	444	240,031
Telemark	357.6	527	195.3	289	135,860
UNN	357.8	537	186.7	280	147,894
Vestfold	304.2	567	186.8	349	176,835
Vestre Viken	346.7	1,272	211.6	775	363,780
OUS	296.6	986	167.0	542	427,887
Norway	343.5	13,485	190.8	7,460	3,981,340

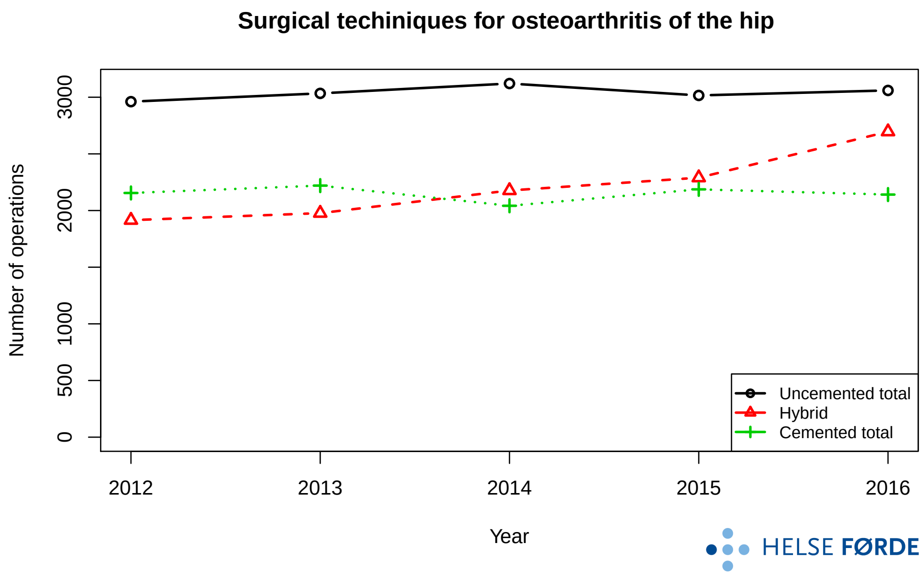


Figure 5.7: Surgical techniques for treating osteoarthritis of the hip, development over time. Total number of operations in Norway during the years 2012–2016, patients aged 18 years and older, broken down by method: primary total prosthetic replacement without cement, primary total prosthetic replacement using hybrid technique, and primary total prosthetic replacement using cement.

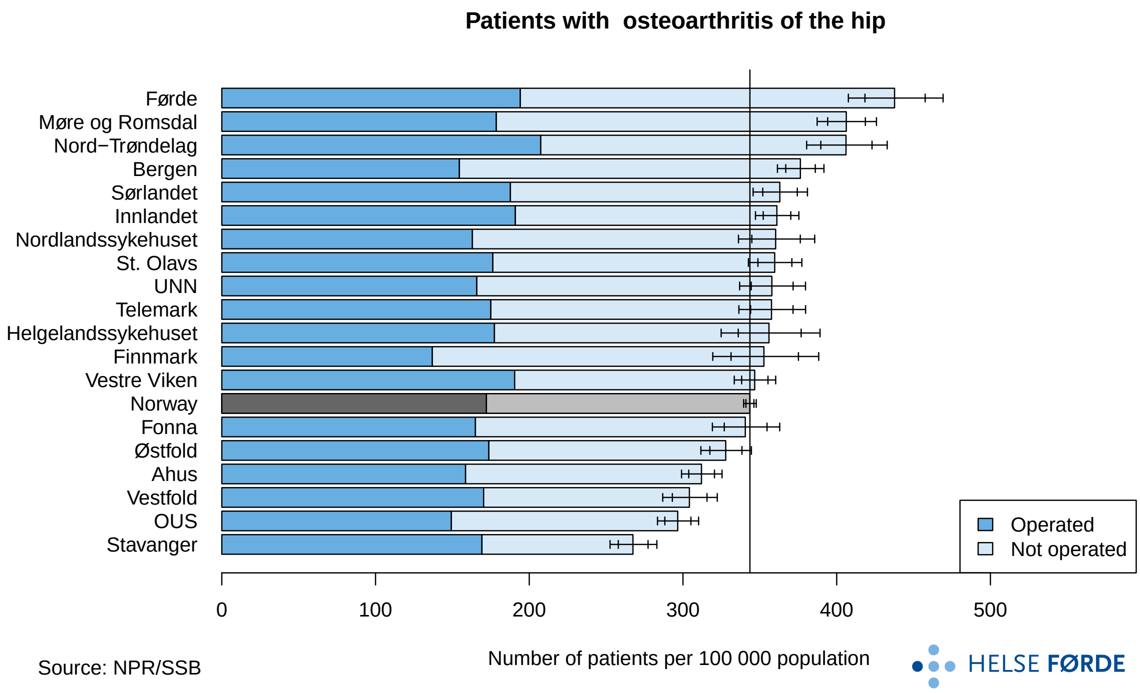


Figure 5.8: Patient rate: number of patients with osteoarthritis of the hip in contact with the specialist health service, per 100,000 population (18 years and older). The vertical line indicates the average patient rate for Norway as a whole, and bars represent an average patient rate for hospital referral areas in the period 2012–2016, with 95 % and 99.8 % confidence intervals. Rates have been adjusted for gender and age.

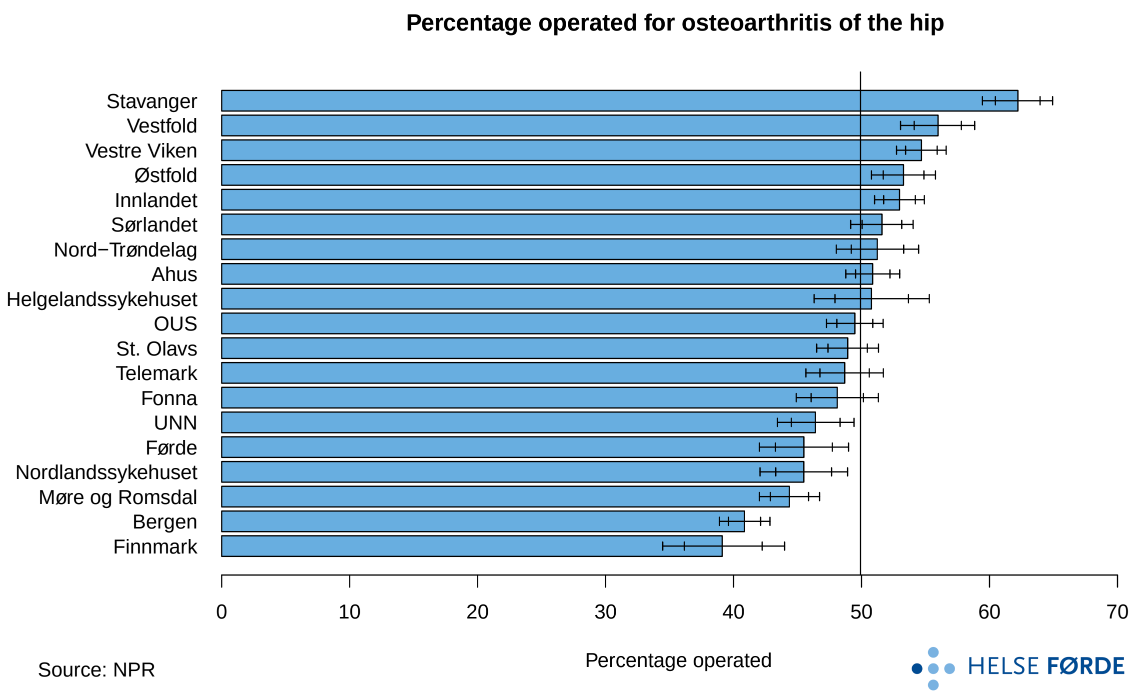


Figure 5.9: Percentage of patients with osteoarthritis of the hip operated on during the period 2012–2016. The bars show, with 95 % and 99.8 % confidence intervals, how many per cent of patients with osteoarthritis of the hip were operated on per hospital referral area. The vertical line indicates the percentage operated on for Norway as a whole. The percentages have been adjusted for gender and age and concern patients aged 18 years and older.

5.1.2 Osteoarthritis of the knee

Every year, about 5,000 patients with arthrosis of the knee undergo knee replacement surgery (prosthetic replacement) (Leddregisteret, 2017). Norway has fewer knee replacements per capita than the other Nordic countries, but the number of operations is increasing in all the Nordic countries (Niemeläinen et al., 2017). Prosthetic replacement is an option that can provide good pain relief and improve the patient's functioning and quality of life in the later stage of the disease (Martin & Crowley, 2017).

Total prosthetic replacement is the most common operation, but partial prosthetic replacement and correction of joint misalignment by means of osteotomy (cutting the bone) are also used. Arthroscopy (keyhole surgery) has been a popular treatment for early-stage osteoarthritis of the knee, but repeated studies have shown little or no effect compared to conservative treatment. Arthroscopy is no longer a recommended treatment for osteoarthritis of the knee (Best Practice, 2017a; Siemieniuk et al., 2017). Arthroscopy as a treatment for degenerative knee disease is discussed in Chapter 5.1.3.

Sample

Osteoarthritis of the knee is defined by a primary or secondary diagnosis of ICD-10 code M17.

Surgical treatment is defined by diagnosed osteoarthritis of the knee in combination with one or more of the NCSP procedure codes for primary partial prosthetic replacement (NGB01, NGB02, NGB03, NGB04, NGB11, NGB12, NGB13, NGB14), primary total prosthetic replacement (NGB20, NGB30, NGB40), other primary prosthetic replacement (NGB99) or osteotomy (NGK59, NGK69).

In our analyses, we count patients with osteoarthritis of the knee, which means that only one registered case of osteoarthritis of the knee is counted per patient. Up to two primary total prosthetic replacements per patient are counted. In order to arrive at as correct a number of operations as possible, it is a requirement that operations must be at least one day apart to count as separate procedures.

Patients aged 18 years or older are included in the sample, except in the figures that show the gender and age distribution of patients with osteoarthritis of the knee (Figure 5.10) and the gender and age distribution of patients who have been operated for osteoarthritis of the knee (Figure 5.11).

The surgery and patient rates have been adjusted for gender and age.

Findings

During the period 2012–2016, an average of 5,708 operations to treat osteoarthritis of the knee in persons aged 18 years and older were registered per year (Table 5.2). Most of these operations (more than 80 %) were total prosthetic replacements (Figure 5.15). Most of the patients were between 60 and 80 years of age, and more than half were women (Figure 5.11).

Førde hospital referral area had by far the highest number of operations per 100,000 population, with an average of 224 operations per year, while the OUS area had the lowest number at 120 operations per 100,000 population per year (Table 5.2 and Figure 5.12). The surgery rate for Norway as a whole was 146 per 100,000 population. The variation in surgery rates between hospital referral areas exceeded what can be explained by chance.

The surgery rates per year increased slightly during the period, both for several hospital referral areas and for the country as a whole (Figure 5.13). Few patients with osteoarthritis of the knee were operated at private hospitals under contracts subject to competitive tendering and/or renegotiation, but a significant proportion of patients resident in the hospital referral areas of Ahus, Østfold, Fonna, Helgeland Hospital and Finnmark, among others, were operated at hospitals in other areas (Figure 5.14).

Total prosthetic replacement was a far more common technique than partial prosthetic replacement and osteotomy (Figure 5.15). Approx. 10 % of operations for osteoarthritis of the knee were partial prosthetic replacement procedures, while approx. 5 % were osteotomies. Østfold and Vestfold hospital referral areas had the highest percentage of partial prosthetic replacements, while the St. Olavs area had the lowest percentage. We found the highest percentage of patients who underwent osteotomies in Førde hospital referral area, while the St. Olavs area again had the lowest percentage. For the country as a whole, we also found that the number of total prosthetic replacements increased during the period 2012–2016 (Figure 5.16). A quarter of patients with osteoarthritis of the knee who were not treated by prosthetic replacement or osteotomy underwent knee arthroscopy. The use of arthroscopy varied between hospital referral areas, as shown in Chapter 5.1.3.

Slightly more women than men diagnosed with osteoarthritis of the knee were in contact with the specialist health service during the period (Figure 5.10). For the country as a whole, an average of 504 patients per 100,000 population per year were in contact with the specialist health service (Figure 5.17 and Table 5.2). A quarter of these patients had surgery (Figure 5.18).

Comments

The variation between the different hospital referral areas' surgery rates for osteoarthritis of the knee was moderate (see Chapter 5.5). The Førde area in particular, but also Nord-Trøndelag and Sørlandet, stood out with high surgery rates. There was relatively little variation between the other hospital referral areas. We have deemed the variation in surgery rates to be unwarranted because there is no known corresponding geographical variation in the prevalence of osteoarthritis of the knee in Norway.

The number of operations for osteoarthritis of the knee (prosthetic replacement and osteotomy) increased somewhat during the period. This is consistent with trends found in the other Nordic countries and with previous recommendations, including in the report *Indikatorer for måling av uberettiget variasjon* ('Indicators for measuring unwarranted variation' – In Norwegian only) (SKDE, 2016).

Generally speaking, the choice of surgical techniques did not vary much. The greatest differences were in the use of partial prosthetic replacement, and to a lesser extent osteotomy, as a treatment option. This could reflect a lack of consensus about outcomes of partial prosthetic replacement.

During the period, there was clear variation in the number of patients diagnosed with osteoarthritis of the knee who were in contact with the specialist health service, and to some extent also in the percentage of such patients who were operated on. This could be an indication of differences in referral practices and capacity, and it may account for part of the variation we found in the use of surgical treatment of osteoarthritis of the knee.

There are no national guidelines for the treatment of osteoarthritis of the knee, but the Norwegian Arthroplasty Register[18] registers the outcomes of surgical treatment.

[18] https://www.kvalitetsregistre.no/registers/nasjonalt-register-leddproteser

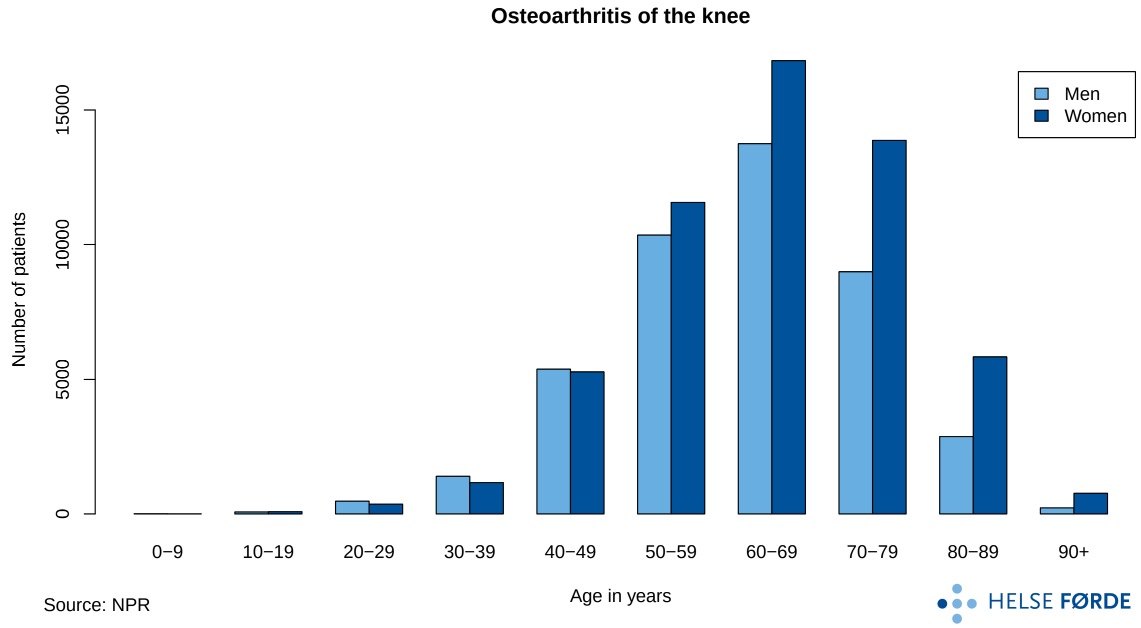


Figure 5.10: Total number of patients with osteoarthritis of the knee who were in contact with the specialist health service during the period 2012–2016, for Norway as a whole. The patients have been broken down by gender and age group.

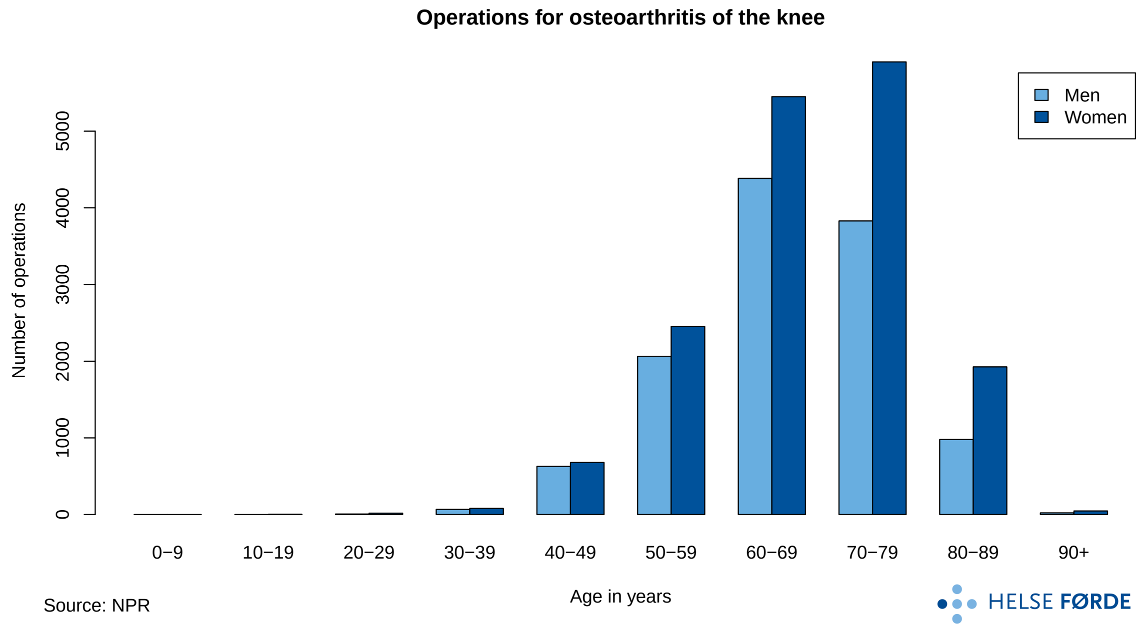


Figure 5.11: Total number of operations for osteoarthritis of the knee during the period 2012–2016, for Norway as a whole. The patients have been broken down by gender and age group.

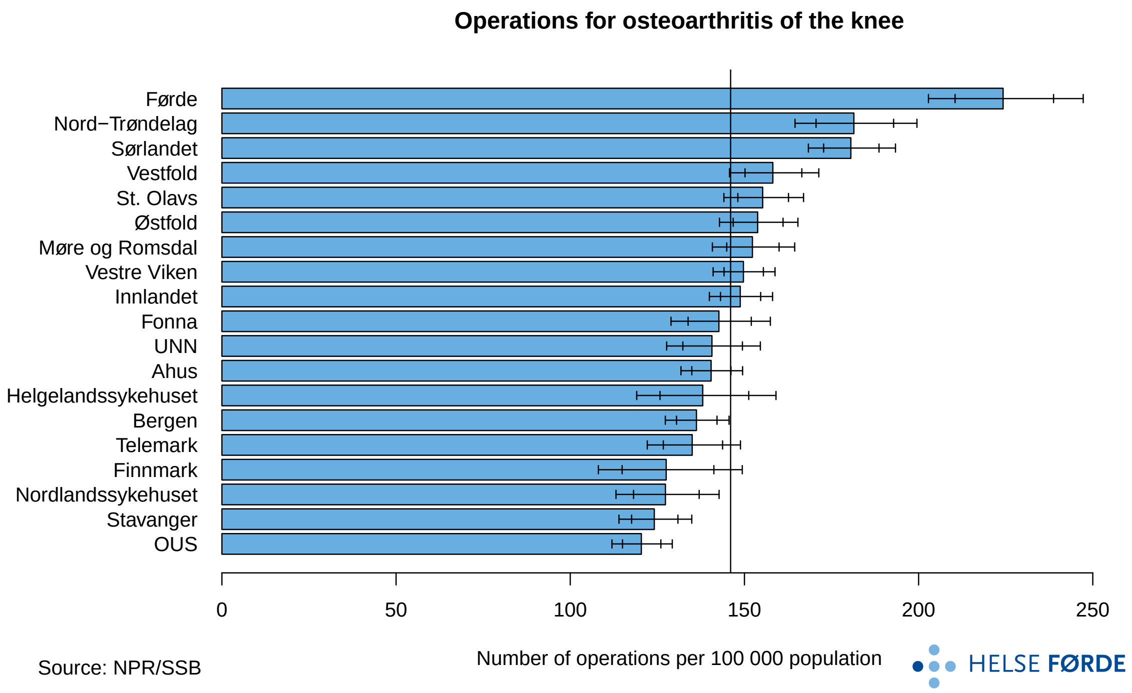


Figure 5.12: Surgery rate: Number of operations for osteoarthritis of the knee per 100,000 population (18 years and older), broken down by hospital referral area. The bars show the average value per year for the period 2012–2016, with pertaining 95 % and 99.8 % confidence intervals. The vertical line indicates the average for Norway as a whole. The rates have been adjusted for gender and age.

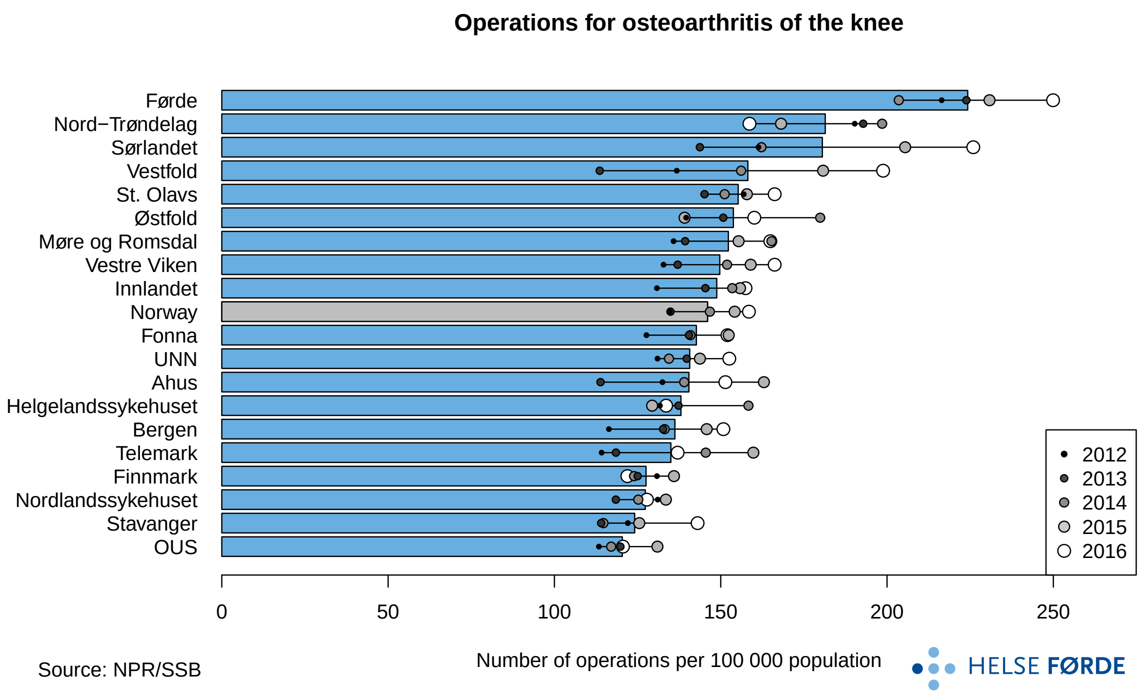


Figure 5.13: Surgery rate: Number of operations for osteoarthritis of the knee per 100,000 population (18 years and older), broken down by hospital referral area and for Norway as a whole. The bars show the average value per year during the period 2012–2016, and the dots represent the rates for each year. The rates have been adjusted for gender and age.

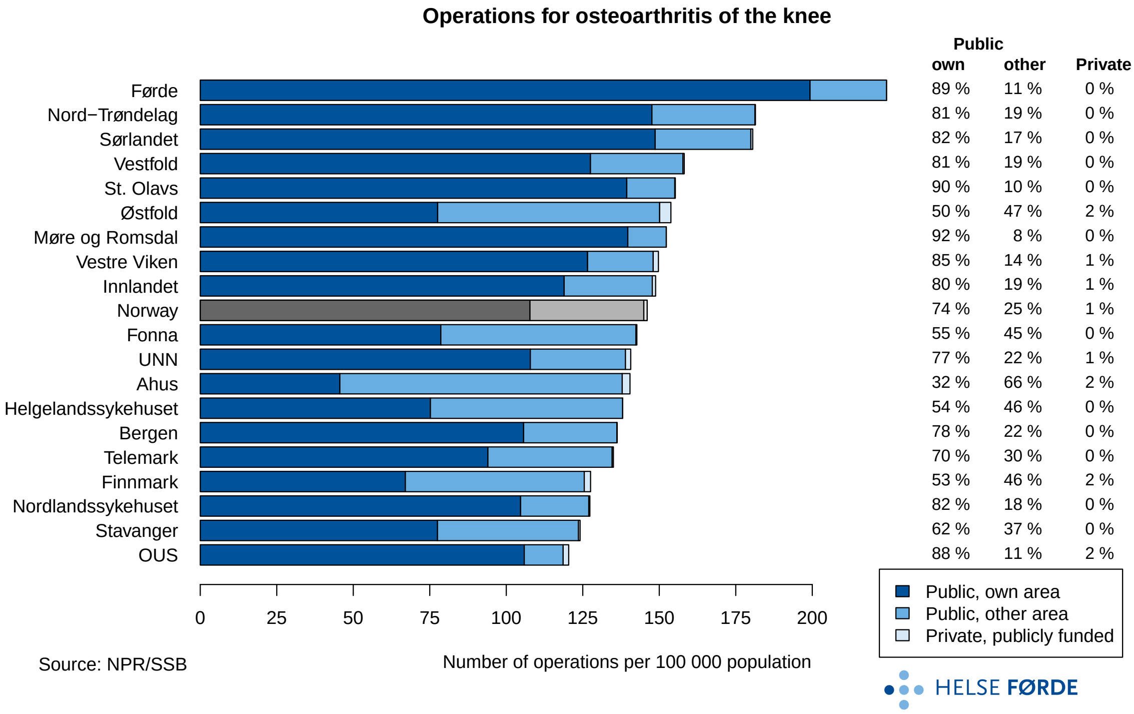


Figure 5.14: Surgery rate: Number of operations for osteoarthritis of the knee per 100,000 population (18 years and older), broken down by hospital referral area. The rates have been adjusted for gender and age. The bars show the average value per year for the period 2012–2016, with the percentage distribution broken down by where the patients had surgery.

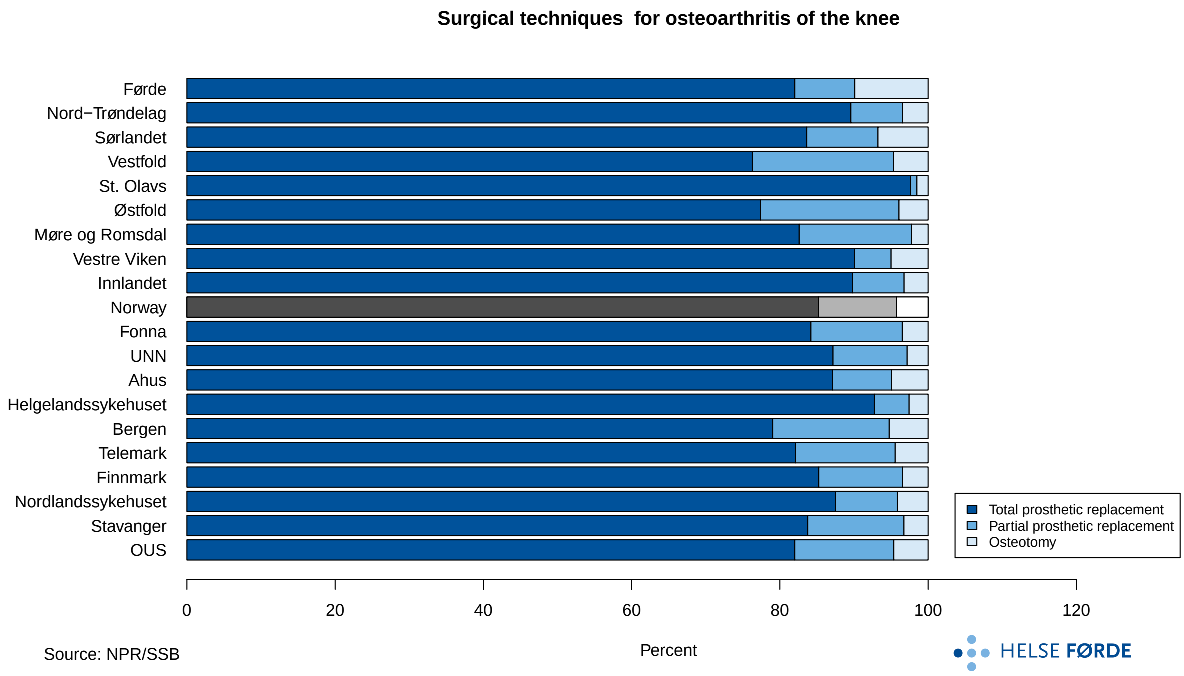


Figure 5.15: Surgical techniques for treating osteoarthritis of the knee, broken down by primary total prosthetic replacement, primary partial prosthetic replacement and osteotomy. The figure shows the percentage distribution of the different surgical techniques, broken down by hospital referral area and for Norway as a whole, for the period 2012–2016 for patients aged 18 years and older.

Table 5.2: Osteoarthritis of the knee. Patient rate (number of patients per 100,000 population), number of patients, surgery rate (number of operations per 100,000 population), number of operations and the population broken down by hospital referral area and for Norway as a whole. The figures represent average values per year during the period 2012–2016 and apply to the population aged 18 years and older. The rates have been adjusted for gender and age.

Hospital referral area	Patient rate	Number of patients	Surgery rate	Number of operations	Population
Ahus	455.4	1,614	140.4	488	370,737
Helgelandssykehuset	573.0	371	138.0	94	61,456
Bergen	559.7	1,806	136.2	429	335,924
Finnmark	587.0	345	127.5	75	58,702
Fonna	505.7	691	142.7	194	135,469
Førde	698.7	612	224.3	199	84,077
Nord-Trøndelag	605.4	680	181.4	209	106,072
Møre og Romsdal	584.9	1,220	152.3	322	201,630
Stavanger	340.3	802	124.1	276	265,081
Innlandet	501.9	1,719	148.8	524	315,870
Nordlandssykehuset	497.9	555	127.3	144	106,963
Østfold	484.7	1,123	153.8	360	222,700
Sørlandet	511.2	1,143	180.6	402	224,372
St. Olavs	603.0	1,404	155.2	356	240,031
Telemark	568.8	815	135.0	198	135,860
UNN	540.3	810	140.7	212	147,894
Vestfold	440.3	811	158.2	294	176,835
Vestre Viken	512.1	1,873	149.7	547	363,780
OUS	422.3	1,444	120.4	385	427,887
Norway	503.8	19,839	146.0	5,708	3,981,340

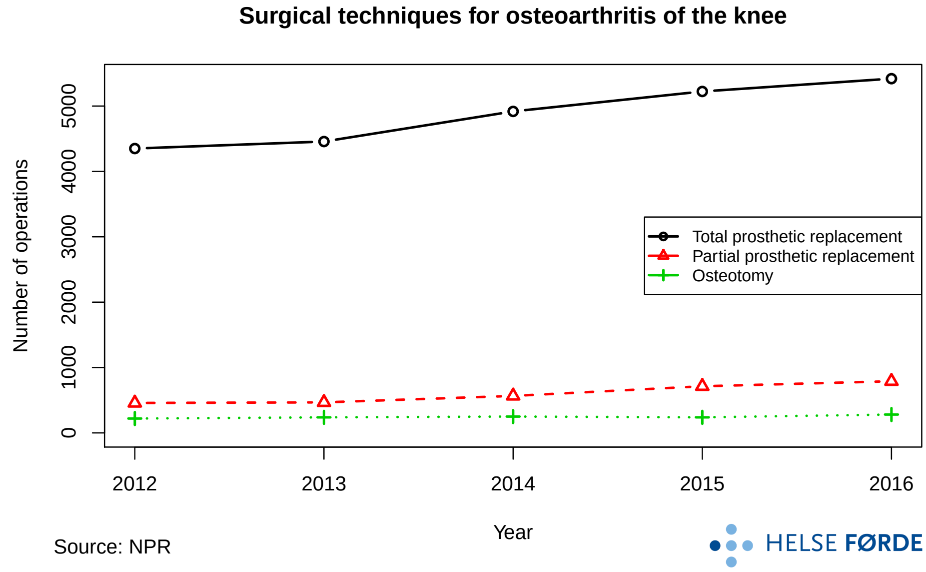


Figure 5.16: Surgical techniques for treating osteoarthritis of the knee, development over time. Total number of operations for osteoarthritis of the knee in Norway during the period 2012–2016, patients aged 18 years and older, broken down by primary total prosthetic replacement, primary partial prosthetic replacement and osteotomy.

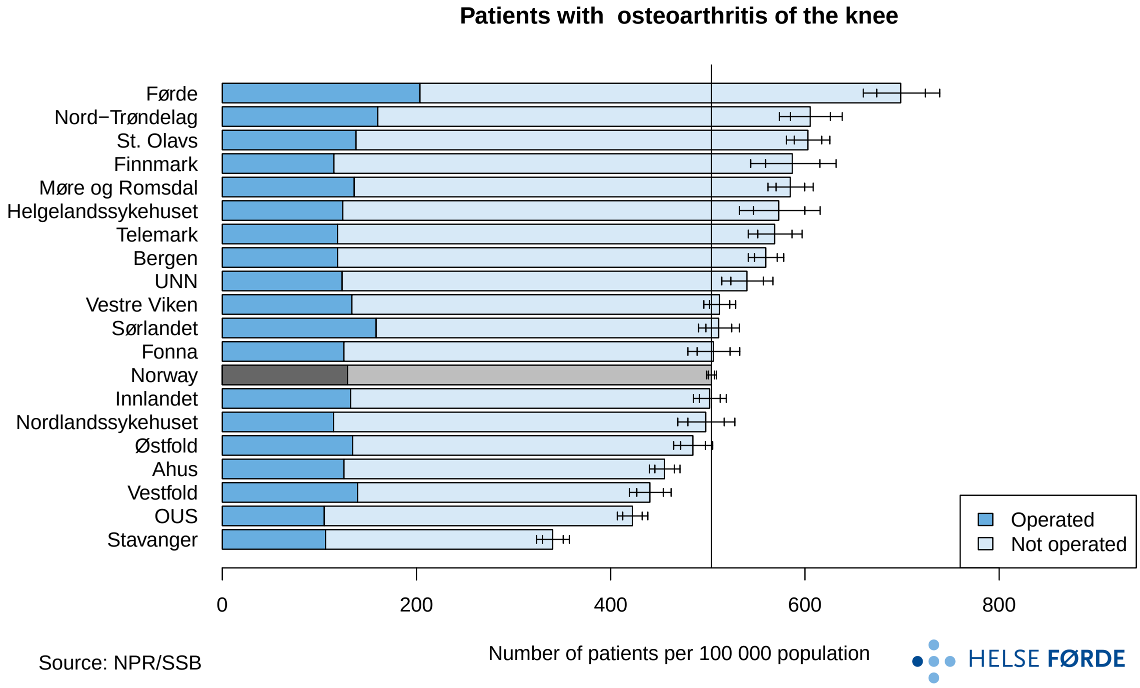


Figure 5.17: Patient rate: number of patients with osteoarthritis of the knee who were in contact with the specialist health service, per 100,000 population (18 years and older), broken down by hospital referral area and for Norway as a whole. The whole bars represent an average patient rate for the period 2012–2016, with 95 % and 99.8 % confidence intervals. The rates have been adjusted for gender and age.

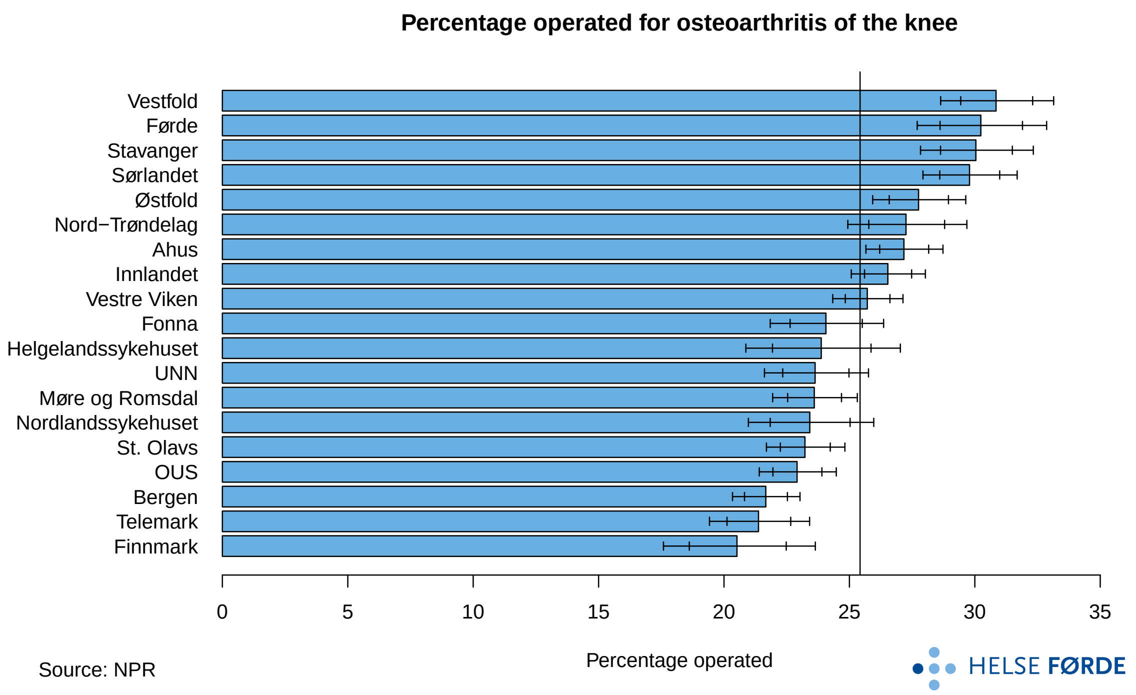


Figure 5.18: Percentage of patients with osteoarthritis of the knee operated on during the period 2012–2016. The bars show, with 95 % and 99.8 % confidence intervals, how many per cent of patients with osteoarthritis of the hip were operated on per hospital referral area. The vertical line indicates the percentage operated on for Norway as a whole. The percentages have been adjusted for gender and age and concern patients aged 18 years and older.

5.1.3 Arthroscopic surgery for degenerative knee disease

Arthroscopy of the knee joint is the most common orthopaedic operation both in Norway and internationally (Siemieniuk et al., 2017). In 2016, the number of knee arthroscopies had dropped below 10,000, a marked decrease from the more than 13,000 arthroscopies performed in 2012 (Holtedahl et al., 2018). Half of the patients are 50 years or older, and most of them suffer from degenerative knee disease, i.e. age-related changes in the knee joint, such as wear and tear on cartilage surfaces (osteoarthritis) or meniscal tears (Siemieniuk et al., 2017).

Several studies have shown that arthroscopy for degenerative knee disease, which involves joint lavage and removal of meniscus flaps and cartilage debris, has little or no effect (Siemieniuk et al., 2017). In recent decades, the focus has been on reducing the number of such procedures, particularly in the older age groups. South-Eastern Norway RHA is one of the organisations that has made determined efforts to change its practice. In the international context, we see that several countries have taken action to reduce the number of arthroscopies in connection with degenerative joint disease. Among other things, the NHS plans to stop public funding for such arthroscopies, and Finland has already done so (Holtedahl et al., 2018).

Sample

Degenerative knee disease is defined by a primary or secondary diagnosis of ICD-10 codes for osteoarthritis of the knee (M17, M22.4) or degenerative meniscal injuries (M23.2, M23.3, M23.4, M23.8, M23.9).

Surgical treatment (arthroscopy) is defined by diagnosed degenerative knee disease in combination with one of more of the following NCSP procedure codes: arthroscopy of the knee joint (NGA11), arthroscopic meniscus operations (NGD01, NGD11, NGD91), operations on the synovia and joint surfaces of the knee (NGF01, NGF11, NGF31, NGF91), or the tariff code for therapeutic knee arthroscopy (K05b).

In order to arrive at as correct a number of operations as possible and avoid follow-up appointments being counted as (new) operations, it is a requirement that operations must be at least 180 days apart to count as separate procedures.

Only patients aged 50 years or older are included in the sample, except in Figure 5.19 which shows the total number of operations for degenerative knee disease in Norway as a whole during the period 2012–2016, with patients broken down by gender and age group.

The arthroscopy rates have been adjusted for gender and age.

Findings

The number of arthroscopies performed on persons aged 50 years and older was halved during the period 2012–2016; from 8,857 arthroscopies in 2013 to 4,172 arthroscopies in 2016. An average of 6,724 arthroscopies per year were registered during the period (Table 5.3). Osteoarthritis of the knee was the primary diagnosis for more than a third of all arthroscopies, and the percentage varied between hospital areas from just under 20 % to more than 60 % (Figure 5.23).

For Norway as a whole, the number of arthroscopies per 100,000 population peaked at 511 in 2013, and the lowest number was found in 2016, with 231 arthroscopies per 100,000 population (Figure 5.21). The average for the period was 383 arthroscopies per 100,000 population per year (Figure 5.20 and Table 5.3).

Møre og Romsdal hospital referral area had the highest average arthroscopy rate at 670 procedures per 100,000 population, while the Stavanger area had the lowest at 147.

There was a clear reduction in the number of arthroscopy procedures for degenerative knee disease in patients over 50 years of age in the hospital referral areas, and this is in line with recent guidelines. This trend is reflected in Figure 5.24, which shows that the number of arthroscopies decreased, particularly during the last two years, both for degenerative meniscus injuries and osteoarthritis. The number of arthroscopies performed for current meniscal tears (S83.2) did not increase during the period. A similar development has been documented in other Nordic countries in connection with the reduction of arthroscopies for degenerative knee disease (Mattila et al., 2016). There was a clear reduction in the arthroscopy rates of both public hospitals and private service providers that receive public funding for Norway as a whole. On average, 65 % of all arthroscopies took place at public hospitals, and most of them in the hospital referral area where the patient was resident (Figure 5.22), but, in six of the hospital referral areas, we found that about half of the arthroscopies were performed at private hospitals under contracts subject to competitive tendering and/or renegotiation or by specialists in private practice under public funding contracts, and this percentage was highest (65 %) in St. Olavs hospital referral area.

Comments

There was particularly high variation in the use of arthroscopy in connection with degenerative knee disease (see Chapter 5.5). Arthroscopy was more than four times as common among patients aged 50 years and older in Møre og Romsdal as in Stavanger hospital referral area. The variation is probably due to differences in preferences and the supply of specialist health services in different parts of Norway. The variation is characterised as unwarranted because there is no known corresponding geographical variation in the prevalence of degenerative knee disease in Norway.

We found a clear reduction in the number of arthroscopies for degenerative knee disease in the period 2012–2016. The number of arthroscopies was halved, and there was a marked decrease in nearly all hospital referral areas. South-Eastern Norway RHA, which provides specialist health services for half of the Norwegian population, has since made targeted efforts to reduce the use of arthroscopies in connection with degenerative knee disease. We found that the arthroscopy rates for 2016 were below the national average for all hospital referral areas in the South-Eastern Norway health region, while they were above the national average in the Central Norway health region.

There is a professional consensus that, for degenerative knee disease, and for older patients in particular, arthroscopic procedures bring little or no benefit. The use of arthroscopic surgery for degenerative knee disease remained disproportionately high during the period. Arthroscopies performed by providers that are fully privately funded come in addition to these numbers. They have been estimated to make up approx. 15 % of all arthroscopies in Norway as a whole and for patients of all ages, with an increase of 12 % during the period 2012–2016 (Holtedahl et al., 2018).

Implementation of international guidelines published in 2017 (Siemieniuk et al., 2017) and possible focused efforts at the RHA level can help to further reduce this variation in future.

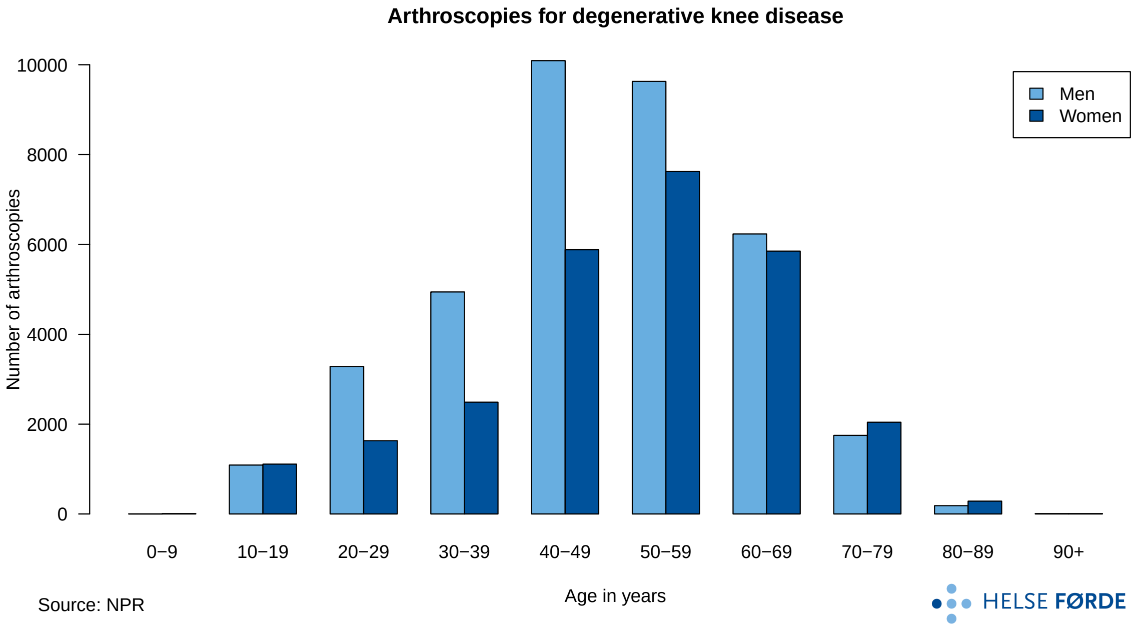


Figure 5.19: Total number of arthroscopies for degenerative knee disease during the period 2012–2016, for Norway as a whole. The patients have been broken down by gender and age group.

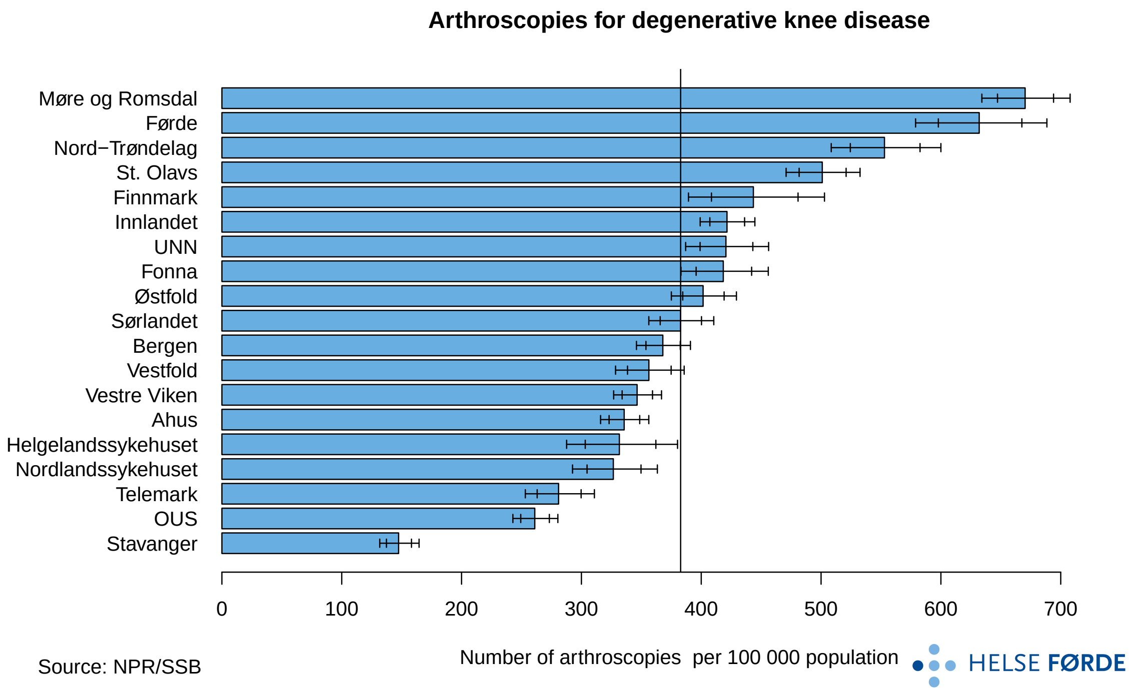


Figure 5.20: Arthroscopy rate: Number of arthroscopies for degenerative knee disease per 100,000 population (50 years and older), broken down by hospital referral area. The bars show the average value per year for the period 2012–2016, with pertaining 95 % and 99.8 % confidence intervals. The vertical line indicates the average for Norway as a whole. The rates have been adjusted for gender and age.

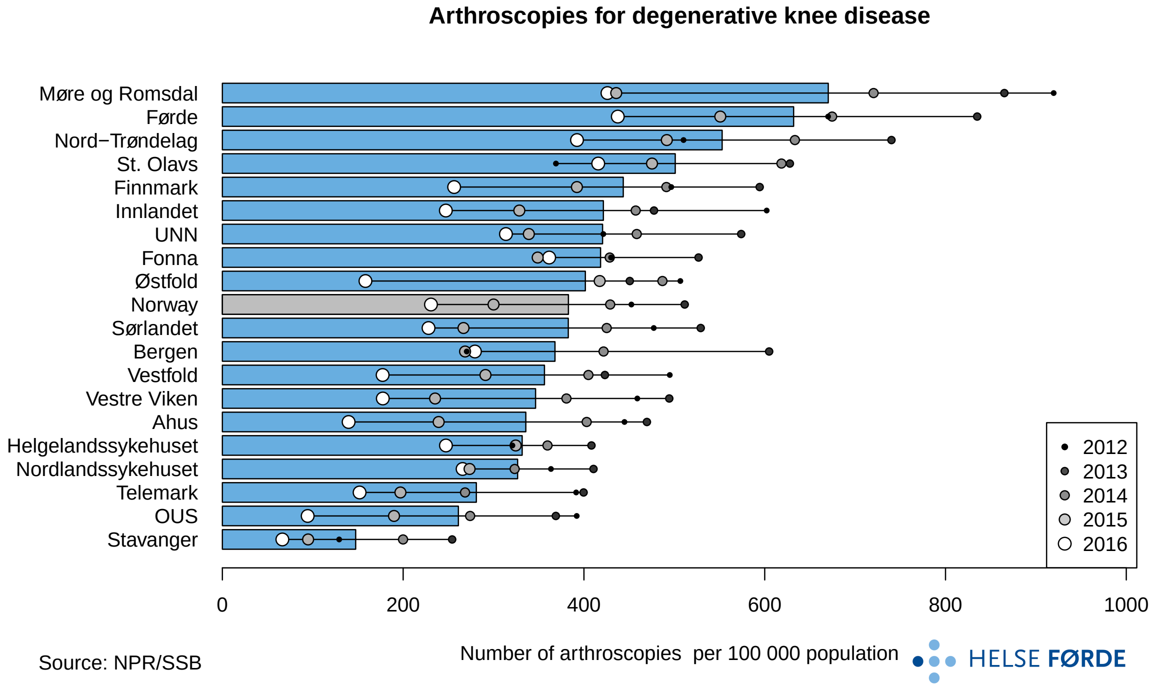


Figure 5.21: Arthroscopy rate: Number of arthroscopies for degenerative knee disease per 100,000 population (50 years and older), broken down by hospital referral area and for Norway as a whole. Bars show the average value per year during 2012–2016, and dots represent rates for each year. Rates have been adjusted for gender and age.

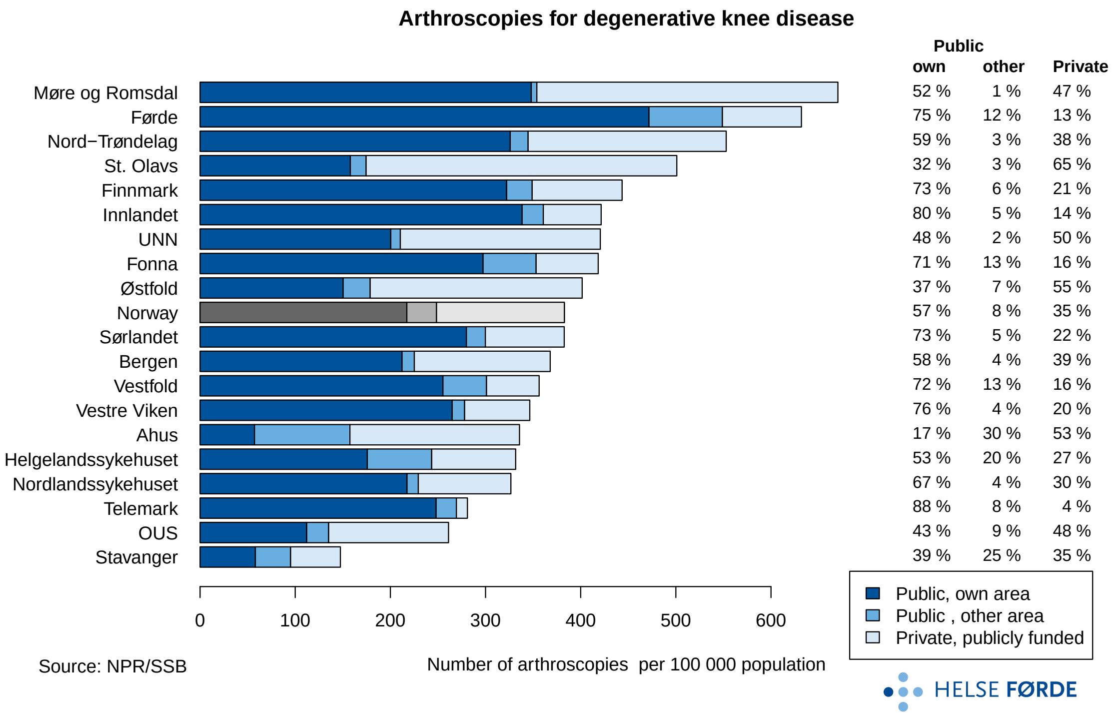


Figure 5.22: Arthroscopy rate: Number of arthroscopies for degenerative knee disease per 100,000 population (50 years and older), broken down by hospital referral area. The rates have been adjusted for gender and age. The bars show the average value per year for the period 2012–2016, with the percentage distribution broken down by where the patients had surgery.

Table 5.3: Arthroscopy for degenerative knee disease. Arthroscopy rate (number of arthroscopies for degenerative knee disease per 100,000 population aged 50 years and older), number of arthroscopies and population (50 years and older), broken down by hospital referral area and for Norway as a whole. The figures represent average values per year during the period 2012–2016. The rates have been adjusted for gender and age.

Hospital referral area	Arthroscopy rate	Number of arthroscopies	Population
Ahus	335.7	538	156,409
Helgelandssykehuset	331.7	100	30,558
Bergen	368.0	514	138,429
Finnmark	443.5	119	26,330
Fonna	418.4	255	60,843
Førde	632.0	257	40,986
Nord-Trøndelag	552.9	283	51,771
Møre og Romsdal	670.3	639	95,169
Stavanger	147.5	158	102,343
Innlandet	421.5	659	158,927
Nordlandssykehuset	326.6	165	51,028
Østfold	401.6	421	105,143
Sørlandet	382.7	384	99,650
St. Olavs	501.0	508	100,550
Telemark	281.0	184	66,158
UNN	420.6	285	67,368
Vestfold	356.3	299	83,852
Vestre Viken	346.5	580	165,839
OUS	261.1	376	141,668
Norway	382.8	6,724	1,743,021

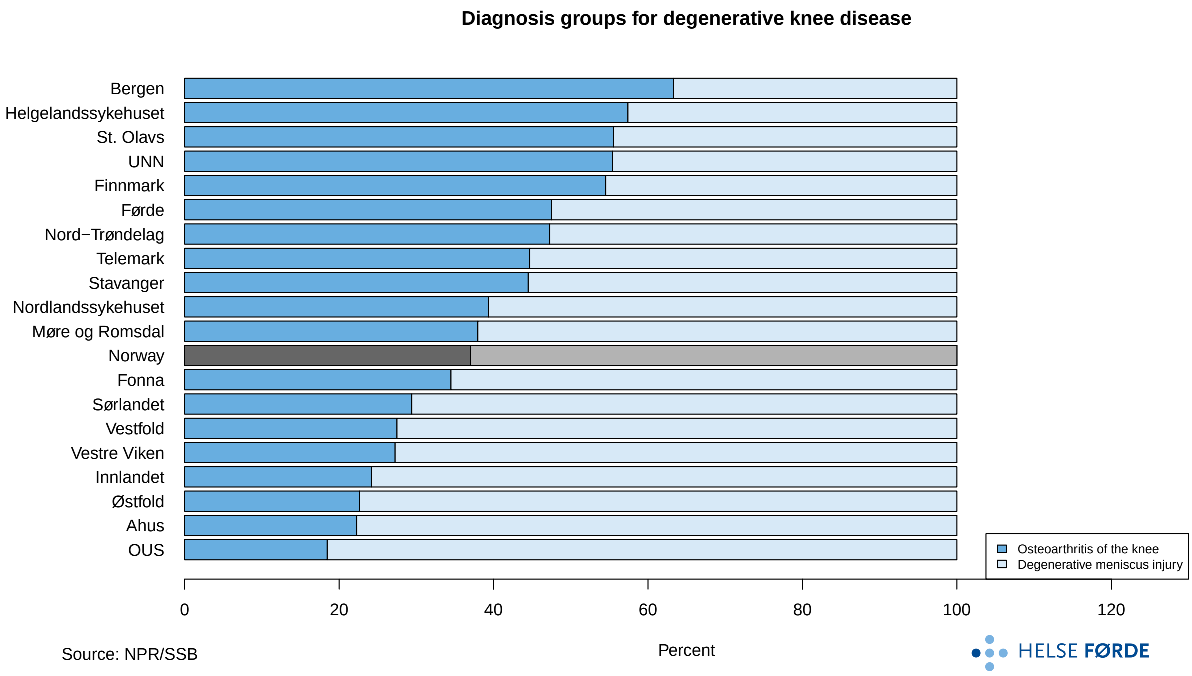


Figure 5.23: Diagnosis groups for arthroscopy for degenerative knee disease: osteoarthritis of the knee and degenerative meniscus injury. Percentage distribution of diagnosis groups broken down by hospital referral area and Norway as a whole, for the period 2012–2016 for patients aged 50 years and older.

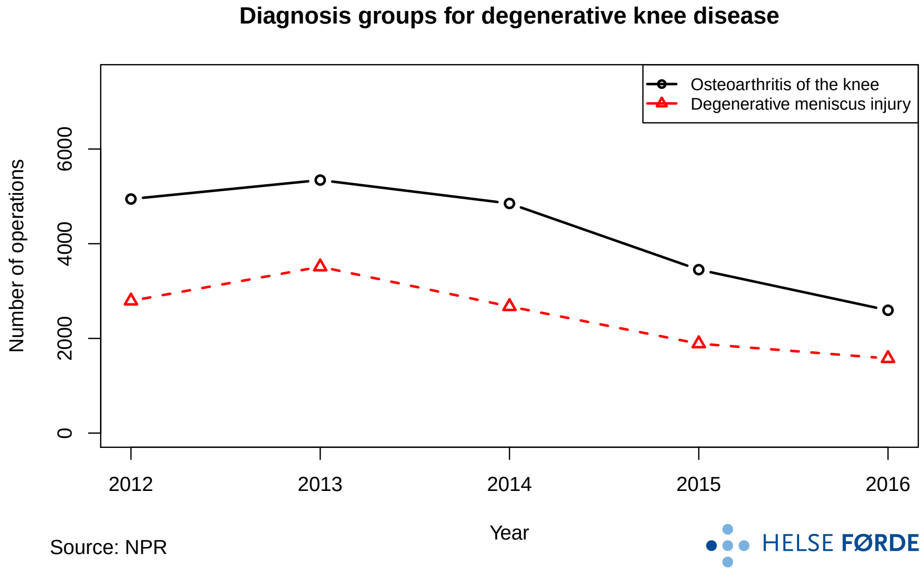


Figure 5.24: Diagnosis groups for arthroscopy for degenerative knee disease: osteoarthritis of the knee and degenerative meniscus injury. Development over time in the number of arthroscopies for different diagnosis groups, for the period 2012–2016 for patients aged 50 years and older

5.1.4 Osteoarthritis of the thumb

Early-stage osteoarthritis of the thumb (arthrosis of the joint between the thumb and wrist) is treated conservatively, while surgical treatment may be indicated for advanced cases (NEL, 2017a). The surgical treatment options are reconstruction of the joint function, fusion or prosthetic replacement of the joint. Although there is no professional consensus on which technique is preferable, surgery often provides good pain relief and function (Best Practice, 2017a; NEL, 2017a).

Sample

Osteoarthritis of the thumb is defined by a primary or secondary diagnosis of ICD-10 code M18 (arthrosis of first carpometacarpal joint).

Surgical treatment is defined by diagnosed osteoarthrosis of the thumb in combination with one or more of the NCSP procedure codes for primary prosthetic replacement (NDB01, NDB02, NDB03, NDB11, NDB12, NDB13, NDB20, NDB30, NDB40, NDB50, NDB80, NDB81, NDB82, NDB99), excision arthroplasty (NDG02), interposition arthroplasty (NDG12), other arthroplasty (NDG22), fusion (NDG32, NDG42, NDG52), other excision, reconstruction or fusion (NDG92), partial or total excision of other carpal bone(s)(NDK11), or certain procedures in code blocks NDK, NDE, NDF and NDL.[19]

In our analyses, we count patients with osteoarthritis of the thumb, which means that only one registered case of osteoarthritis of the thumb is counted per patient. In order to arrive at as correct a number of operations as possible, it is a requirement that operations must be at least one day apart to count as separate procedures.

Only patients aged 18 years or older are included in the sample, except in the figures that show the gender and age distribution of patients with osteoarthritis of the thumb (Figure 5.25)) and the gender and age distribution of patients who have been operated for osteoarthritis of the thumb (Figure 5.26).

The surgery and patient rates have been adjusted for gender and age.

Findings

An average of 838 operations for osteoarthritis of the thumb were registered per year during the period 2012–2016 (Table 5.4). The patients operated on were over 40 years old, with most patients in the age group 60-69 years (Figure 5.26). About three out of four of them were women.

The hospital referral areas with the highest average number of operations per 100,000 population were Fonna at 37 and St. Olavs at 35 operations per year. These surgery rates are markedly higher than those of other hospital referral areas (Table 5.4 and Figure 5.27), and the number of operations appears to be increasing (Figure 5.28). OUS hospital referral area had the lowest number, with an average of 12 operations per 100,000 population per year. We found that the variation in surgery rates exceeded what can be explained by chance. However, the analyses are based on small figures, and annual rates for the small hospital referral areas in particular could have an element of random variation. We have nevertheless chosen to include the annual rates in the figure.

Most operations for osteoarthritis of the thumb were performed at public hospitals in the hospital referral area where the patient was resident (Figure 5.29), 72 % for Norway as a whole. However, few patients from Ahus and Nord-Trøndelag hospital referral areas were operated in the area where

[19] Updated in January 2019.

they lived (25 % and 22 %, respectively). As regards Fonna hospital referral area, which stood out with the highest number of operations in relation to the population, it is worth noting that the vast majority of the operations, 90 %, were performed at Haugesund Sanitetsforenings Revmatismesykehus, a private institution that is owned by the Haugesund branch of the Norwegian Women's Public Health Association and defined as a public hospital in Fonna hospital referral area in this atlas. Patients from the hospital referral areas of Nord-Trøndelag (41 %) and St. Olavs (30 %) were most likely to have their operations performed by private service providers that receive public funding.

Different surgical techniques were used in different parts of Norway (Figure 5.30). The use of excision arthroplasty increased from 2012 to 2016, and for Norway as a whole, it was the most common method together with interposition arthroplasty (Figure 5.31). The highest percentage of patients operated using the excision arthroplasty technique was found in the hospital referral areas of St. Olavs (more than 80 %) and Finnmark (approx. 75 %), while interposition arthroplasty was used in more than 90 % of operations on patients from the Fonna and Bergen areas. About one third of patients in the hospital referral areas of Sørlandet and Helgeland Hospital were operated on using the arthrodesis technique. Prosthetic replacement was most common in Førde hospital referral area during the period 2012–2016, but use of the technique appears to have been discontinued in 2016.

About three out of four patients diagnosed with osteoarthritis of the thumb who were in contact with the specialist health service were women (Figure 5.25). For the country as a whole, an average of 64 patients per 100,000 population per year were in contact with the specialist health service (Table 5.4 and Figure 5.32). Just under 30 % of these patients had surgery (Figure 5.33).

Comments

The observed variation in the surgery rates for osteoarthritis of the thumb was considerable. Surgical treatment is three times as common in Fonna hospital referral area as in the OUS area. However, with a small number of operations during the period, a relatively high proportion of the observed variation could be random, and the element of systematic variation is uncertain. It is our assessment that the systematic variation in surgical treatment of osteoarthritis of the thumb during the period 2012–2016 was moderate to high, and unwarranted (see Chapter 5.5). We have deemed the variation in surgery rates to be unwarranted because there is no known corresponding geographical variation in the prevalence of osteoarthritis of the thumb in Norway.

The use of different surgical techniques also varied greatly between hospital referral areas. We assume that this reflects an absence of guidelines or consensus on what is the best technique, but it could also be a factor that, at large hospitals, operations on patients with osteoarthritis of the thumb may be performed by plastic surgeons. At the national level, we saw a shift in which technique was most popular, from interposition arthroplasty in 2012 to excision arthroplasty in 2016.

We also found a clear variation between hospital referral areas, both in terms of the number of patients with osteoarthritis of the thumb per 100,000 population who were in contact with the specialist health service and in terms of the what percentage of these patients had surgery. This could reflect differences in referral practices, capacity and the absence of guidelines, among other things, and these factors could be part of the reason for the variation in surgical treatment of osteoarthritis of the thumb.

There are no national guidelines for the treatment of osteoarthritis of the thumb, nor a quality register for hand surgery.

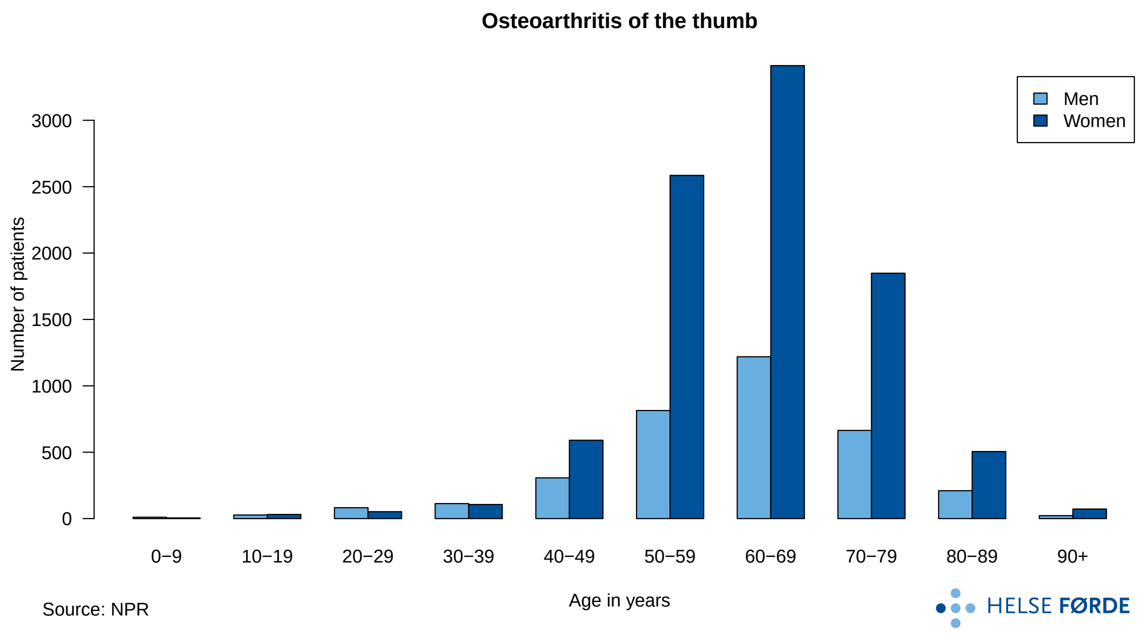


Figure 5.25: Total number of patients with osteoarthritis of the thumb who were in contact with the specialist health service during the period 2012–2016, for Norway as a whole. The patients have been broken down by gender and age group.

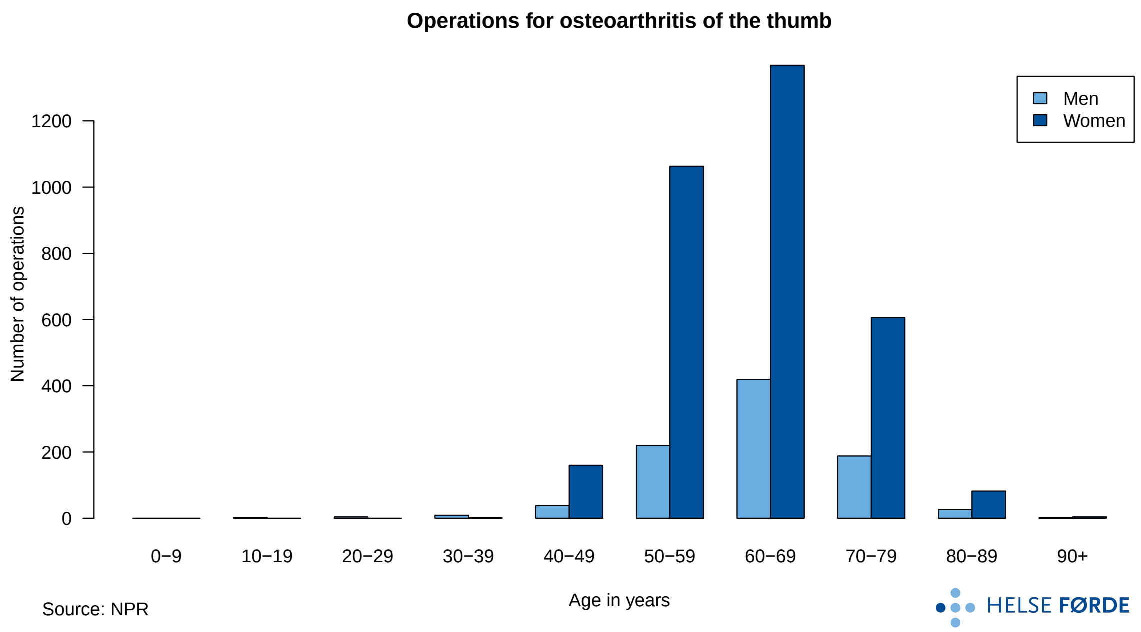


Figure 5.26: Total number of operations for osteoarthritis of the thumb during the period 2012–2016, for Norway as a whole. The patients have been broken down by gender and age group.

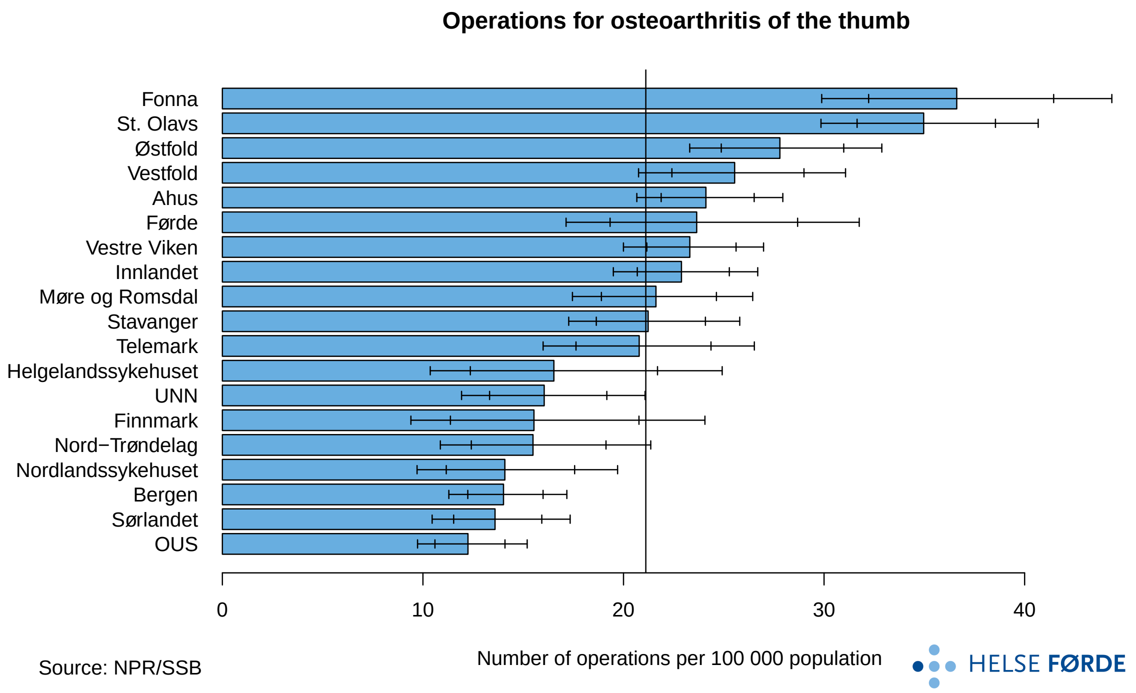


Figure 5.27: Surgery rate: Number of operations for osteoarthritis of the thumb per 100,000 population (18 years and older), broken down by hospital referral area. Bars show average value per year (2012–2016), with 95 % and 99.8 % confidence intervals. Vertical line indicates average for Norway. Rates have been adjusted for gender and age.

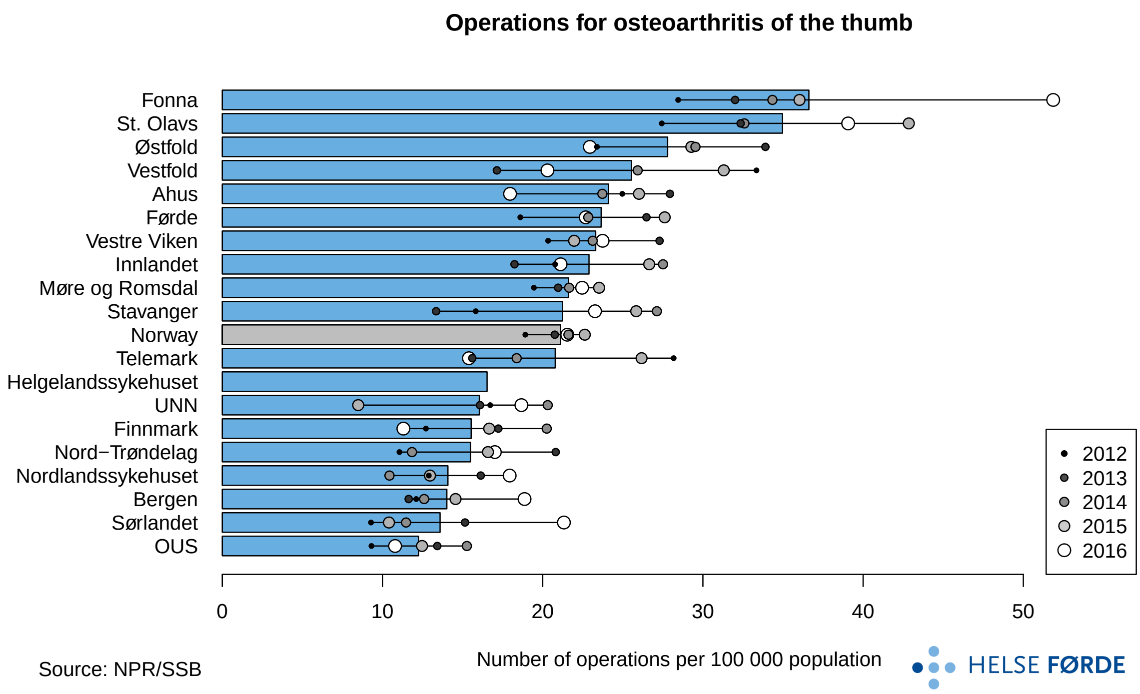


Figure 5.28: Surgery rate: Number of operations for osteoarthritis of the thumb per 100,000 population (18 years and older), broken down by hospital referral area and for Norway as a whole. Bars show average value per year during 2012–2016, and dots represent rates for each year. Rates have been adjusted for gender and age. Annual rates for Helgelandssykehuset have been omitted due to privacy considerations; fewer than six people were operated on during at least one of the years in question.

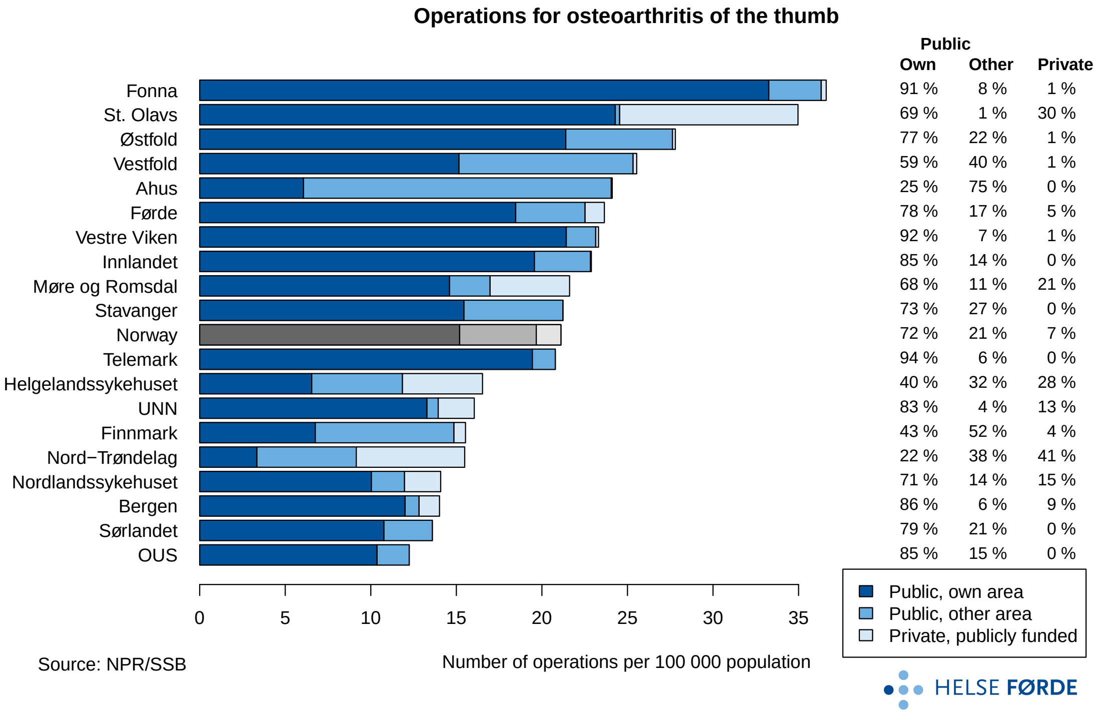


Figure 5.29: Surgery rate: Number of operations for osteoarthritis of the thumb per 100,000 population, broken down by hospital referral area. The percentages have been adjusted for gender and age and concern patients aged 18 years and older. The bars show the average value per year for the period 2012–2016, with the percentage distribution broken down by where the patients had surgery.

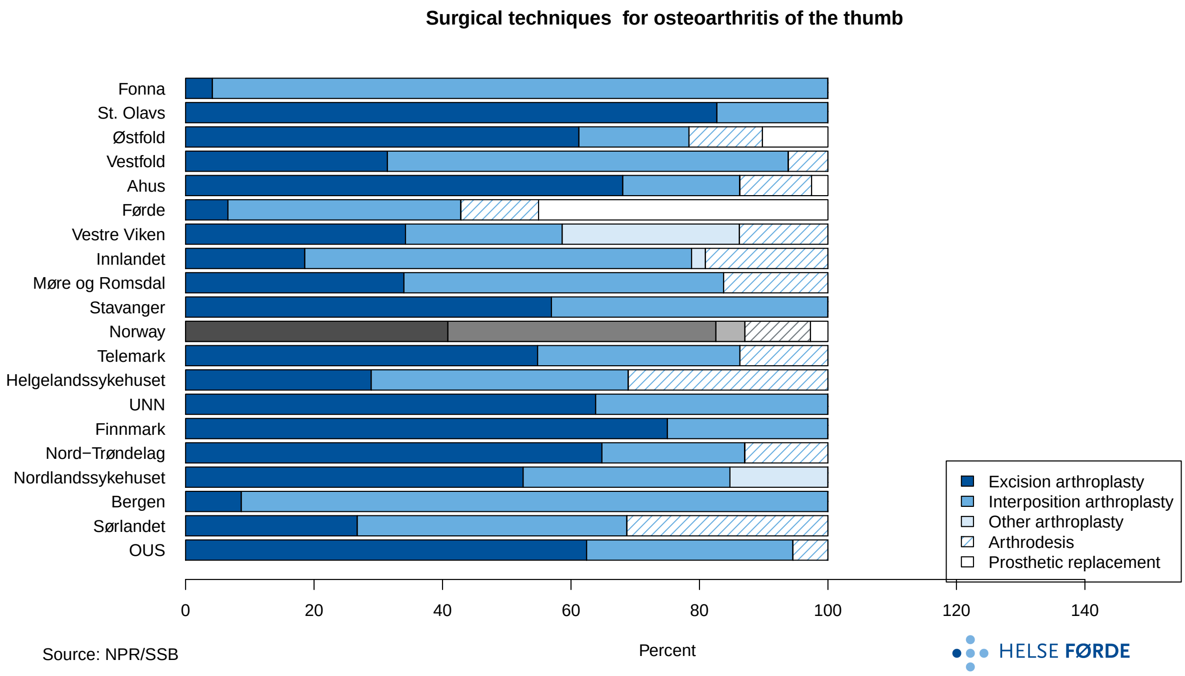


Figure 5.30: Surgical techniques for treating osteoarthritis of the thumb, broken down by excision arthroplasty, interposition arthroplasty, other arthroplasty, arthrodesis and prosthetic replacement. The figure shows the percentage distribution of the different surgical techniques broken down by hospital referral area and Norway as a whole, for the period 2012–2016 for patients aged 18 years and older.

Table 5.4: Osteoarthritis of the thumb. Patient rate (number of patients per 100,000 population), number of patients, surgery rate (number of operations per 100,000 population), number of operations and the population, broken down by hospital referral area and for Norway as a whole. The figures represent average values per year during the period 2012–2016 and apply to the population aged 18 years and older. The rates have been adjusted for gender and age.

Hospital referral area	Patient rate	Number of patients	Surgery rate	Number of operations	Population
Ahus	59.9	214	24.1	86	370,737
Helgelandssykehuset	44.0	29	16.5	11	61,456
Bergen	59.9	191	14.0	45	335,924
Finnmark	61.7	36	15.5	9	58,702
Fonna	86.9	119	36.6	50	135,469
Førde	83.3	74	23.6	21	84,077
Nord-Trøndelag	73.9	84	15.5	18	106,072
Møre og Romsdal	75.0	158	21.6	46	201,630
Stavanger	42.5	98	21.2	49	265,081
Innlandet	61.8	214	22.9	80	315,870
Nordlandssykehuset	53.7	61	14.1	16	106,963
Østfold	73.7	173	27.8	66	222,700
Sørlandet	47.8	108	13.6	31	224,372
St. Olavs	83.9	195	35.0	81	240,031
Telemark	60.4	89	20.8	31	135,860
UNN	58.1	88	16.0	24	147,894
Vestfold	64.4	121	25.5	48	176,835
Vestre Viken	61.2	227	23.3	87	363,780
OUS	70.3	244	12.2	40	427,887
Norway	63.7	2,523	21.1	838	3,981,340

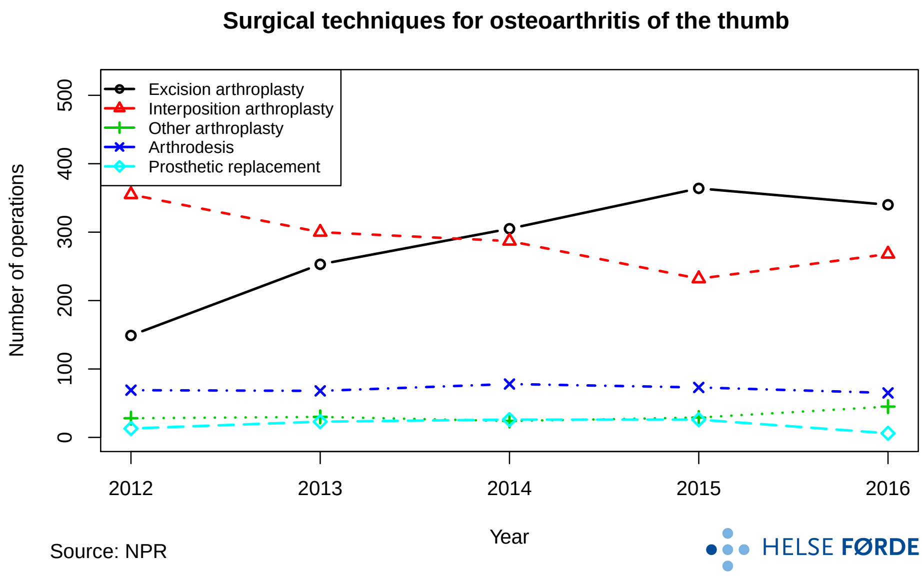


Figure 5.31: Surgical techniques for treating osteoarthritis of the thumb, development over time. Total number of operations for osteoarthritis of the thumb in Norway during the period 2012–2016, patients aged 18 years and older, broken down by excision arthroplasty, interposition arthroplasty, other arthroplasty, arthrodesis and prosthetic replacement.

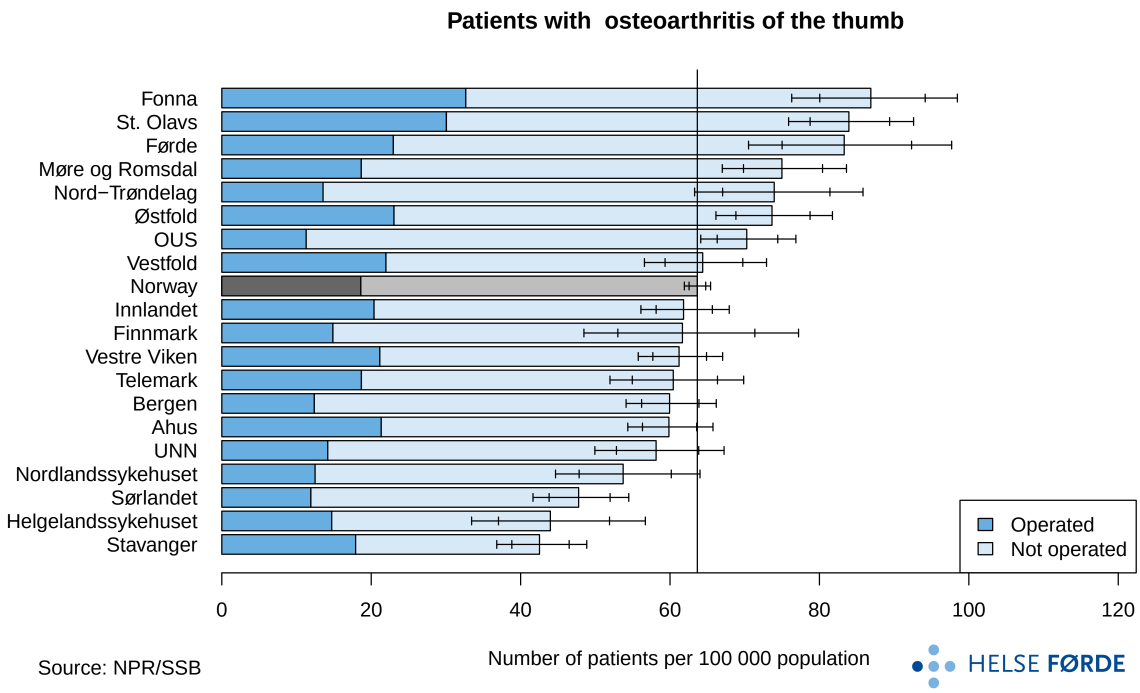


Figure 5.32: Patient rate: number of patients with osteoarthritis of the thumb in contact with the specialist health service, per 100,000 population, broken down by hospital referral area and for Norway as a whole. Bars represent an average patient rate (2012–2016), with 95 % and 99.8 % confidence intervals, and are broken down by patients operated on (dark blue) and patients not operated on (light blue). Rates have been adjusted for gender and age.

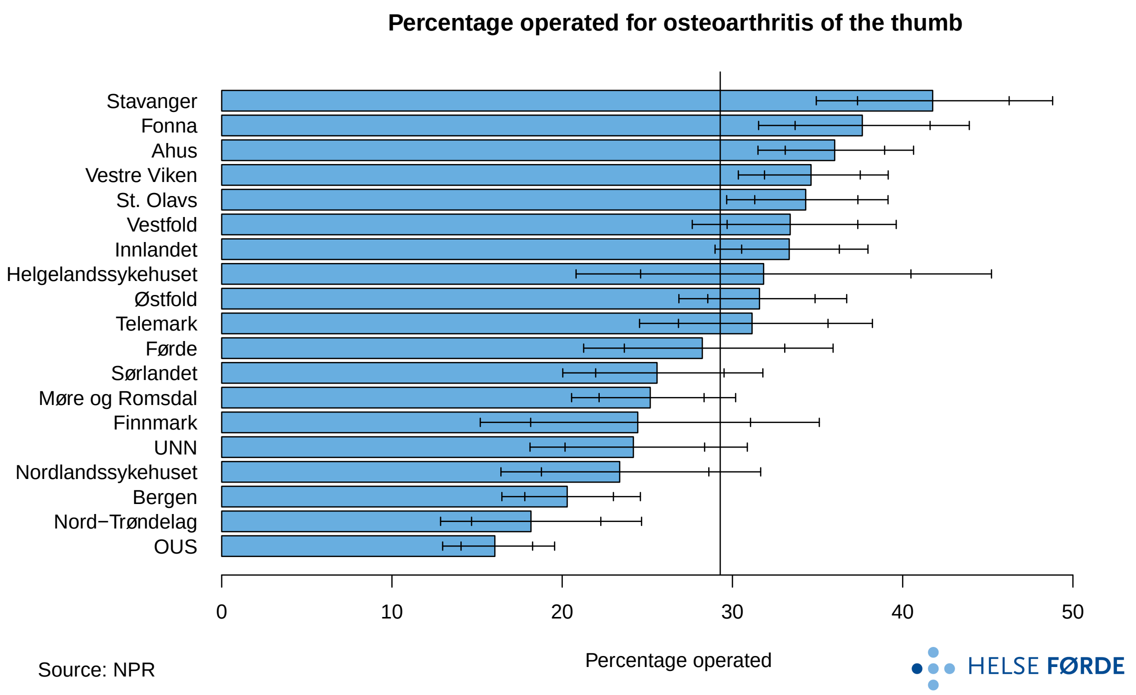


Figure 5.33: Percentage of patients with osteoarthritis of the thumb operated on during 2012–2016. Bars show, with 95 % and 99.8 % confidence intervals, how many per cent of patients with osteoarthritis of the thumb (in contact with the specialist health service) were operated on per hospital referral area. Vertical line indicates percentage operated on for Norway. Percentages have been adjusted for gender and age and concern patients 18 years and older.

5.2 Fractures

Patients with fractures are a large group of orthopaedic patients. The three most common fractures are wrist fractures, ankle fractures and hip fractures. With nearly 9,000 operations per year, hip fractures top the list of surgical treatment of fractures, and for orthopaedics in general, knee arthroscopy is the only procedure that is more common. Patients with shoulder and clavicular fractures, and surgery for such fractures in particular, make up a far smaller group.

Fractures are usually treated by the specialist health service, and the data will therefore give a more complete picture than for other orthopaedic conditions where the municipal health service plays a more important role as a treatment provider. The number of registered fractures in the different hospital referral areas will therefore give an indication of whether there are differences in incidence, while the percentage of fractures that are surgically treated can tell us something about variations in practice and the number of operations per 100,000 population tells us about the use of surgery. Although it is known that the incidence can vary between regions and the reason for such variation is often unknown, the variation in the use of health services cannot be explained by morbidity alone (Court-Brown & Caesar, 2006).

Fractures often occur as a result of a fall from the patient's own height. Elderly people with reduced bone density (osteoporosis) are at particular risk of such low-energy injuries (Petron, 2016; NEL, 2018b). The most common types of such fractures are hip fractures, wrist fractures and shoulder fractures, and they are most common among women (Bergdahl et al., 2016). Younger people with normal bone density more often sustain fractures caused by high-energy trauma, for example sports or road traffic accidents. Men are over-represented, and clavicular fractures and ankle fractures are typical in this category. The latter also occur as low-energy fractures in older age groups.

The purpose of treating fractures is to facilitate good healing by correcting any misalignments and stabilising the fracture to restore as much normal function as possible and prevent late effects. Many fractures are treated conservatively, i.e. with a plaster cast or similar external immobilisation methods. Surgical treatment can be used to stabilise the fracture by means of plates, screws, intramedullary nails or pins. Alternatively, if the fracture is located near a joint, prosthetic replacement may be an option. The choice of treatment depends on a number of factors relating to the patient and the bone quality, including the patient's age and activity level, bone quality and how serious or complex the fracture is (Furnes, 2015). With the exception of age, these factors are not included in our data, and the analyses will therefore not provide a detailed picture of the situation. Here we refer to, e.g., the *Norwegian Hip Fracture Register*[20] which has such data and can give more details about the outcome of different forms of treatment. In this healthcare atlas, we will highlight any geographical differences in the use of health services in the treatment of fractures.

The number of fractures will probably increase as the elderly population grows in the years ahead (Curtis et al., 2016). The treatment of fractures (surgery, rehabilitation, nursing and care) costs society a great deal, and the condition represents a considerable public health burden. Prevention of fractures and treatment in accordance with good guidelines could potentially reduce costs as well as human suffering (Solberg et al., 2015).

The analyses are based on both diagnosis codes and procedure codes. In our experience, procedure codes are more reliable, so they are emphasised most in the assessment of our findings.

[20]https://www.kvalitetsregistre.no/registers/nasjonalt-hoftebruddregister

5.2.1 Wrist fractures

Wrist fractures (distal radial fractures) are the most common type of fracture in Norway, with approximately 13,000 wrist fractures in adults per year, i.e. approx. 20 % of all fractures (Kvernmo et al., 2017; Lofthus et al., 2008). This is among the highest incidences in the world, and more than twice as high as in the USA (Lofthus et al., 2008; Fanuele et al., 2009).

National guidelines for the treatment of wrist fractures in adults were drawn up in 2013. The Norwegian Orthopaedic Association took the initiative for these guidelines in order to reduce the variation in treatment procedures between hospitals and to ensure optimal patient treatment (Kvernmo et al., 2015; Krukhaug, 2015).

Stable wrist fractures are treated with a plaster cast, reduction to restore correct alignment, and followed up through scheduled follow-up appointments. Surgical treatment is recommended for unstable wrist fractures. Stabilising the fractures with plates is recommended rather than external fixation or pinning. It is also recommended that restraint should be exercised when it comes to operating on patients with a low level of functioning, i.e. patients who are permanently incapable of carrying out everyday activities independently (Kvernmo et al., 2015).

Sample

Wrist fracture is defined by a primary or secondary diagnosis of ICD-10 codes S52.5 (fracture of lower end of radius) or S52.6 (fracture of lower end of both ulna and radius).

Surgical treatment is defined by a diagnosed wrist fracture in combination with one or more of the NCSP procedure codes for treatment of fractures in the wrist: external fixation (NCJ25, NCJ27), fixation using bioimplant (NCJ35, NCJ37), fixation using wire, cerclage or pin (NCJ45, NCJ47), fixation using intramedullary nail (NCJ55, NCJ57), fixation using plate and screws (NCJ65, NCJ67), fixation using screws alone (NCJ75, NCJ77), fixation using other or combined methods (NCJ85, NCJ87) or other fracture surgery (NCJ95, NCJ97).

Conservative (non-surgical) treatment of wrist fractures is defined by ICD-10 codes S52.5 and S52.6 as a primary or secondary diagnosis in the absence of the above-mentioned surgical procedure codes.

It is a requirement that more than 180 days must elapse between contacts with the health service for a registered wrist fracture in order for a fracture to be counted as a new fracture. This requirement was set in order to arrive at as correct a number of wrist fractures as possible and avoid follow-up appointments being counted as new fractures. Correspondingly, operations must be at least 180 days apart to be counted as separate procedures.

Only patients aged 18 years or older are included in the sample, except in the figures that show the gender and age distribution of patients with broken wrists (Figure 5.34) and the gender and age distribution of patients who have been operated for wrist fractures (Figure 5.35).

Treatment in the municipal health service is defined by the ICPC-2 code L72 (fracture: radius/ulna) and tariff codes 106a (plaster cast and bandage) and 106b (treatment of fracture that requires reduction under anaesthesia and, if relevant, X-ray imaging before and after).

The surgery and patient rates have been adjusted for gender and age.

Findings

The specialist health service registered an average of 12,471 wrist fractures per year in patients aged 18 years and older during the period 2012–2016. The average number of wrist fractures treated surgically during that period was 3,812 per year, meaning that 31 % of fractures were operated on (Table 5.5 and Figure 5.39). In adults, we found that women made up the majority of patients aged 40 years and older, with the highest number of fractures found in the age group 60–69 years (Figure 5.34). This age group also had the highest number of operations for wrist fractures (Figure 5.35).

The hospital referral area with the most wrist fractures was Bergen, with an annual average of 362 fractures per 100,000 population, while the area with the fewest wrist fractures was Stavanger with an average of 261 fractures per 100,000 population (Table 5.5). Based on the confidence intervals in Figure 5.36, we see that the variation between hospital referral areas in wrist fractures was higher than we would expect from random variation.

We found clear variation between hospital referral areas in the number of operations for wrist fractures per 100,000 population (Figure 5.37). Førde hospital referral area tops the list with 148 operations, while Helgeland Hospital is at the bottom of the list with 63 operations per 100,000 population per year (Table 5.5). We found that the surgery rates changed greatly from one year to the next, particularly in small hospital referral areas such as Førde and Helgeland Hospital (Figure 5.38). We identified a tendency for surgery rates to decrease in the hospital referral areas with the highest numbers and increase in the areas with the lowest numbers during the period 2012–2016. As a result, the variation between hospital referral areas was somewhat smaller at the end of the period.

For Norway as a whole, one in three wrist fractures were operated on (Figure 5.39). Vestfold hospital referral area had the highest percentage of wrist fractures operated (47 %), while the Finnmark and Helgeland Hospital areas had the lowest percentage (22 %). We see a clear variation between hospital referral areas in the proportion of wrist fractures treated surgically.

As shown in figure 5.40, plate fixation was the most used of the three common surgical techniques in Norway for treating wrist fractures during the period 2012–2016. For the country as a whole, only one in five were treated with pinning or external fixation, but we see that the use of the different techniques varies between hospital referral areas. Figure 5.41 shows that, for Norway as a whole, the use of plates increased and the use of pinning or external fixation decreased during the period.

Figures from Helfo show that about 11,000 patients with forearm fractures are registered by the municipal health service (regular GPs or emergency primary healthcare services) each year. The vast majority of them are referred to the specialist health service for treatment. Finnmark stood out somewhat because more patients were treated by the municipal health service there than in other hospital referral areas. During the period, about 100 patients per year received conservative treatment under the auspices of the municipal health services in Finnmark hospital referral area, compared with about 700 patients for Norway as a whole. If these patients from the Finnmark area were not referred to the specialist health service, the number of conservatively treated wrist fractures in the hospital referral area could potentially be higher than the NPR data indicate. This means that the percentage of patients operated on could be even lower than our analyses based on NPR data show for Finnmark, which was already at the bottom of the list.

Comments

There was considerable variation in surgery rates for wrist fractures (see Chapter 5.5). Surgery was more than twice as common in Førde and Vestfold hospital referral areas as in the Helgeland Hospital and Finnmark areas during the period 2012–2016.

We found some variation in the fracture rates for the different hospital referral areas. The variation was quite small, but since fractures are usually treated by the specialist health service, it is conceivable that the fracture rate reflects variation in incidence between different parts of Norway and will have a bearing on the number of operations per 100,000 population. Despite the small variation in incidence, the variation in the surgery rate and the percentage operated on was so high that there is reason to believe that there is an element of unwarranted variation in the surgical treatment of wrist fractures.

In the period after the publication of national guidelines for the treatment of wrist fractures (2013), we found that the treatment practices became more uniform throughout Norway. The variation in surgery rates decreased, particularly during the last two years of the period, when the hospital referral areas with the highest and lowest number of operations per 100,000 population came closer to the national average. We also found that the use of plate fixation, as recommended in the guidelines, increased and became the most common method for patients in most hospital referral areas.

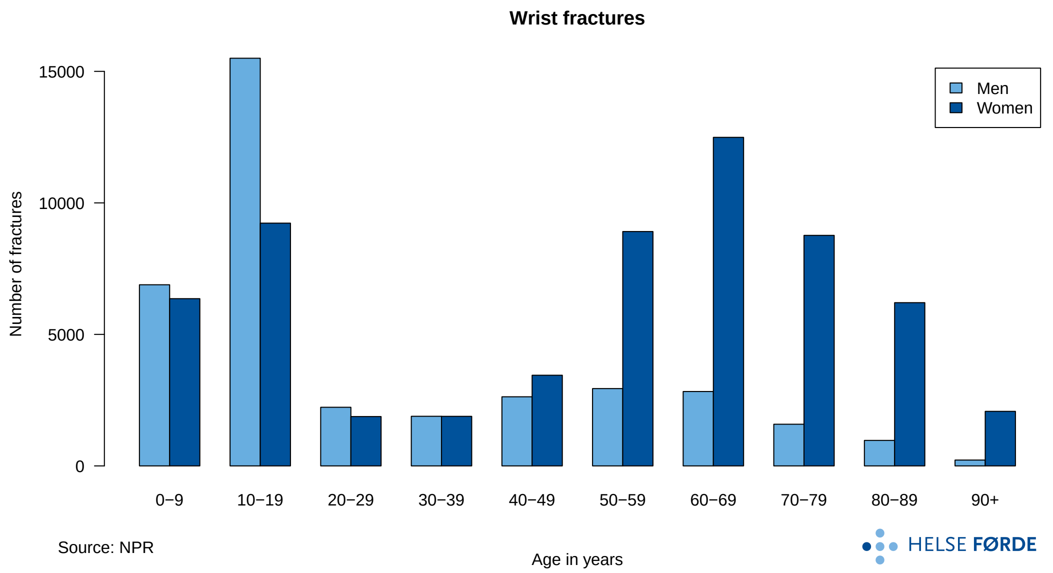


Figure 5.34: Total number of wrist fractures during the period 2012–2016, for Norway as a whole. The patients have been broken down by gender and age group.

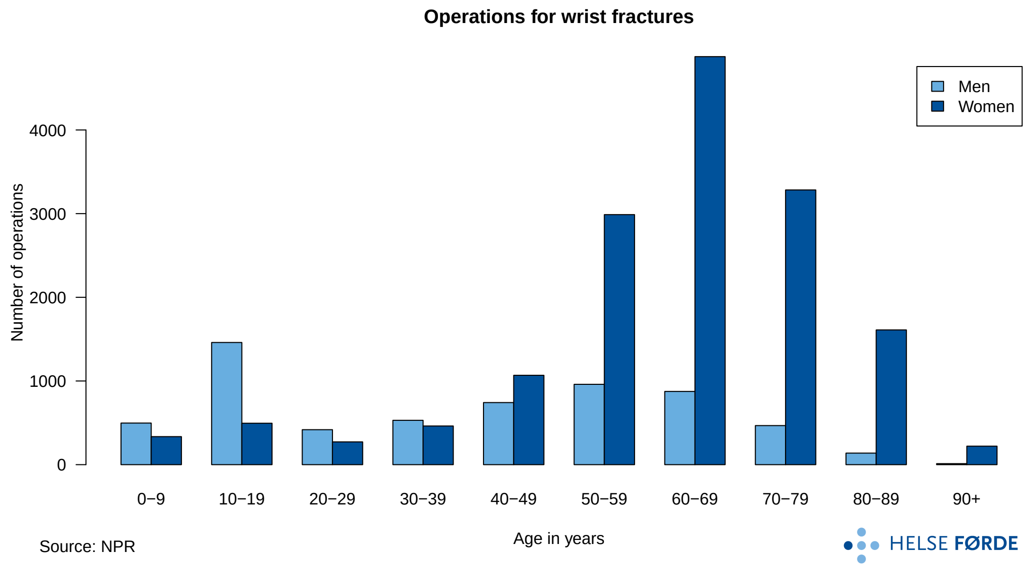


Figure 5.35: Total number of operations for wrist fractures during the period 2012–2016, for Norway as a whole. The patients have been broken down by gender and age group.

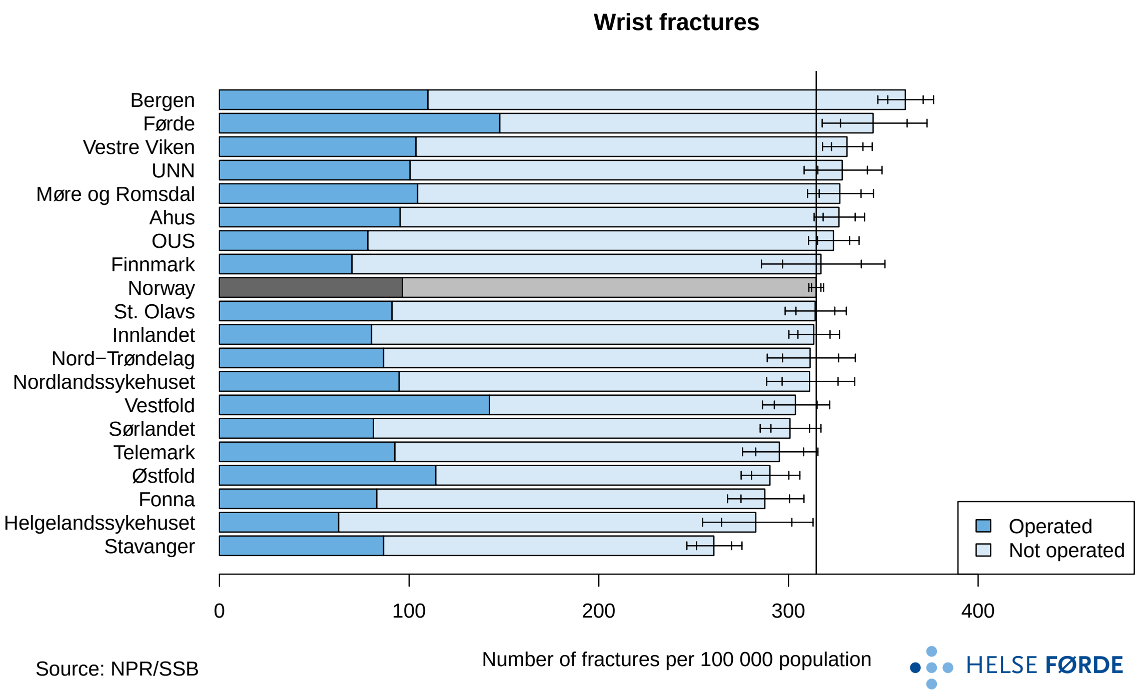


Figure 5.36: Fracture rate: Total number of wrist fractures per 100,000 population (18 years and older) during the period 2012–2016, broken down by hospital referral area and for Norway as a whole. The bars show the average value per year with 95 % and 99.8 % confidence intervals, and are broken down by operated and non-operated fractures, represented by the blue and light blue section of the bar, respectively. The vertical line indicates the rate for Norway as a whole. The rates have been adjusted for gender and age.

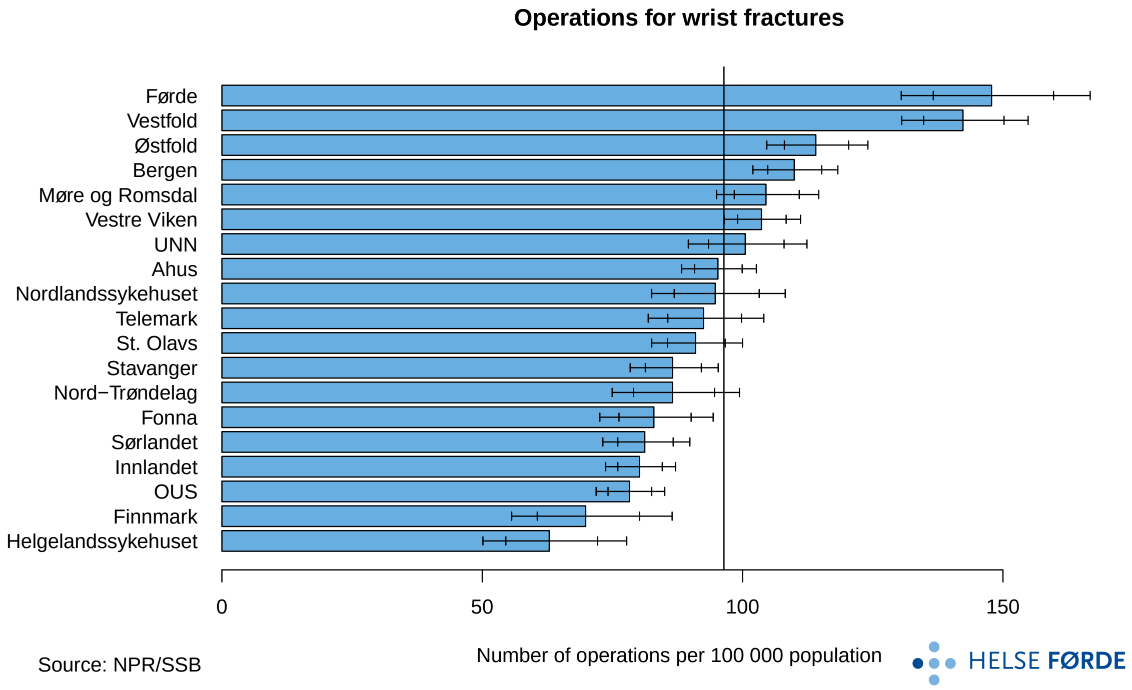


Figure 5.37: Surgery rate: Number of operated wrist fractures per 100,000 population (18 years and older), broken down by hospital referral area. The bars show the average value per year for the period 2012–2016, with pertaining 95 % and 99.8 % confidence intervals. The vertical line indicates the average for Norway as a whole. The rates have been adjusted for gender and age.

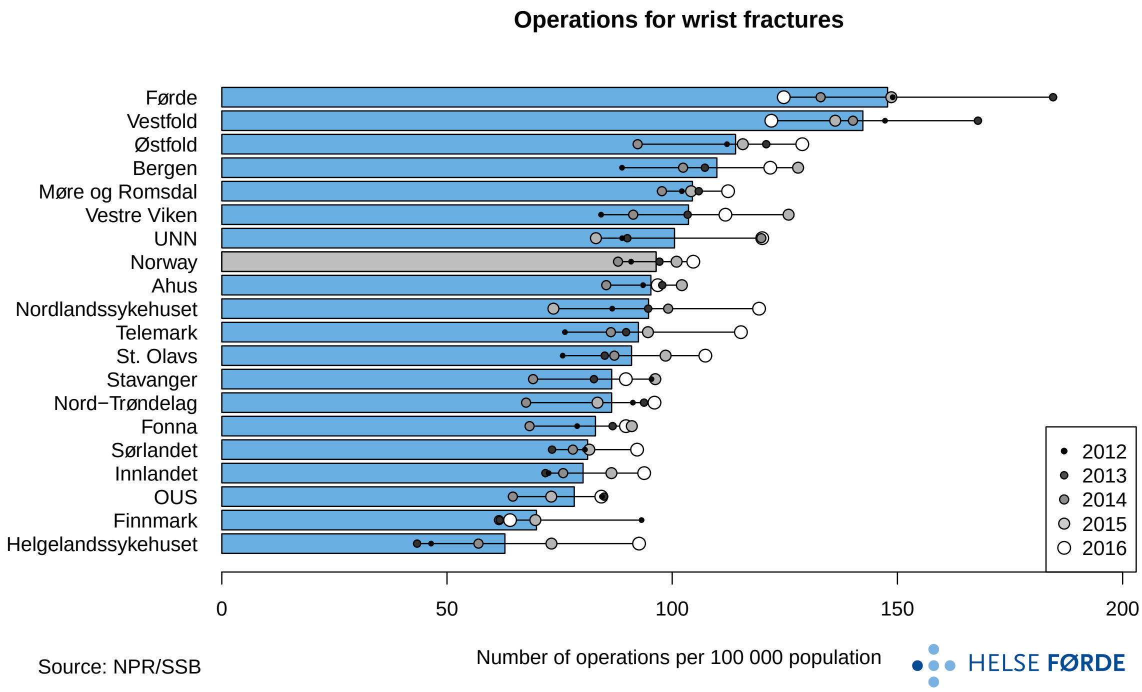


Figure 5.38: Surgery rate: Number of operated wrist fractures per 100,000 population (18 years and older), broken down by hospital referral area and for Norway as a whole. The bars show the average value per year for the period 2012–2016, and the dots represent the rates for each year. The rates have been adjusted for gender and age.

Table 5.5: Wrist fracture. Fracture rate, number of fractures, surgery rate, number of operations and the population broken down by hospital referral area and Norway. Figures represent average values per year during 2012–2016 and apply to the population aged 18 years and older. Rates have been adjusted for gender and age.

Hospital referral area	Fracture rate	Number of fractures	Surgery rate	Number of operations	Population
Ahus	326.6	1,163	95.3	341	370,737
Helgelandssykehuset	282.8	185	62.9	41	61,456
Bergen	361.6	1,171	109.9	352	335,924
Finnmark	317.1	184	69.9	41	58,702
Fonna	287.6	394	83.0	113	135,469
Førde	344.6	303	147.8	130	84,077
Nord-Trøndelag	311.4	349	86.6	98	106,072
Møre og Romsdal	327.1	686	104.5	220	201,630
Stavanger	260.7	632	86.6	206	265,081
Innlandet	313.4	1,077	80.2	280	315,870
Nordlandssykehuset	311.1	348	94.7	107	106,963
Østfold	290.2	677	114.1	267	222,700
Sørlandet	300.8	677	81.2	183	224,372
St. Olavs	314.1	731	91.0	211	240,031
Telemark	295.2	429	92.5	136	135,860
UNN	328.3	492	100.5	151	147,894
Vestfold	303.7	565	142.3	267	176,835
Vestre Viken	330.9	1,226	103.6	384	363,780
OUS	323.7	1,182	78.3	284	427,887
Norway	314.6	12,471	96.4	3,812	3,981,340

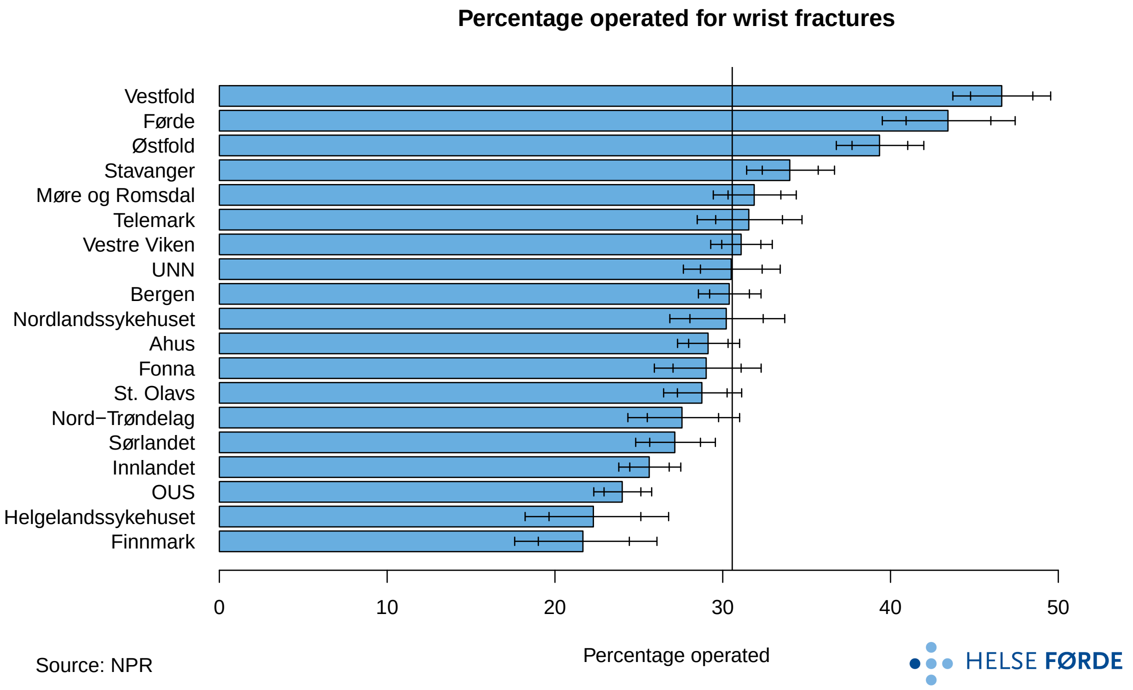


Figure 5.39: Percentage of wrist fractures operated (2012–2016), with 95 % and 99.8 % confidence intervals, per hospital referral area. Vertical line indicates percentage operated on for Norway as a whole. Percentages have been adjusted for gender and age and concern patients aged 18 years and older.

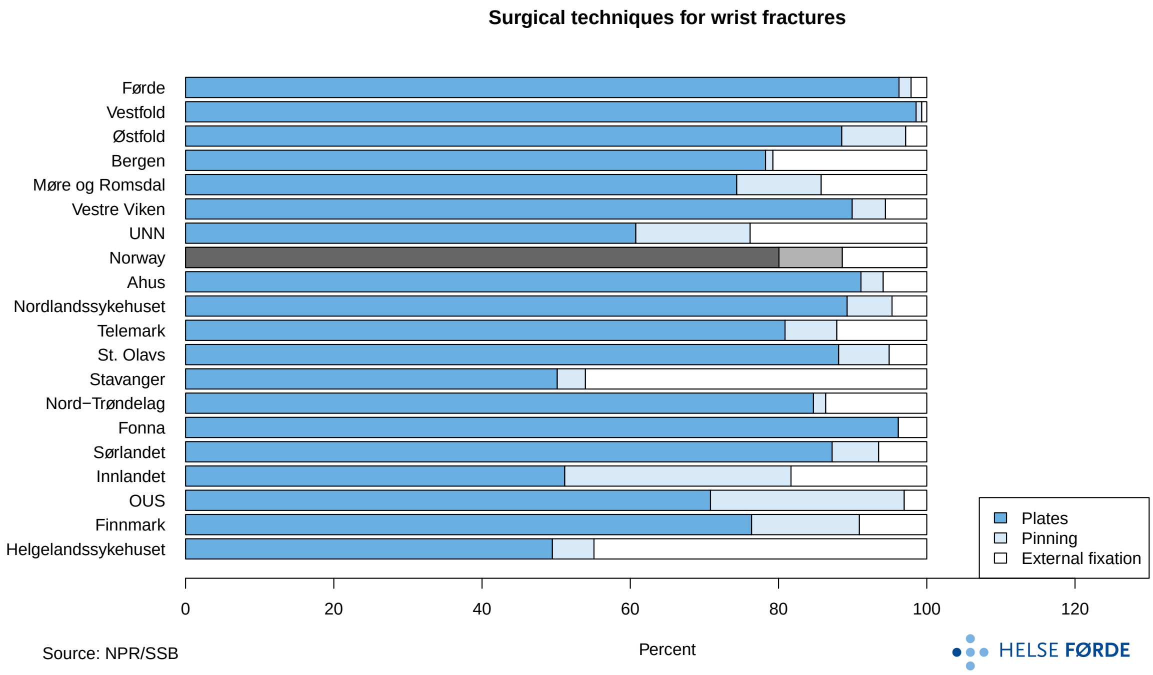


Figure 5.40: Surgical techniques for treating wrist fractures in patients aged 18 years and older, broken down by hospital referral area and for Norway as a whole, and by the most common methods: plates, pinning and external fixation. The figure shows the percentage of operations for wrist fractures in which the different techniques were used during the period 2012–2016.

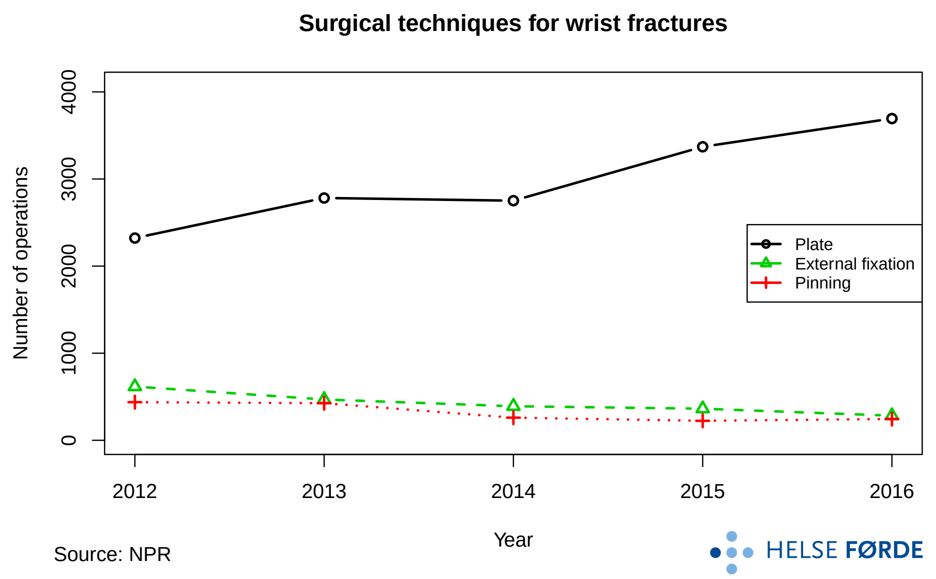


Figure 5.41: Surgical techniques for treating wrist fractures, development over time. Total number of wrist operations in Norway as a whole during the period 2012–2016 for patients aged 18 year and older, broken down by external fixation, pinning and plates.

5.2.2 Ankle fractures

Ankle fractures (malleolar fractures) are one of Norway's three most common types of fracture, and account for approx. 9 % of all fractures (Matre, 2015; Koehler & Eiff, 2018). Both young men and women older than 65 are well represented in this patient group (Court-Brown et al., 1998; Best Practice, 2018a). The number of ankle fractures has increased in recent years, both because the number of elderly people has increased and because more people take part in sports that can lead to such injuries (Court-Brown et al., 1998; Koehler & Eiff, 2018).

The most common type of ankle fracture is an isolated fracture to one of the bony protuberances (malleoli) on either side of the ankle. This type accounts for 75 % of all ankle fractures. Conservative treatment with a plaster cast or ankle orthosis will normally suffice for stable fractures, while more complicated fractures usually require surgical treatment (NEL, 2016a).

Surgical treatment of ankle fractures has become more common in recent decades. This increase is the result of the identification of a link between restoring proper alignment of the fracture as accurately as possible and improved ankle function. New implants have also been developed. The increase in the treatment of high-energy injuries in young patients has also led to an increase in the number of otherwise healthy elderly patients being operated for ankle fractures (Matre, 2015).

The most common types of ankle fracture have a good prognosis. The prognosis may be poorer for complicated compound fractures with major damage to soft tissue. It is important in order to ensure a good prognosis that misalignment is corrected, that the joint is stable and that the articular surfaces are well positioned in relation to each other (Matre, 2015).

Sample

Ankle fractures are defined by a primary or secondary diagnosis of ICD-10 codes S82.3 (fracture of lower end of tibia), S82.4 (fracture of fibula alone), S82.5 (fracture of medial malleolus), S82.6 (fracture of lateral malleolus), S82.7 (multiple fractures of lower leg) or S82.8 (fractures of other parts of lower leg).

The inclusion of ICD-10 codes S82.3, S82.7 and S 82.8 means that it is possible to include other fractures than malleolar ankle fractures. Nonetheless, we see that many treatment centres use these codes as the primary diagnosis in combination with procedure codes for malleolar ankle surgery, with no secondary diagnosis that would indicate that the reason for the operation was anything other than a malleolar fracture. We have therefore chosen to include ICD-10 codes S82.3, S82.7 and S82.8 in our sample.

Surgical treatment is defined by a diagnosed ankle fracture in combination with one or more of the NCSP procedure codes for external fixation (NHJ20, NHJ21, NHJ22, NHJ23), fixation using bioimplant (NHJ30, NHJ31, NHJ32, NHJ33), fixation using wire, cerclage or pin (NHJ40, NHJ41, NHJ42, NHJ43), fixation using plate and screws (NHJ60, NHJ61, NHJ62, NHJ63), fixation using screws alone (NHJ70, NHJ71, NHJ72, NHJ73), fixation using other or combined methods (NHJ80, NHJ81, NHJ82, NHJ83) or other fracture surgery (NHJ90, NHJ91, NHJ92, NHJ93).

Conservative treatment of ankle fractures is defined as a diagnosed ankle fracture with no procedure codes for surgical treatment.

In order to arrive at as correct a number of ankle fractures as possible and avoid counting follow-up appointments as new fractures, only one ankle fracture per patient has been counted during the five-year period. Correspondingly, only one operation is counted per patient to arrive at as correct a number of primary fracture operations as possible.

Patients aged 18 years or older are included in the sample, except for in the figures that show the gender and age distribution of patients with ankle fractures (Figure 5.42) and the gender and age distribution of patients who have been operated for ankle fractures (Figure 5.43).

Treatment in the municipal health service is defined by the ICPC-2 code L73 (fracture: tibia/fibula) and tariff codes 106a (plaster cast and bandage) and 106b (treatment of fracture that requires reduction under anaesthesia and, if relevant, X-ray imaging before and after).

The surgery and patient rates have been adjusted for gender and age.

Findings

The specialist health service registered an average of 9,155 ankle fractures and 3,069 ankle fracture operations per year (Table 5.6), which means that one third of ankle fractures were surgically treated (Figure 5.47).

In the age group 0–39 years, the majority of ankle fracture patients were men, while women made up the majority of patients in the age group 50 years and older (Figure 5.42). We found a corresponding gender and age distribution for patients who underwent ankle fracture surgery (Figure 5.43).

The hospital referral area with the highest number of ankle fractures in patients aged 18 years and older was Nord-Trøndelag, with an annual average of 265 fractures per 100,000 population, while the area with the fewest fractures was Stavanger, with an average of 195 fractures per 100,000 population (Table 5.6). Based on the confidence intervals in Figure 5.44, we can see that the variation between hospital referral areas in the number of fractures per 100,000 population exceeded what can be explained by chance.

For Norway as a whole, we found that an average of 77 ankle operations were performed per 100,000 population (Table 5.6). The surgery rate per hospital referral area varied from 93 operations in the Nord-Trøndelag area to 58 operations in the Stavanger area (Table 5.6). Figure 5.45 shows that the surgery rates for Nord-Trøndelag, Møre og Romsdal and Østfold hospital referral areas were above the national average, while the surgery rate for residents of the Stavanger area was clearly below the national average. Several hospital referral areas' surgery rates varied quite a lot from year to year, but without showing any clear increasing or decreasing trend (Figure 5.46).

For Norway as a whole, 33 % of ankle fractures were operated on (Figure 5.47), and the percentage varied from 42 % in the Østfold area to nearly 30 % in Stavanger and Finnmark hospital referral areas. The variation in the percentage operated on between the Østfold and Stavanger hospital referral areas exceeds what can be explained by chance, but there was no clear variation between the other hospital referral areas.

Figures from Helfo show that about 11,000 patients with ankle fractures were registered by the municipal health service (regular GPs or emergency primary healthcare services) each year. The vast majority of them are referred to the specialist health service for treatment. Finnmark stood out somewhat because more patients were treated by the municipal health service there than in other hospital referral areas. Just over 40 patients in Finnmark hospital referral area received conservative treatment under the auspices of the municipal health services, compared with about 400 patients for Norway as a whole. If these patients from the Finnmark area were not referred to the specialist health service, the number of conservatively treated ankle fractures in the hospital referral area could be higher than the NPR data indicate. This means that the percentage of patients operated on could be even lower than our analyses based on NPR data show for Finnmark, which was already at the bottom of the list.

Comments

The variation in surgery rates for ankle fractures was moderate to low (see Chapter 5.5). Stavanger stood out with a particularly low surgery rate, while there was relatively little variation between the other hospital referral areas.

The fracture rate did not vary much between hospital referral areas, and in our assessment, this variation could primarily reflect a variation in the incidence of ankle fractures. The fracture rate could explain part of the variation in surgery rates, but we also found variation in the percentage of patients operated on, and Østfold hospital referral area stood out with a higher percentage. It is difficult to assess whether the observed variation is warranted or not.

There are no national guidelines for the treatment of ankle fractures.

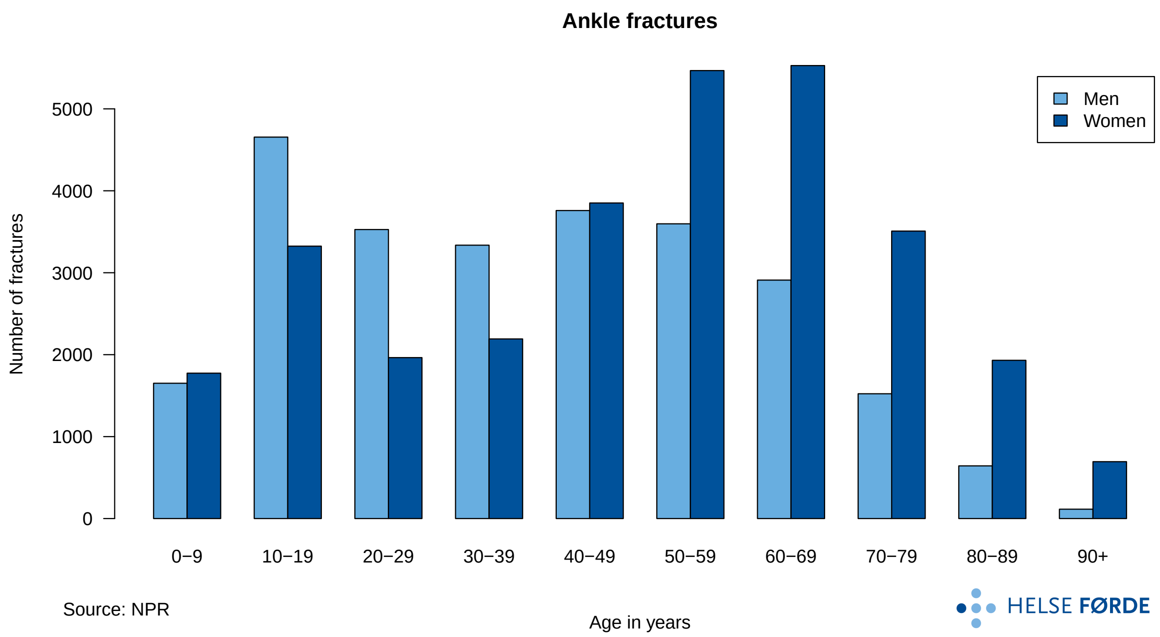


Figure 5.42: Total number of ankle fractures during the period 2012−2016, for Norway as a whole. The patients have been broken down by gender and age group.

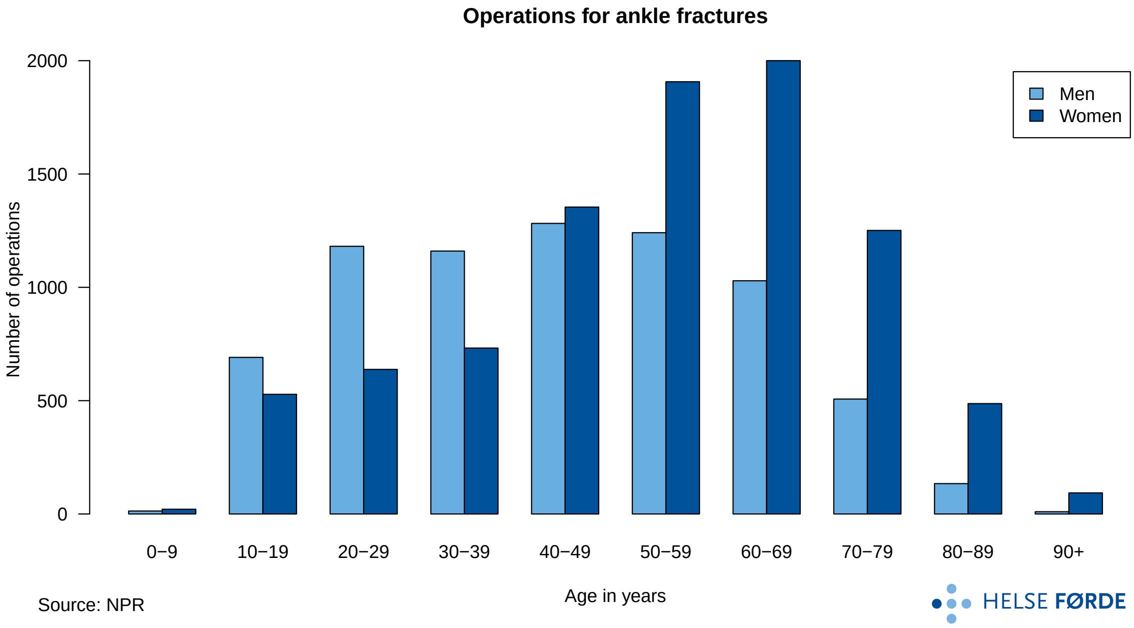


Figure 5.43: Total number of operations for ankle fractures during the period 2012–2016, for Norway as a whole. The patients have been broken down by gender and age group.

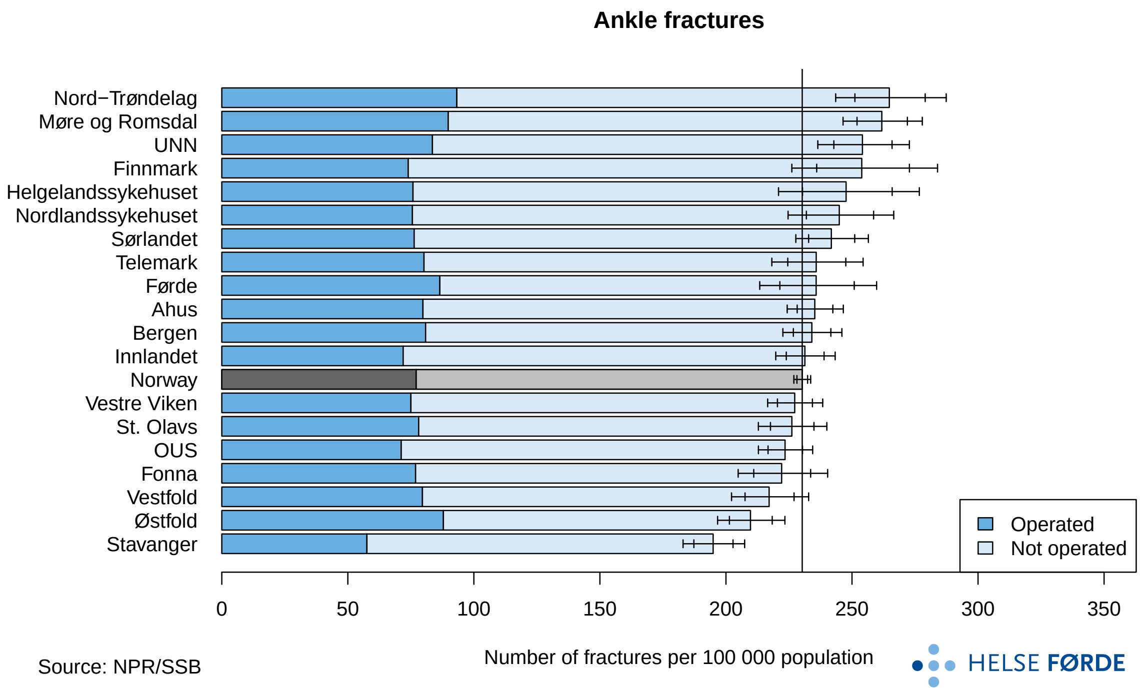


Figure 5.44: Fracture rate: Total number of ankle fractures per 100,000 population (18 years and older) during the period 2012–2016, broken down by hospital referral area and for Norway as a whole. The bars show the average value per year with 95 % and 99.8 % confidence intervals, and are broken down by operated and non-operated fractures, represented by the blue and light blue section of the bar, respectively. The vertical line indicates the rate for Norway as a whole. The rates have been adjusted for gender and age.

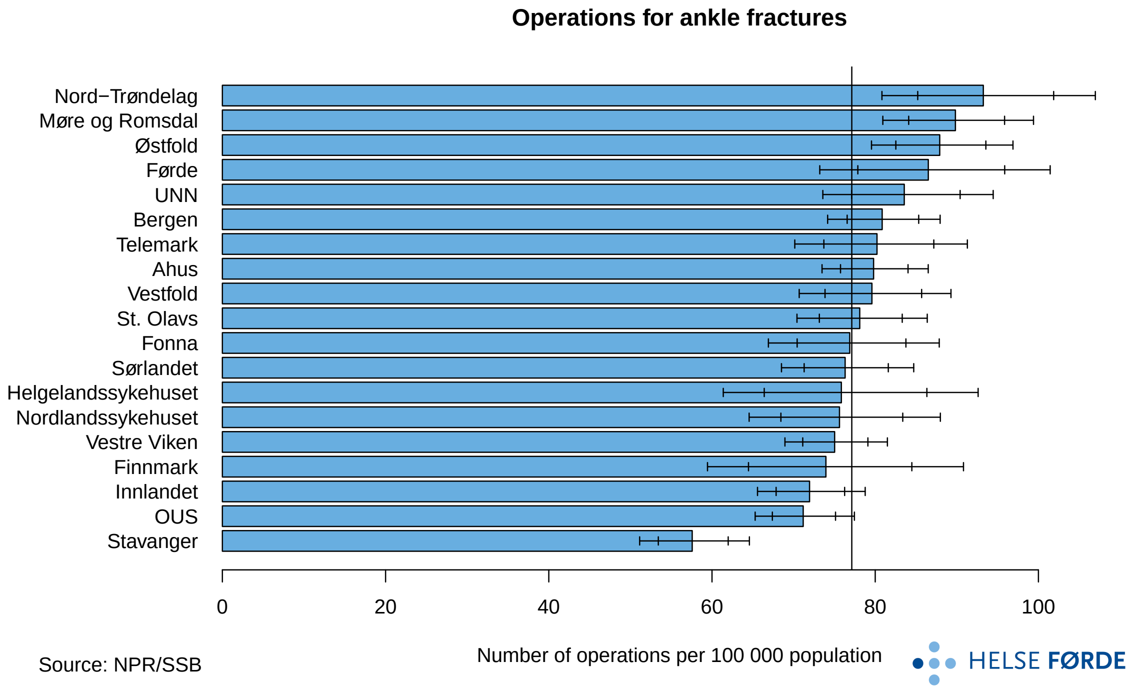


Figure 5.45: Surgery rate: Number of operated ankle fractures per 100,000 population (18 years and older), broken down by hospital referral area. The bars show the average value per year for the period 2012–2016, with pertaining 95 % and 99.8 % confidence intervals. The vertical line indicates the average for Norway as a whole. The rates have been adjusted for gender and age.

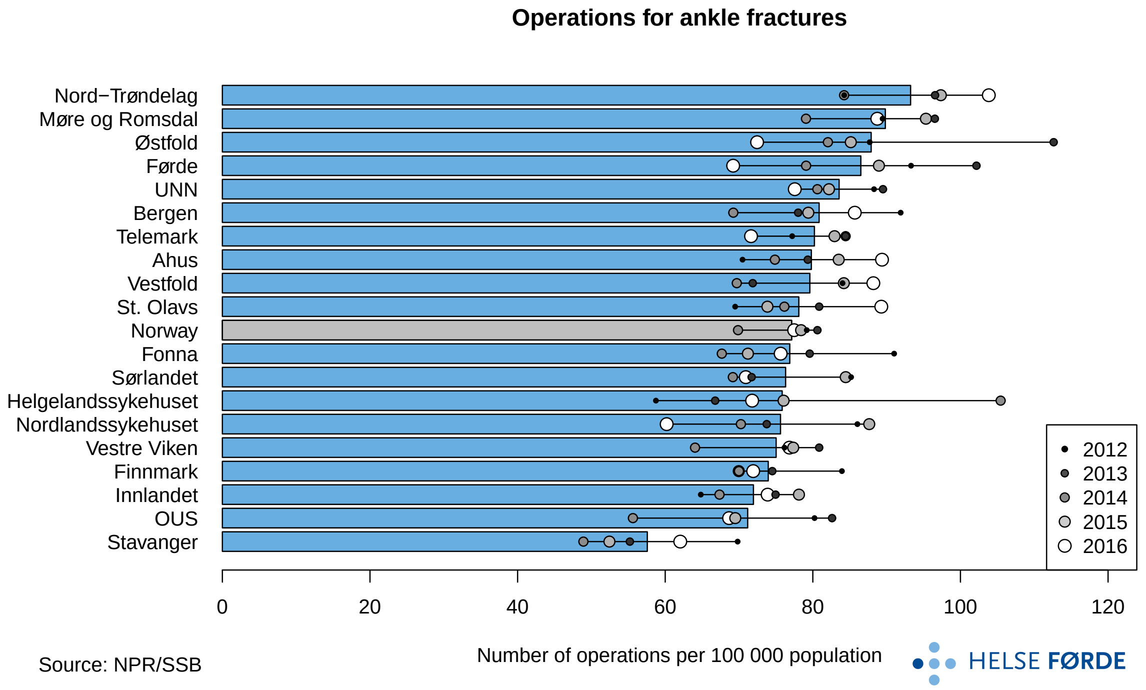


Figure 5.46: Surgery rate: Number of operated ankle fractures per 100,000 population (18 years and older), broken down by hospital referral area and for Norway as a whole. The bars show the average value per year for the period 2012–2016, and the dots represent the rates for each year. The rates have been adjusted for gender and age.

Table 5.6: Ankle fractures. Fracture rate, number of fractures, surgery rate, number of operations and the population broken down by hospital referral area and for Norway as a whole. Figures represent average values per year (2012–2016) and apply to the population aged 18 years and older. Rates have been adjusted for gender and age.

Hospital referral area	Fracture rate	Number of fractures	Surgery rate	Number of operations	Population
Ahus	235.2	865	79.8	293	370,737
Helgelandssykehuset	247.7	154	75.8	47	61,456
Bergen	234.1	772	80.9	267	335,924
Finnmark	253.9	150	74.0	44	58,702
Fonna	222.1	302	76.9	105	135,469
Førde	235.8	202	86.5	74	84,077
Nord-Trøndelag	264.8	284	93.2	100	106,072
Møre og Romsdal	261.8	536	89.8	184	201,630
Stavanger	194.9	500	57.6	145	265,081
Innlandet	231.3	755	72.0	234	315,870
Nordlandssykehuset	245.0	265	75.6	82	106,963
Østfold	209.7	478	87.9	200	222,700
Sørlandet	241.8	543	76.3	172	224,372
St. Olavs	226.2	535	78.1	186	240,031
Telemark	235.8	331	80.2	113	135,860
UNN	254.1	378	83.6	124	147,894
Vestfold	217.1	391	79.6	143	176,835
Vestre Viken	227.3	837	75.0	277	363,780
OUS	223.4	878	71.2	280	427,887
Norway	230.3	9,155	77.1	3,069	3,981,340

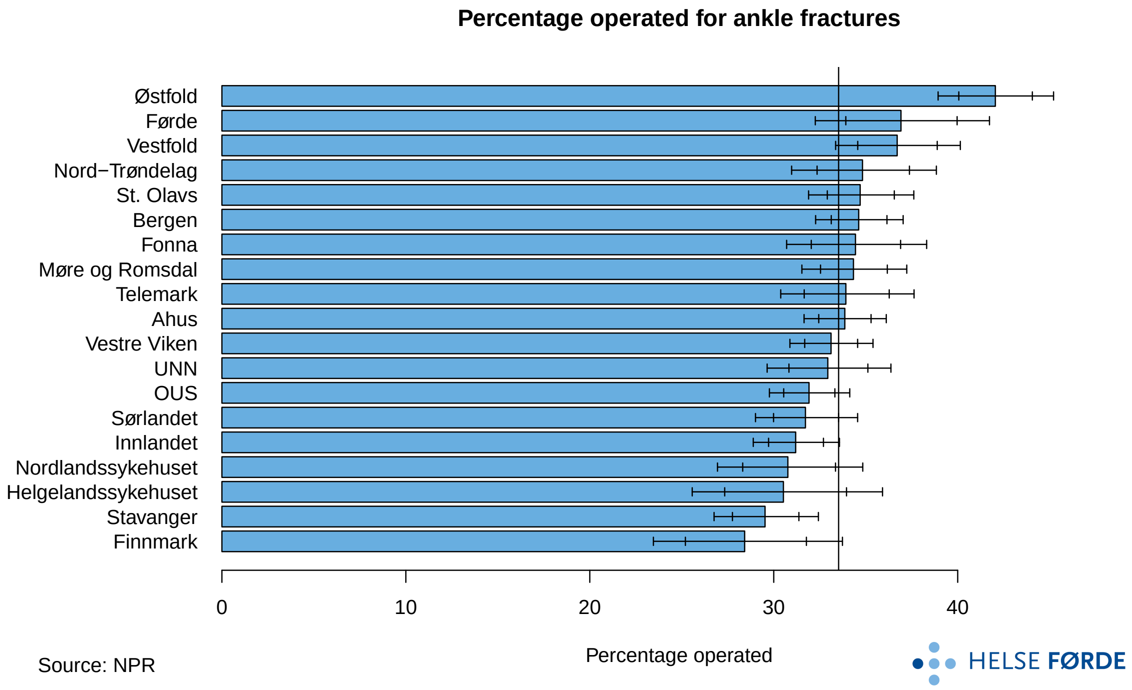


Figure 5.47: Percentage of ankle fractures operated (2012–2016), with 95 % and 99.8 % confidence intervals, per hospital referral area. Vertical line indicates percentage operated on for Norway as a whole. Percentages have been adjusted for gender and age and concern patients 18 years and older.

5.2.3 Hip fractures

Hip fractures (proximal femoral fracture) are one of Norway's three most common types of fracture. Elderly women make up the majority of patients (Johnsen et al., 2015; Søgaard et al., 2016). At approximately 9,000 operations per year, Norway has the highest incidence of hip fractures in Europe (Støen et al., 2012).

A hip fracture is a fracture in the upper part of the femur, either at the neck of femur (collum) or at the bony prominences directly below it (trochanter). Femoral neck fractures will often result in misalignment, and most such cases are treated by prosthetic replacement of the joint. Non-displaced femoral neck fractures are usually fixated by means of screws (Frihagen et al., 2010; Gjertsen et al., 2017). The treatment for fractures at the trochanters (pertrochanteric or subtrochanteric fractures) usually consists of stabilising the fracture using screws, plates or intramedullary nails (Gjertsen et al., 2017).

There is general consensus that patients with hip fractures should be operated on within one or two days of their injury (Johnsen et al., 2015), and national quality indicators[21] have been developed to measure to what extent this goal is achieved. The patients are often frail and have several medical conditions, and many also suffer from dementia (Johnsen et al., 2015). Research shows that a comprehensive geriatric assessment of elderly hip fracture patients can result in lower mortality, shorter lengths of stay, lower costs and fewer patients being discharged to an institution (Eamer et al., 2018). On the basis of the above, the Norwegian Orthopaedic Association, the Norwegian Geriatrics Society and the Norwegian Anaesthesiological Society drew up the guidelines *Norske retningsliner for tverrfaglig behandling av hoftebrudd* ('Norwegian guidelines for interdisciplinary treatment of hip fractures' – in Norwegian only) (Legeforeningen, 2018).

Sample

Surgical treatment of hip fractures is defined by a primary or secondary diagnosis of ICD-10 codes S72.0 (fracture of neck of femur), S72.1 (pertrochanteric fracture) or S72.2 (subtrochanteric fracture) in combination with one or more of the NCSP procedure codes for primary prosthetic replacement (code block NFB) or fracture surgery (code block NFJ). All codes in code block NFB are included. The following procedure codes from code block NFJ are included: external fixation (NFJ20, NFJ21, NFJ22), fixation using bioimplant (NFJ30, NFJ31, NFJ32), fixation using wire, cerclage or pin (NFJ40, NFJ41, NFJ42), fixation using intramedullary nail (NFJ50, NFJ51, NFJ52), fixation using plate and screws (NFJ60, NFJ61, NFJ62), fixation using screws alone (NFJ70, NFJ71, NFJ72), fixation using other or combined methods (NFJ80, NFJ81, NFJ82) or other fracture surgery (NFJ90, NFJ91, NFJ92).

Surgical treatment of femoral neck fractures is defined by a primary or secondary diagnosis of ICD-10 code S72.0 in combination with one or more of the NCSP procedure codes for surgical treatment of hip fractures. The surgical technique figures (Figures 5.55 and 5.56) include the following procedures: total prosthetic replacement (NFB20, NFB30, NFB40), partial prosthetic replacement (NFB00, NFB01, NFB02, NFB09, NFB10, NFB11, NFB12, NFB19) and fracture surgery (NFJ20, NFJ30, NFJ40, NFJ50, NFJ60, NFJ70, NFJ80, NFJ90).

Correspondingly, surgical treatment of trochanteric fractures is defined by a primary or secondary diagnosis of ICD-10 code S72.1 or S72.2 in combination with one or more of the NCSP procedure codes for surgical treatment of hip fractures. The surgical technique figures[22] (Figure 5.59 and 5.60) include

[21] https://helsenorge.no/Kvalitetsindikatorer/behandling-av-sykdom-og-overlevelse/hoftebrudd-operert-innen-24-og-48-timer

[22] Updated in January 2019.

fixation using intramedullary nail (NFJ51, NFJ52), fixation using sliding hip screw and plate (NFJ61, NFJ62, NFJ81, NFJ82) and other surgical techniques (osteosynthesis: NFJ21, NFJ22, NFJ31, NFJ32, NFJ41, NFJ42, NFJ71, NFJ72, NFJ91, NFJ92 and prosthetic replacement: NFB20, NFB30, NFB40, NFB00, NFB01, NFB02, NFB09, NFB10, NFB11, NFB12, NFB19).

It is a requirement that more than 180 days must elapse between contacts with the health service for a registered hip fracture for the same person in order for a fracture to be counted as a new fracture. This requirement was set in order to arrive at as correct a number of hip fractures as possible and avoid follow-up appointments being counted as new fractures. Correspondingly, operations must be at least 180 days apart to be counted as separate procedures. Only patients aged 18 years or older are included in the sample, except in the figures that show the gender and age distribution of patients who have been operated for hip fractures (Figure 5.48).

The surgery rates have been adjusted for gender and age.

Findings

For the period 2012–2016, we found that an average of 8,892 operations per year were performed on patients with hip fractures, with the highest number found in the age group 80–89 years (Table 5.7 and Figure 5.48). Of these operations, 68 % were on women.

We see from Table 5.7 and Figure 5.49 that an average of 222 hip fracture operations per 100,000 population were performed in Norway each year. Østfold and Innlandet hospital referral areas were just over the national average during the period with 242 operations per 100,000 population, while the Stavanger and OUS areas were slightly below the national average with 205 and 209 operations per 100,000 population, respectively. For Norway as a whole, the number of operations per 100,000 population remained relatively stable throughout the period (Figure 5.50).

During the period, the average length of hospital stays in connection with surgical treatment for hip fractures was 5.9 days (median length 5 days) per episode of care, and it varied from 4.7 days in Stavanger to 7.8 days in Førde hospital referral area (Figure 5.51). There was a slight decreasing trend in the average length of stay during the period. This was particularly pronounced in Telemark hospital referral area, where the average length of stay decreased by 3 days during the period. The lengths of stay decreased by about one day in Førde, Bergen and Stavanger hospital referral areas, while it increased by a day in Finnmark during the period.

The average lengths of stay have been adjusted for age, gender and comorbidity, but we found that the difference between the adjusted and unadjusted figures was negligible. Long-term stays, i.e. stays longer than 20 days, made up 3 % (1,321 stays) of the total of 44,438 admissions for hip fracture surgery during the period. They have been excluded from the calculations of length of stay. Some stays are registered with codes for rehabilitation in hospital, and we found that the length of stay increased if we included these stays. This tendency was particularly pronounced for patients in Helgeland Hospital, Telemark and Stavanger hospital referral areas. Patients in these areas appear to begin their rehabilitation during the episode of care to a greater extent than patients in other hospital referral areas.

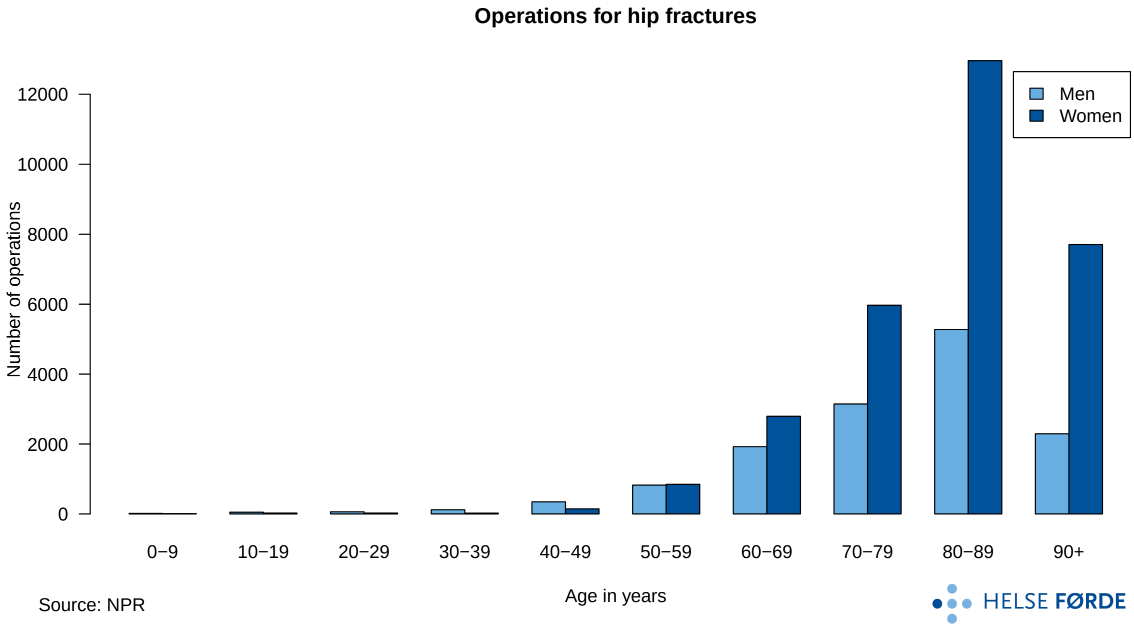


Figure 5.48: Total number of operations for hip fractures during the period 2012–2016, for Norway as a whole. The patients have been broken down by gender and age group.

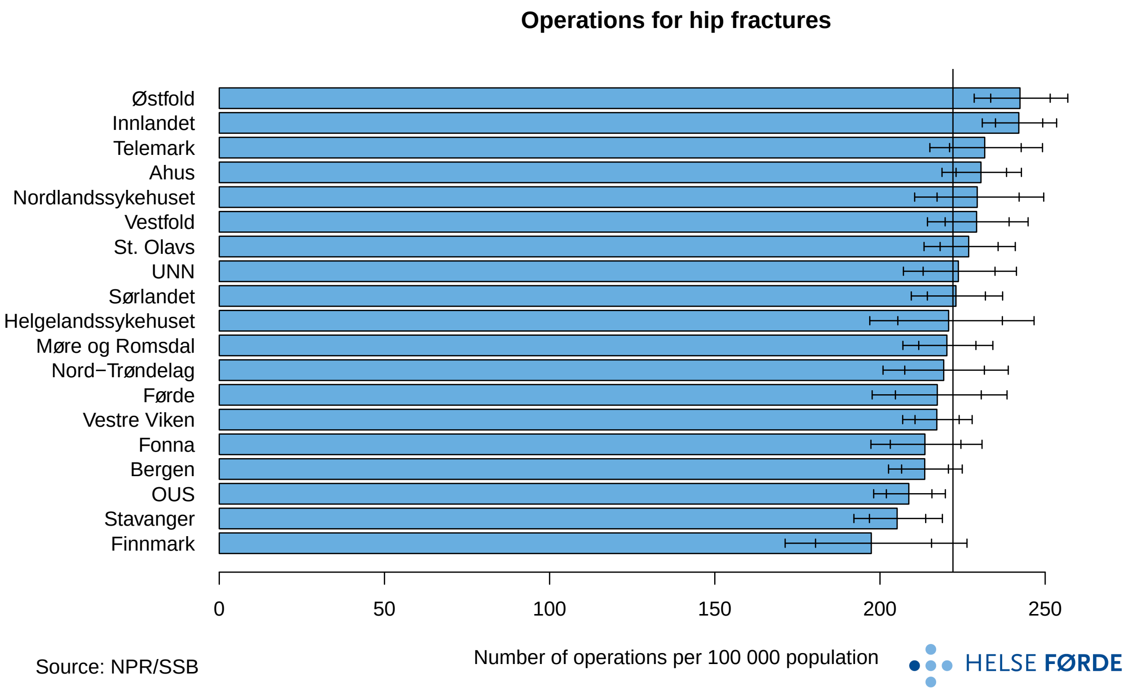


Figure 5.49: Surgery rate: Number of operated hip fractures per 100,000 population (18 years and older), broken down by hospital referral area. The bars show the average value per year for the period 2012–2016, with pertaining 95 % and 99.8 % confidence intervals. The vertical line indicates the average for Norway as a whole. The rates have been adjusted for gender and age.

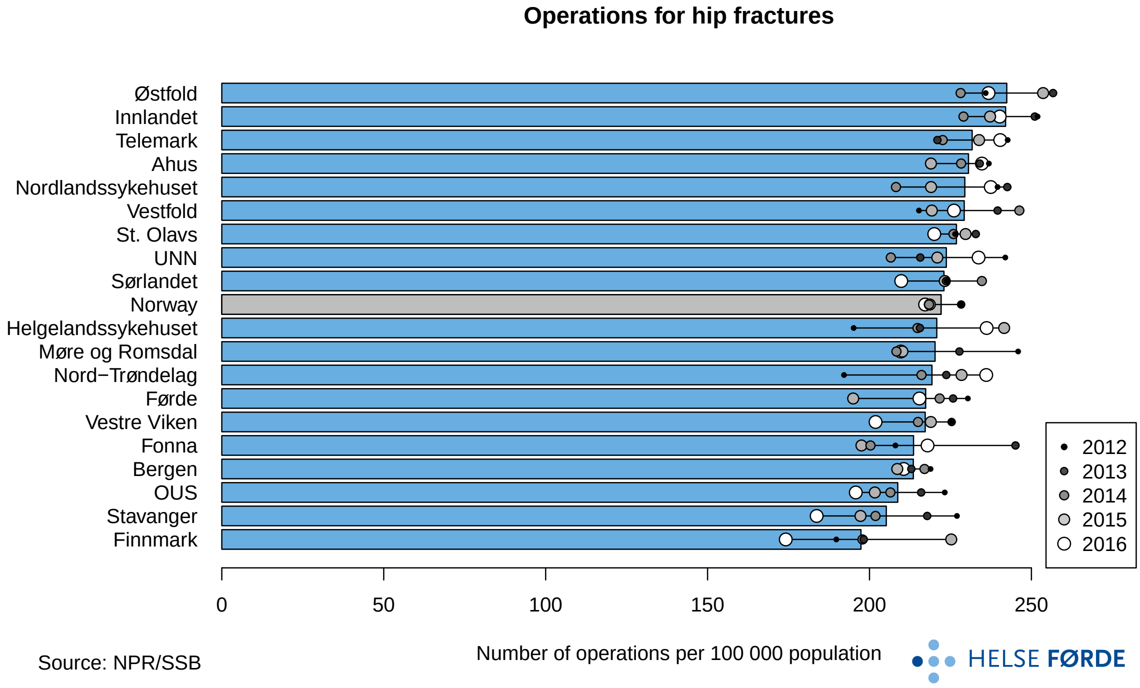


Figure 5.50: Surgery rate: Number of operated hip fractures per 100,000 population (18 years and older), broken down by hospital referral area and for Norway as a whole. The bars show the average per year for the period 2012–2016, and the dots represent the rates for each year. The rates have been adjusted for gender and age.

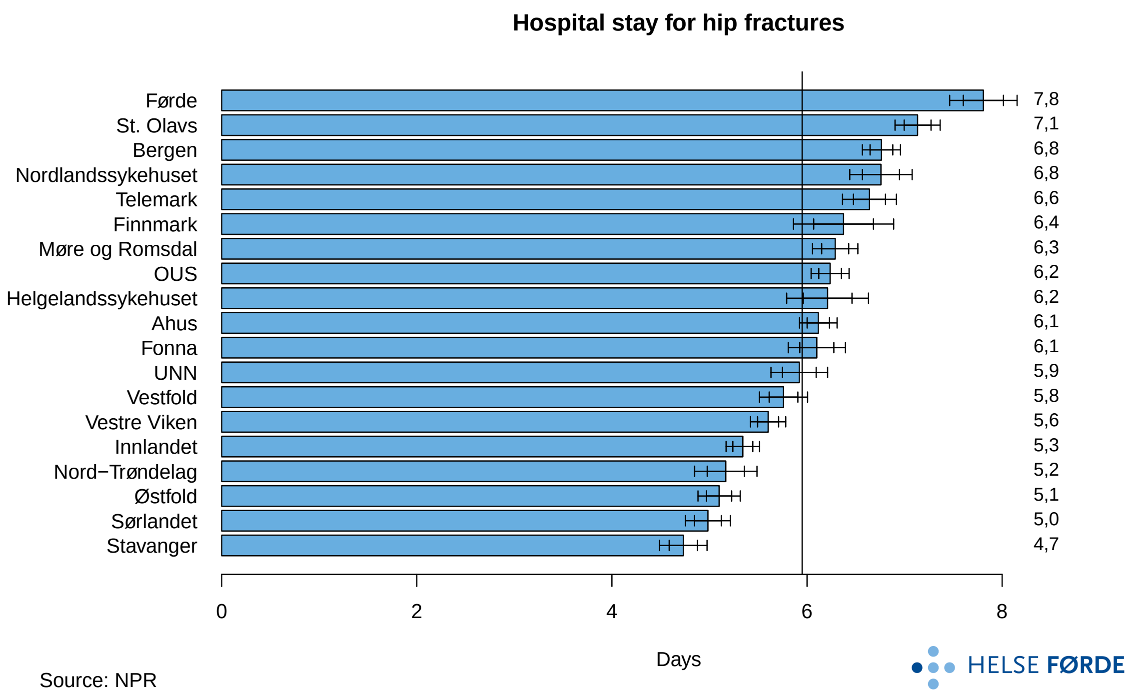


Figure 5.51: Average number of bed days per episode of care for hip fractures for patients aged 18 years and older during the period 2012–2016. The bars show the average value, with 95 % and 99.8 % confidence intervals, per hospital referral area. The vertical line indicates the average for Norway as a whole. The averages have been adjusted for gender, age and comorbidity.

Table 5.7: Hip fractures. Surgery rate, number of operations and population size, broken down by type of fracture, hospital referral area and for Norway as a whole. Figures represent average values per year (2012–2016) and apply to the population 18 years and older. Rates have been adjusted for gender and age.

	Surgery rate and number of operations for						
	Hip fractures		Femoral neck fractures		Trochanteric fractures		Population
Hospital referral area	Rate	Number	Rate	Number	Rate	Number	
Ahus	230.6	722	141.4	444	89.5	278	370,737
Helgelandssykehuset	220.8	154	142.5	100	79.0	55	61,456
Bergen	213.5	706	128.2	421	85.5	286	335,924
Finnmark	197.4	104	130.1	69	68.0	35	58,702
Fonna	213.6	313	137.4	200	76.4	113	135,469
Førde	217.3	224	122.0	124	95.4	100	84,077
Nord-Trøndelag	219.3	261	138.4	164	81.3	96	106,072
Møre og Romsdal	220.3	509	135.9	311	84.6	199	201,630
Stavanger	205.2	456	128.0	284	77.1	172	265,081
Innlandet	242.0	901	145.8	541	96.7	360	315,870
Nordlandssykehuset	229.4	268	147.8	171	82.1	96	106,963
Østfold	242.4	566	148.5	347	94.2	219	222,700
Sørlandet	223.0	501	144.5	324	79.0	178	224,372
St. Olavs	226.8	521	143.9	330	83.3	191	240,031
Telemark	231.7	359	139.8	216	92.2	144	135,860
UNN	223.7	332	144.1	213	79.7	118	147,894
Vestfold	229.2	437	138.9	264	90.8	174	176,835
Vestre Viken	217.2	821	126.7	477	90.8	344	363,780
OUS	208.7	736	121.0	421	87.7	314	427,887
Norway	222.1	8,892	136.0	5,421	86.4	3,471	3,981,340

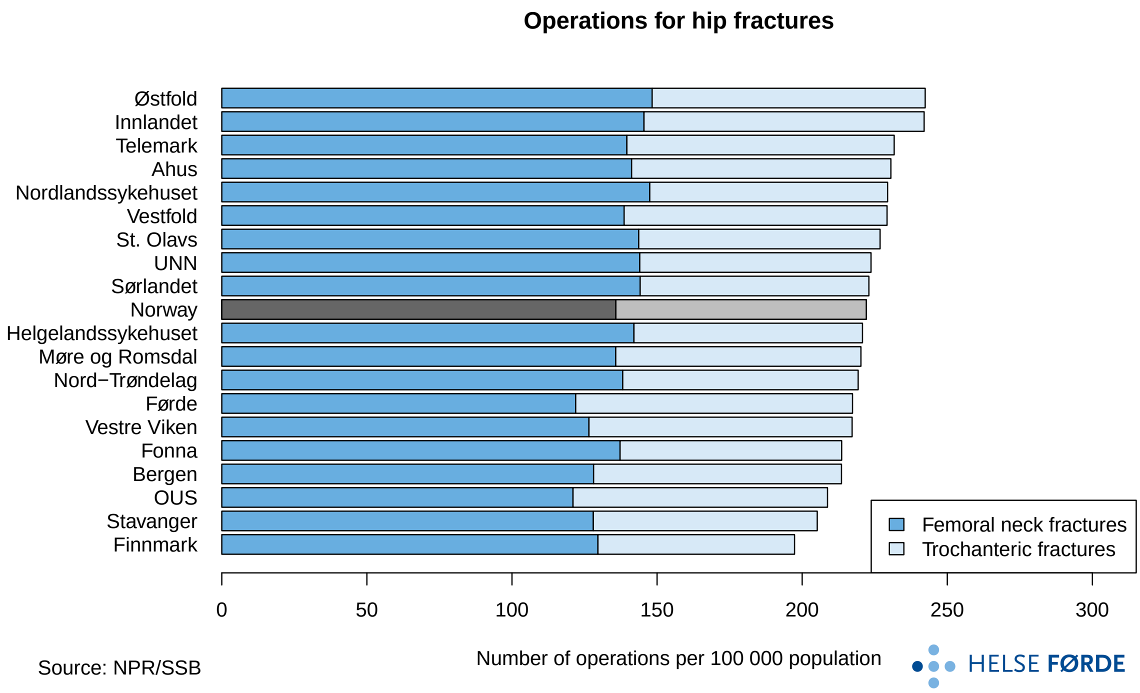


Figure 5.52: Surgery rate: Number of operated hip fractures per 100,000 population (18 years and older). The bars show average value per year (2012–2016), broken down by hospital referral area and for Norway as a whole. The rates have been adjusted for gender and age.

Femoral neck fractures

An average of 136 operations per year per 100,000 population were performed for femoral neck fractures, which made up 61 % of all hip fractures (Figure 5.52). The hospital referral areas of Østfold (148 operations) and Innlandet (146 operations) stood out with slightly higher average surgery rates, while Vestre Viken (127 operations) and OUS (121 operations) stood out with slightly lower surgery rates, but the variation between hospital referral areas is nonetheless low.

Figure 5.55 shows treatment of femoral neck fractures broken down by total prosthetic replacement, partial prosthetic replacement and osteosynthesis. The surgical technique chosen to treat a femoral neck fracture depends on whether there is misalignment or not, but femoral neck fractures are nevertheless presented as a group. The reason for this is that the data do not contain information about misalignment. We know from the Norwegian Hip Fracture Register[23] and other sources that approx. 75 % of all femoral neck fractures are misaligned, and partial prosthetic replacement is the recommended treatment, while osteosynthesis is an option for femoral neck fractures without misalignment.

Approx. 60 % of femoral neck fractures were treated with partial prosthetic replacement during the period (Figure 5.55), and the variation between hospital referral areas was greater than expected. We found the highest percentage of patients treated with partial prosthetic replacement in Østfold hospital referral area (over 70 %), while the corresponding percentage for the Helgeland Hospital area was surprisingly low (approx. 40 %). Part of this variation could be due to coding errors, but it seems likely that there were real differences in practice during the period.

The Norwegian guidelines for interdisciplinary treatment of hip fractures, *Norske retningslinjer for tverrfaglig behandling av hoftebrudd* (Legeforeningen, 2018), recommend total prosthetic replacement for patients who are otherwise healthy and fit. We found that the percentage of patients with femoral neck fractures who were treated with total prosthetic replacement was highest in Stavanger hospital referral area (20 %) and lowest in the Vestfold area (2 %).

Osteosynthesis is mostly used on the quarter of femoral neck fractures where there is no misalignment. The percentage of approx. 30 % for Norway as a whole is as expected, but the variation between hospital referral areas is greater than we would expect in this case as well. We found that the number of partial prosthetic replacement operations remained relatively stable during the period, while the number of osteosynthesis operations decreased somewhat and the number of total prosthetic replacement operations was more or less constant (Figure 5.56).

[23] https://www.kvalitetsregistre.no/registers/nasjonalt-hoftebruddregister

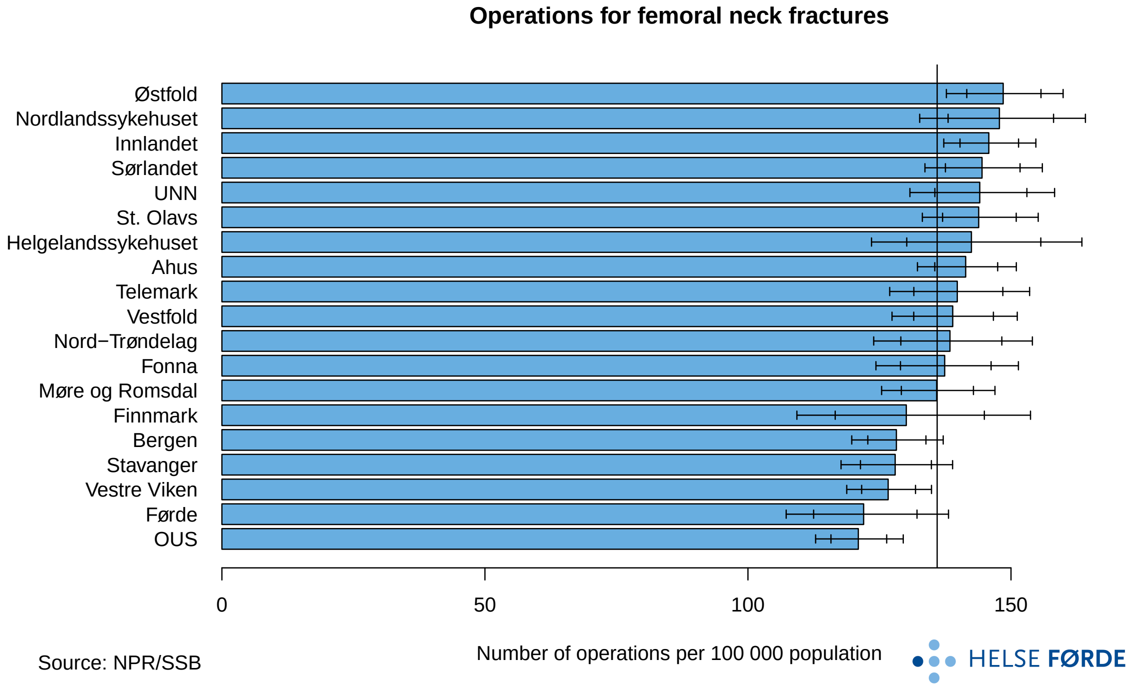


Figure 5.53: Surgery rate: number of operated femoral neck fractures per 100,000 population (18 years and older), broken down by hospital referral area. The bars show the average value per year for the period 2012–2016, with pertaining 95 % and 99.8 % confidence intervals. The vertical line indicates the average for Norway as a whole. The rates have been adjusted for gender and age.

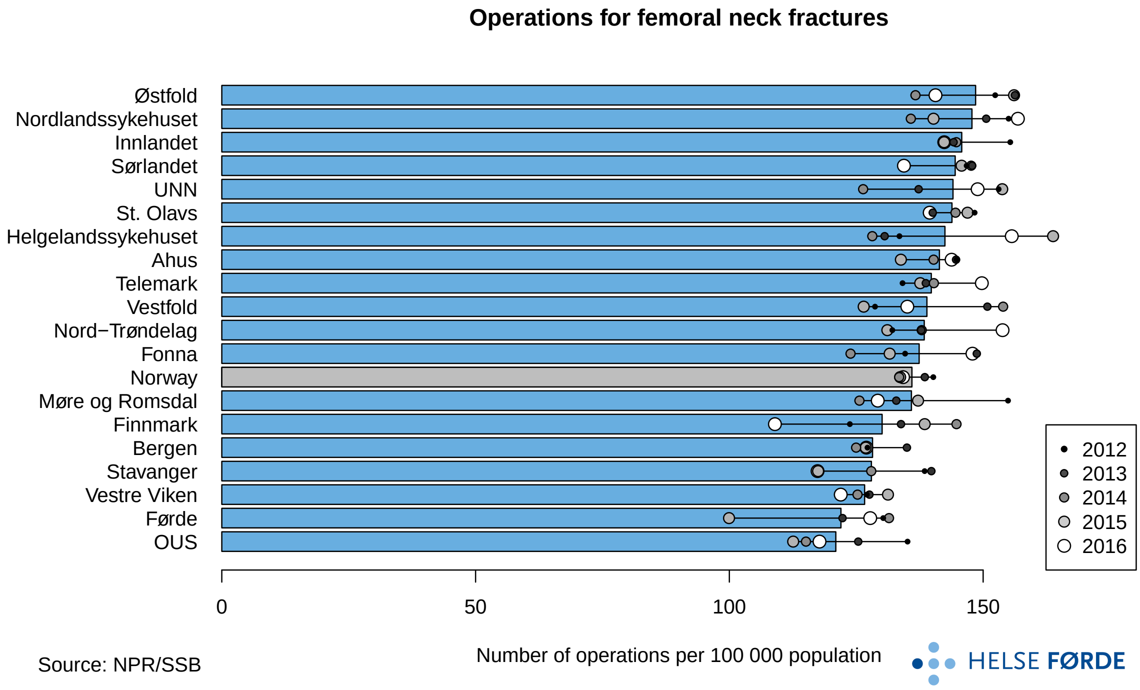


Figure 5.54: Surgery rate: number of operated femoral neck fractures per 100,000 population (18 years and older), broken down by hospital referral area and for Norway as a whole. The bars show the average value per year for the period 2012–2016, and the dots represent the rates for each year. The rates have been adjusted for gender and age.

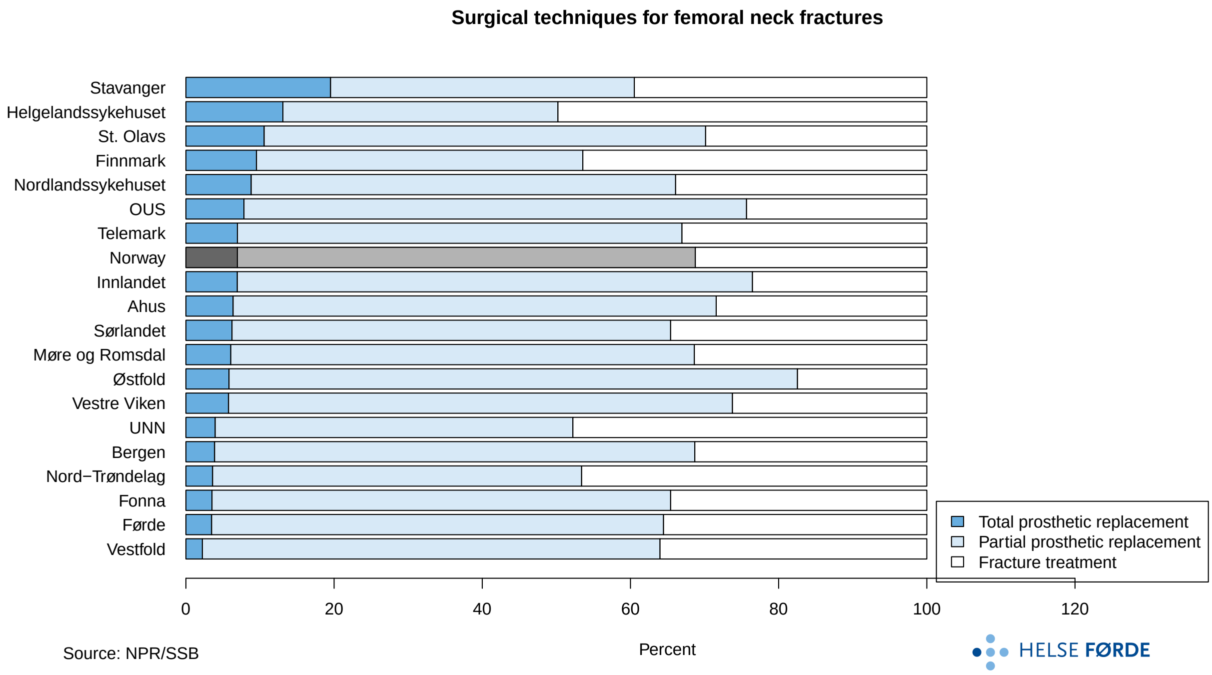


Figure 5.55: Surgical techniques for treating femoral neck fractures in patients aged 18 years and older, broken down by hospital referral area and for Norway as a whole, and by the most common methods: total prosthetic replacement, partial prosthetic replacement and treatment using different forms of osteosynthesis. The figure shows the percentage of operations for femoral neck fractures in which the different techniques were used during the period 2012–2016.

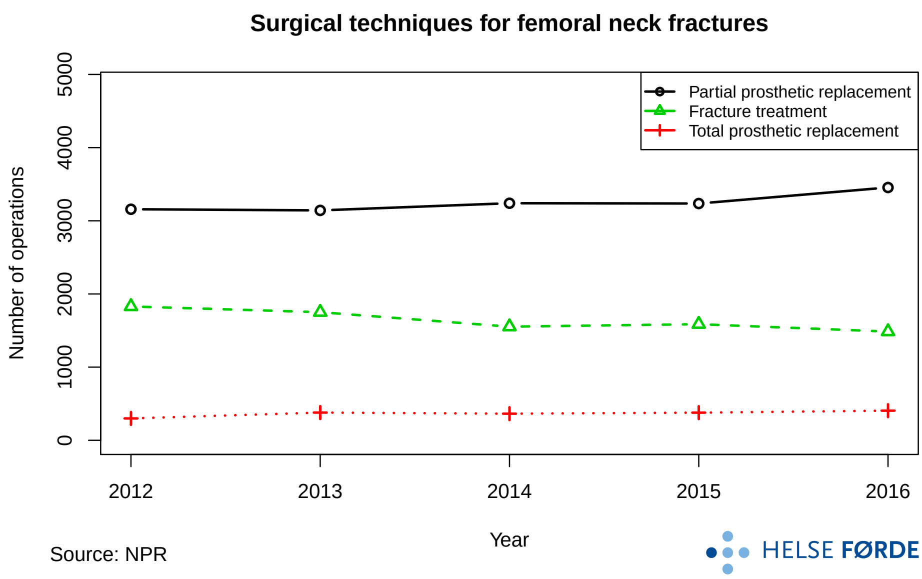


Figure 5.56: Surgical techniques for treating femoral neck fractures, development over time. Total number of femoral neck fractures for Norway as a whole during the period 2012–2016 for patients aged 18 year and older, broken down by total prosthetic replacement, partial prosthetic replacement and treatment using different forms of osteosynthesis.

Trochanteric fractures

During the period 2012–2016, 39 % of hip fractures were trochanteric fractures (Figure 5.52). For Norway as a whole, an average of 86 operations per year per 100,000 population were performed to treat trochanteric fractures (Table 5.7). Figure 5.57 shows that there was little variation in surgery rates for trochanteric fractures. The hospital referral areas that stood out were Innlandet, which had a somewhat higher average surgery rate (97), and Stavanger (77) and Finnmark (68), which had lower surgery rates that random variation could explain. The ratio between the highest and lowest surgery rates is 1.4, which indicates that the variation was not very high. Several hospital referral areas' surgery rates varied from year to year, but without showing any clear increasing or decreasing trend (Figure 5.58).

During the period, nearly all (98 %) patients with trochanteric fractures were treated with osteosynthesis, i.e. fixation of the fracture. The choice of surgical technique depends on the type of trochanteric fracture in question, and these differences cannot be identified from our data set. The most common surgical techniques used to treat trochanteric fractures[24] were fixation using an intramedullary nail or sliding hip screw (Figures 5.59 and 5.60). For Norway as a whole, the sliding hip screw was the most common surgical technique (62 %), although use of the intramedullary nail technique increased from 28 % to 41 % during the period. Partial and total prosthetic replacement were rarely used (2 %). In 1 % of operations, only procedure codes for fixation with osteosynthesis equipment other than a sliding hip screw or intramedullary nail were registered (fixation using wire, cerclage or pin, screws or bioimplants).

The choice of surgical methods to treat patients with trochanteric fractures varied between hospital referral areas (Figure 5.59). We found that the percentage of sliding hip screw operations was highest in the hospital referral areas of Finnmark (93 %), Ahus and OUS (85 %). The percentage of intramedullary nail fixation was highest in the Østfold and Førde areas (more than 90 %), while the method was used in approx. 50 % of cases in four hospital referral areas. During the period, prosthetic replacement was most common in the Sørlandet (5 %) and St. Olavs (4 %) areas, while it was used in 2 % of operations in half of the hospital referral areas, and not at all in Finnmark and Førde.

[24] Updated in January 2019.

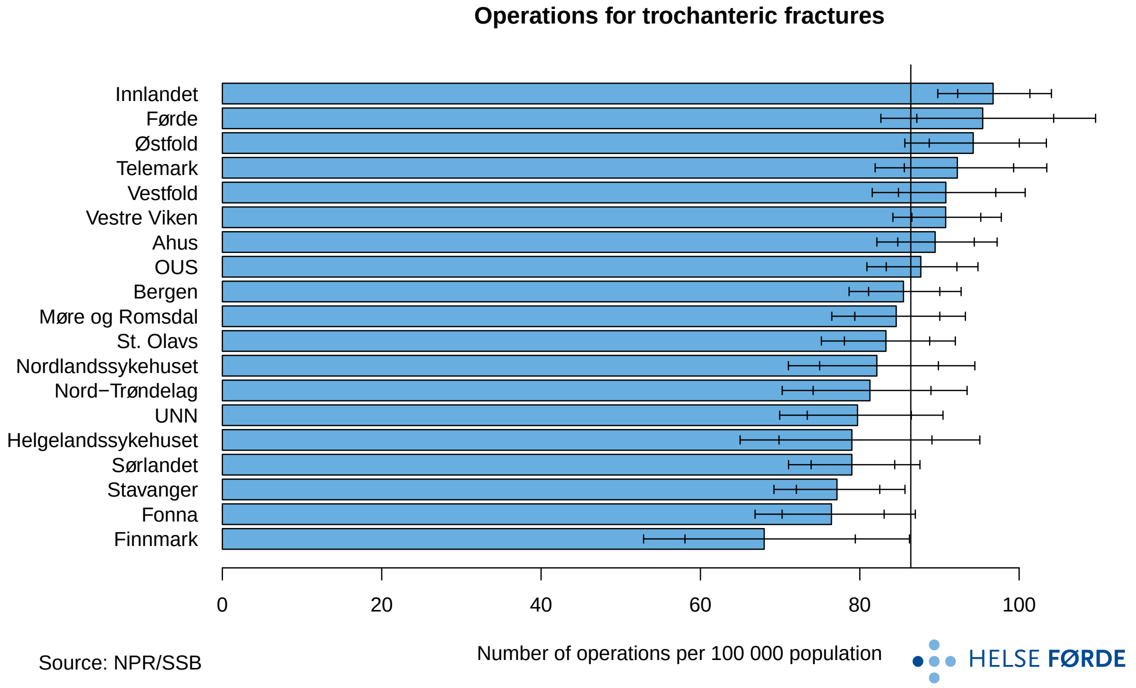


Figure 5.57: Surgery rate: number of operated trochanteric fractures (hip fractures that are not femoral neck fractures) per 100,000 population (18 years and older), broken down by hospital referral area. The bars show the average value per year for the period 2012–2016, with pertaining 95 % and 99.8 % confidence intervals. The vertical line indicates the average for Norway as a whole. The rates have been adjusted for gender and age.

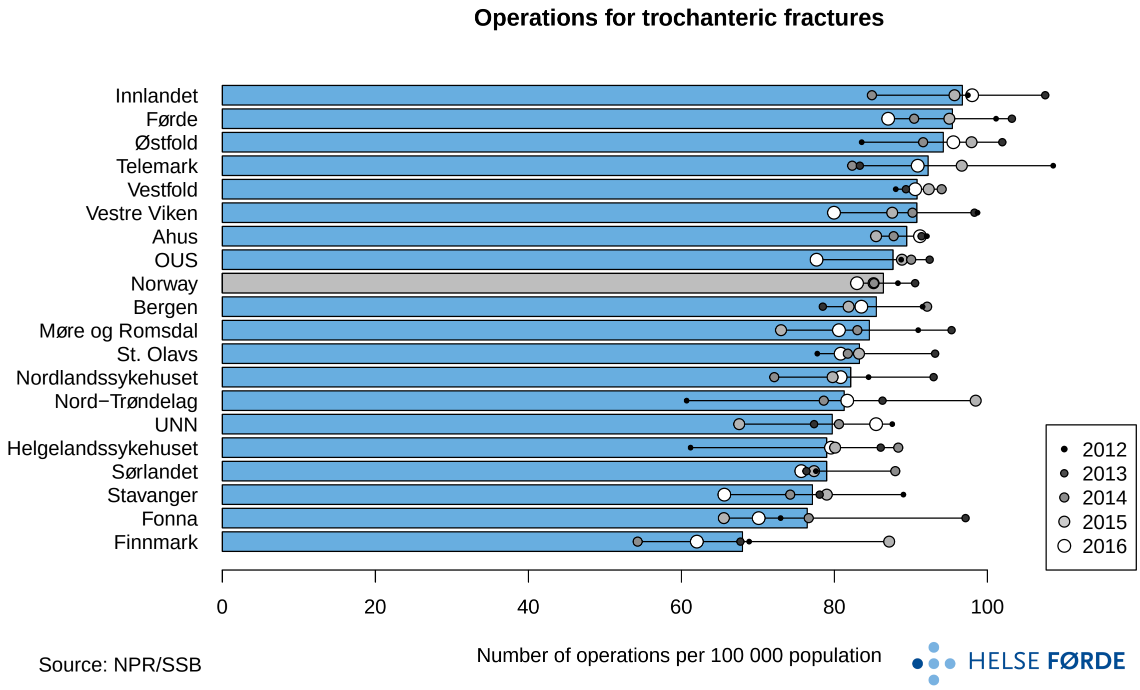


Figure 5.58: Surgery rate: number of operated trochanteric fractures (hip fractures that are not femoral neck fractures) per 100,000 population (18 years and older), broken down by hospital referral area and for Norway as a whole. The bars show the average value per year for the period 2012–2016, and the dots represent the rates for each year. The rates have been adjusted for gender and age.

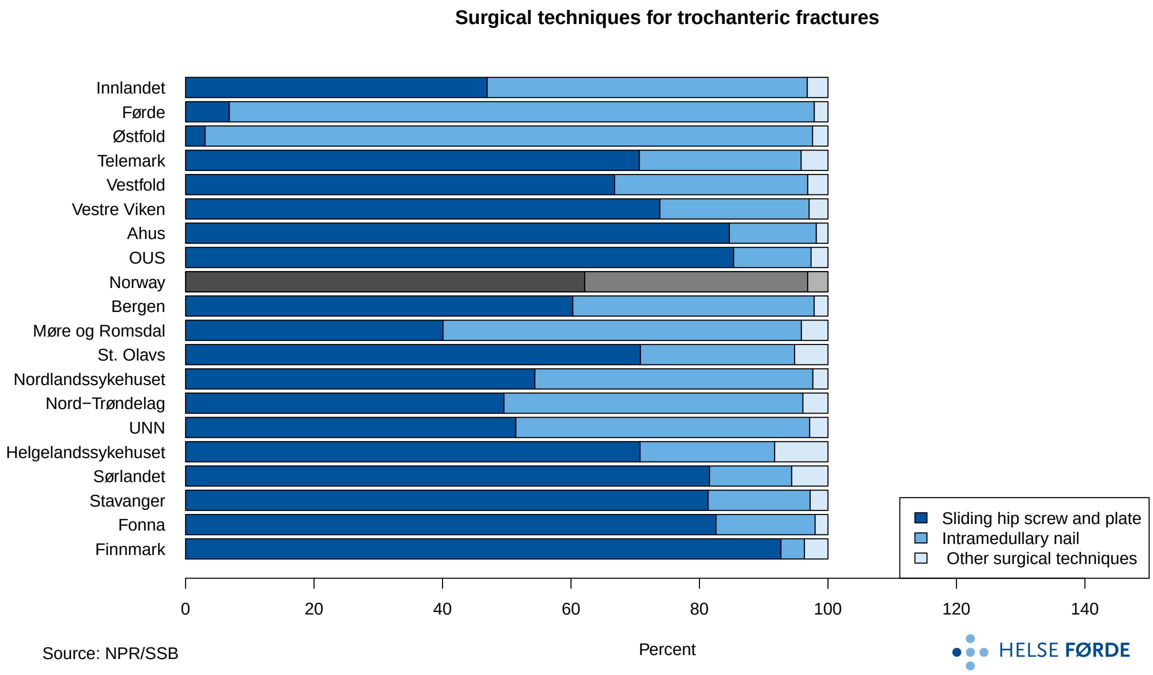


Figure 5.59: Surgical techniques used to treat trochanteric fractures (hip fractures that are not femoral neck fractures) in patients aged 18 years and older, broken down by hospital referral area and for Norway as a whole. The surgical techniques are broken down into the categories: sliding hip screw and plate, intramedullary nail and other surgical techniques. The figure shows the percentage of operations for trochanteric fractures in which the different techniques were used during the period 2012–2016. Updated in January 2019.

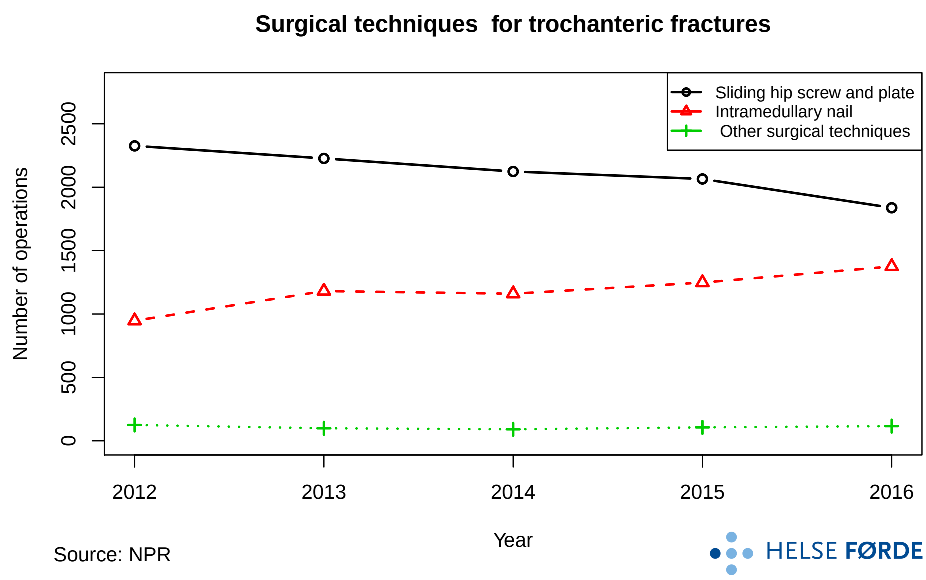


Figure 5.60: Surgical techniques for treating trochanteric fractures (hip fractures that are not femoral neck fractures), development over time. Total number of trochanteric fracture operations in Norway as a whole during the period 2012–2016 for patients aged 18 year and older, broken down by the categories: sliding hip screw and plate, intramedullary nail and other surgical techniques. Updated in January 2019.

Comments

The variation in surgery rates for hip fractures was low during the period 2012–2016 (see Chapter 5.5). The vast majority of patients with hip fractures receive surgical treatment, and there is consensus in the medical community about the indications for surgery. The variation in surgery rates primarily reflects the variation in the incidence of hip fractures between the different hospital referral areas, and we will therefore characterise this variation as warranted.

The average length of hospital stays for patients operated for hip fractures was three days longer in hospital referral areas with the longest stays than for patients from the areas with the shortest stays. We have not investigated how much of the variation is due to differences in the way services are organised or in access to, e.g., district medical centres during the postoperative period.

Of all hip fractures during the period 2012–2016, 61 % were femoral neck fractures and 39 % were trochanteric fractures. There was variation between hospital referral areas as regards whether sliding hip screws or intramedullary nails were the most commonly used surgical technique for treating trochanteric fractures. We found that the sliding hip screw technique was most common, but that the use of intramedullary nails increased during the period.[25] The variation was less pronounced for femoral neck fractures, although the variation in the use of partial prosthetic replacement to treat femoral neck fractures was surprisingly high. The data provide limited information about the type of fracture, and it is therefore not possible to directly correlate the analyses with the existing recommendations for choice of surgical technique.

[25]Updated in January 2019.

5.2.4 Shoulder fractures

Shoulder fractures, or fractures of the upper end of the humerus (proximal humeral fracture), account for approx. 5 % of adult extremity fractures (Court-Brown & Caesar, 2006). In persons over 60 years of age, shoulder fractures are the third most common type of fracture, with only hip and wrist fractures being more common(Roux et al., 2012).

Conservative treatment is considered relevant for about 80 % of shoulder fractures. If a fracture is clearly displaced or the bone has shattered into several pieces, surgery may be an option (Roux et al., 2012; Furnes, 2015; Bassett, 2017). Surgery can take the form of pinning, plate fixation or prosthetic replacement. Damage to nerves and blood vessels occurs in connection with 20–35 % of shoulder fractures, and prosthetic replacement may be necessary at a later date if the blood supply to the bone has been damaged or the bone fails to heal (NEL, 2016b; Bassett, 2017).

Despite several studies, clear guidelines are still lacking for the treatment of shoulder fractures (Rangan et al., 2015).

Sample

Shoulder fracture is defined by a primary or secondary diagnosis of ICD-10 code S42.2 (fracture of upper end of humerus). Surgical treatment of shoulder fractures is defined by a diagnosed shoulder fracture in combination with one or more of the NCSP procedure codes[26] for fixation of fracture (NBJ21, NBJ31, NBJ41, NBJ51, NBJ61, NBJ71, NBJ81, NBJ91) or primary prosthetic replacement (NBB02, NBB12, NBB20, NBB30, NBB40, NBB99).

Conservative treatment is defined by a shoulder fracture diagnosis and the absence of procedure codes for surgical treatment as listed above.

It is a requirement that more than 180 days must have elapsed between contacts with the health service for a registered shoulder fracture for the same person in order for a fracture to be counted as a new fracture. This requirement was set in order to arrive at as correct a number of shoulder fractures as possible and avoid follow-up appointments being counted as new fractures. Correspondingly, operations must be at least 180 days apart to be counted as separate procedures. Only patients aged 18 years or older are included in the sample, except in the figures that show the gender and age distribution of patients with shoulder fractures (Figure 5.61) and the gender and age distribution of patients who have been operated for shoulder fractures (Figure 5.62).

The surgery and patient rates have been adjusted for gender and age.

Findings

During the period 2012–2016, an average of 5,551 shoulder fractures per year, and 865 operations for shoulder fractures, were registered for Norway as a whole, meaning that 16% of patients with shoulder fractures had surgery (Table 5.8 and Figure 5.66). The vast majority were over 50 years of age, and about two-thirds were women (Figure 5.61).

On average, 140 shoulder fractures were registered per year per 100,000 population. The hospital referral area with the most shoulder fractures per 100,000 population was Bergen (177), while Helgeland Hospital (111) had the lowest number. The variation in the number of shoulder fractures per 100,000

[26] For codes for 2012–2016, see: https://ehelse.no/Documents/Helsefaglig 20kodeverk/NCMP-NCSP 20- 20NCRP 202016.pdf

population is higher than can be explained by chance (Figure 5.63), but the ratio of 1.6 indicates that the variation in incidence was not great.

For Norway as a whole, there were 22 operations on average on patients with shoulder fractures per 100,000 population per year (Table 5.8 and Figure 5.64). The highest numbers were found in Førde (33) and Østfold (32) hospital referral areas, and the lowest in UNN (14) and Finnmark (11). The rate for Finnmark hospital referral area is uncertain because the calculations are based on fewer than 40 persons. Of the patients who had surgery, 82 % had the fracture fixated and 18 % had a prosthetic replacement.

The surgery rate for Norway as a whole was stable during the period (Figure 5.65). For the individual hospital referral areas, we found changes from year to year, sometimes considerable changes. The clearest example was Førde hospital referral area, where the surgery rate decreased throughout the period. Big changes in surgery rates per year and wide confidence intervals are partly due to the fact that, at least for some hospital referral areas, the calculations are based on a relatively low number of patients. The variation in the percentage of patients operated on also has wide confidence intervals (Figure 5.66), and the variation is greater than can be explained by chance. Østfold and Førde hospital referral areas stand out with nearly 25 % operated on, while the lowest percentages are found in the UNN (11 %) and Finnmark areas. The percentage of patients operated on in Finnmark hospital referral area (8 %) is uncertain because the calculations are based on fewer than 40 persons.

Comments

The observed variation in surgical treatment of shoulder fractures was considerable. Surgical treatment is three times as common in Førde hospital referral area as in the UNN area. However, with a small number of operations during the period, a relatively high proportion of the observed variation could be random, and the element of systematic variation is uncertain. There was no great variation in fracture rates between hospital referral areas. Following an overall assessment, we have characterised the systematic variation in the surgical treatment of shoulder fractures as moderate to high (see Chapter 5.5). There is reason to believe that there was unwarranted variation in the use of surgical treatment for shoulder fractures.

The percentage of shoulder fractures operated on was somewhat lower than expected, but it corresponds to the proportion of shoulder fracture patients expected to benefit from surgical treatment, nationally and internationally.3

There are no national guidelines for the treatment of shoulder fractures.

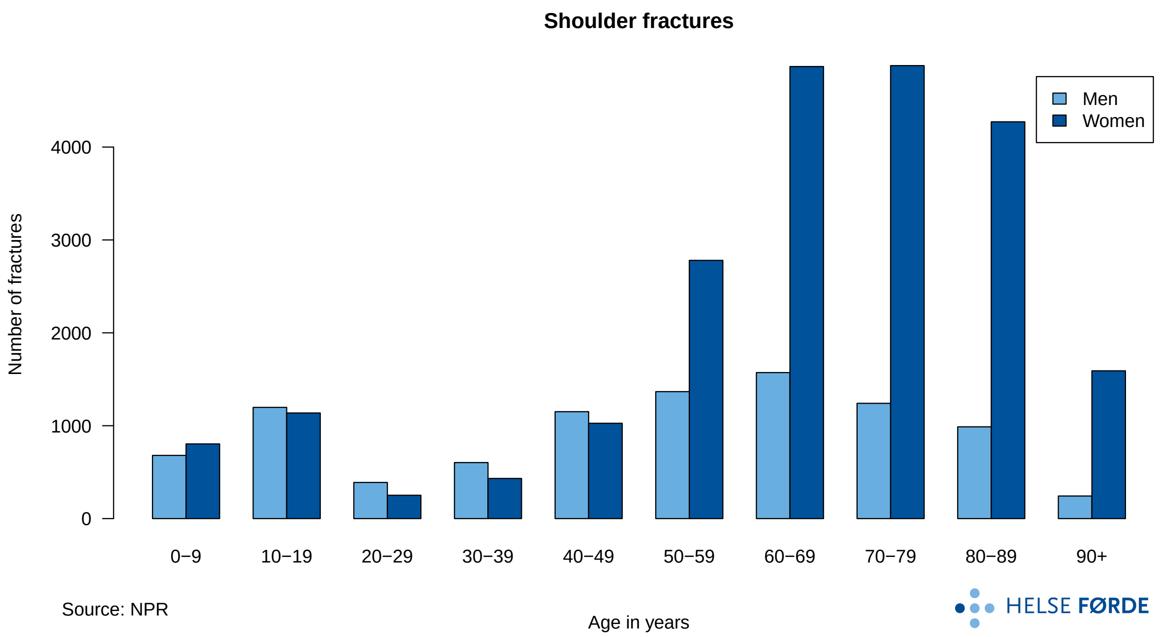


Figure 5.61: Total number of shoulder fractures during the period 2012–2016, for Norway as a whole. The patients have been broken down by gender and age group.

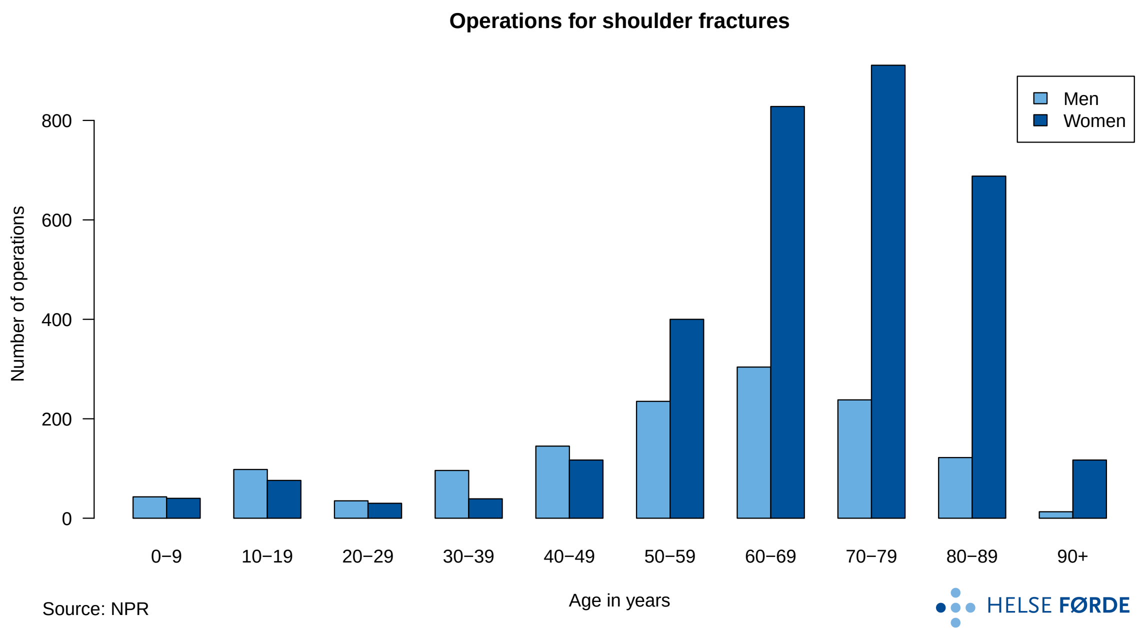


Figure 5.62: Total number of operations for shoulder fractures during the period 2012–2016, for Norway as a whole. The patients have been broken down by gender and age group.

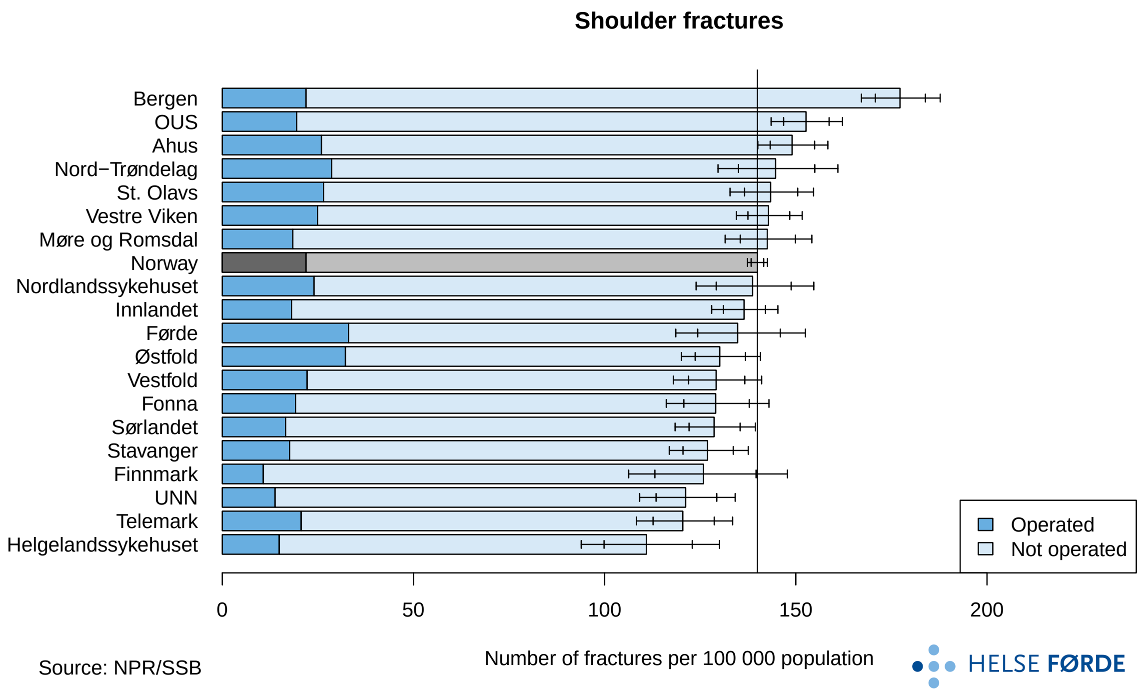


Figure 5.63: Fracture rate: Total number of shoulder fractures per 100,000 population (2012–2016), broken down by hospital referral area and for Norway as a whole. Bars show average value per year with 95 % and 99.8 % confidence intervals, broken down by operated and non-operated fractures. Vertical line indicates rate for Norway as a whole. Rates have been adjusted for gender and age and concern patients 18 years and older.

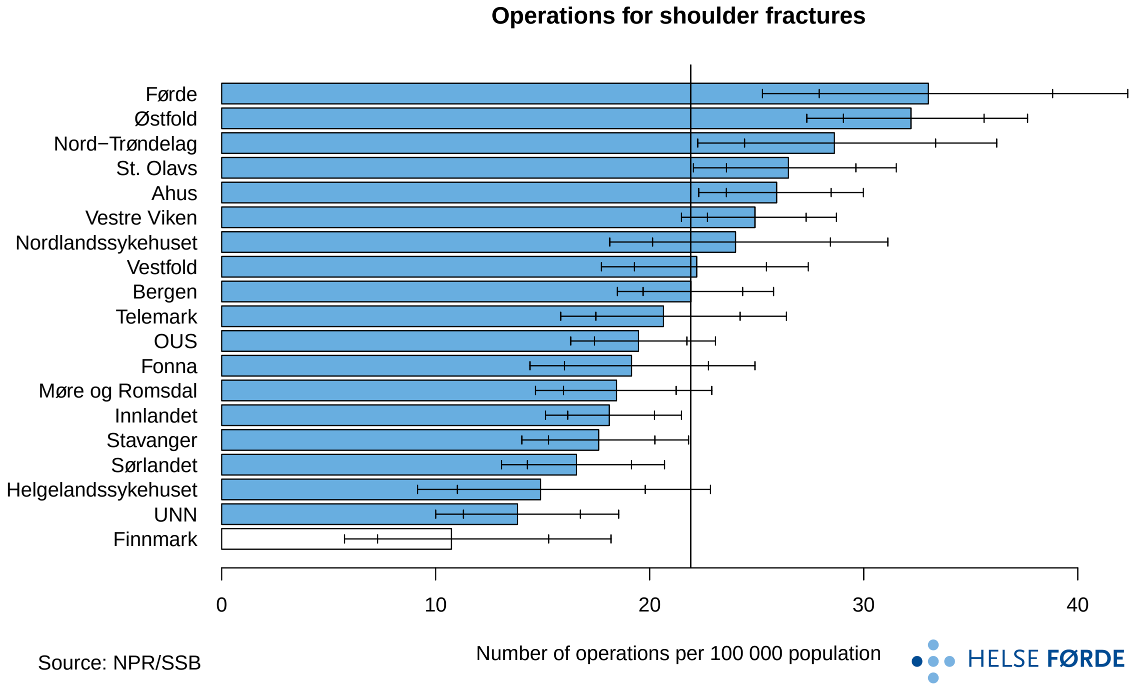


Figure 5.64: Surgery rate: Number of operated shoulder fractures per 100,000 population (18 years and older), broken down by hospital referral area. Bars show average value per year (2012–2016), with 95 % and 99.8 % confidence intervals. Vertical line indicates average for Norway. Rates have been adjusted for gender and age. Finnmark: the calculation is based on fewer than 40 unique persons, which makes the rate uncertain.

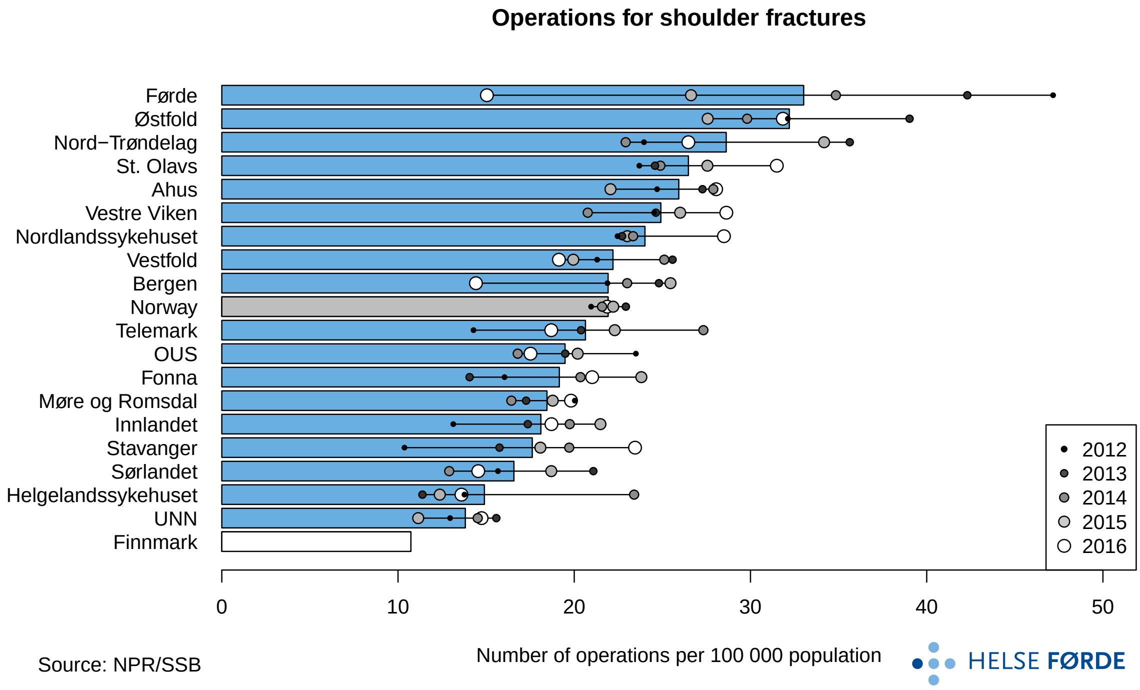


Figure 5.65: Surgery rate: number of operated shoulder fractures per 100,000 population (18 years and older), broken down by hospital referral area and for Norway as a whole. The bars show the average value per year for the period 2012–2016, and the dots represent the rates for each year. The rates have been adjusted for gender and age. Finnmark: the calculation is based on fewer than 40 unique persons, and this makes the rate uncertain.

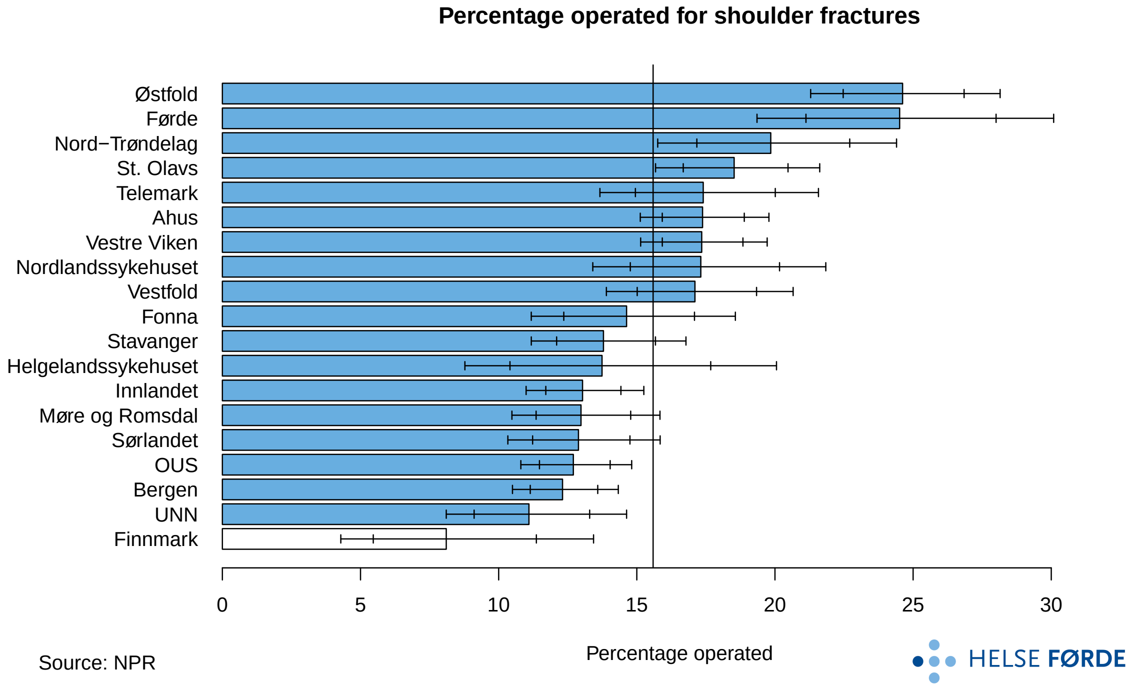


Figure 5.66: Percentage of shoulder fractures operated on, 2012–2016. The bars show, with 95 % and 99.8 % confidence intervals, how many per cent of shoulder fractures were operated on per hospital referral area, with a vertical line for Norway as a whole. The percentages have been adjusted for gender and age and concern patients aged 18 years and older. Finnmark: the calculation is based on fewer than 40 unique persons.

Table 5.8: Shoulder fractures. Fracture rate (fractures per 100,000 population), number of fractures, surgery rate (number of operations per 100,000 population), number of operations and the population broken down by hospital referral area and for Norway as a whole. The figures represent the average values per year during the period 2012–2016 and apply to the population aged 18 years and older. The rates have been adjusted for gender and age.

Hospital referral area	Fracture rate	Number of fractures	Surgery rate	Number of operations	Population
Ahus	149.0	514	25.9	89	370,737
Helgelandssykehuset	110.9	74	14.9	10	61,456
Bergen	177.2	573	21.9	71	335,924
Finnmark	125.8	72	10.7	6	58,702
Fonna	129.0	179	19.2	26	135,469
Førde	134.8	125	33.0	30	84,077
Nord-Trøndelag	144.7	166	28.6	33	106,072
Møre og Romsdal	142.5	308	18.5	40	201,630
Stavanger	126.9	297	17.6	41	265,081
Innlandet	136.5	485	18.1	64	315,870
Nordlandssykehuset	138.7	158	24.0	27	106,963
Østfold	130.1	306	32.2	76	222,700
Sørlandet	128.6	290	16.6	37	224,372
St. Olavs	143.4	333	26.5	61	240,031
Telemark	120.4	180	20.6	31	135,860
UNN	121.2	182	13.8	21	147,894
Vestfold	129.1	242	22.2	42	176,835
Vestre Viken	142.9	530	24.9	92	363,780
OUS	152.7	536	19.5	68	427,887
Norway	139.9	5,551	21.9	865	3,981,340

5.2.5 Clavicular fractures

The incidence of clavicular fractures is increasing and now accounts for 5–10 % of all fractures. It is mostly children and young people who break their clavicle, and such fractures are more common in men than in women (Huttunen et al., 2013). In approx. 80 % of cases, the fracture is in the middle third of the bone, while fractures in either end og the bone are less common (Matre & Hole, 2015). Because of their more flexible bones, fractures in children are somewhat different in nature and heal faster.

Most adult clavicular fractures are treated conservatively. Conservative treatment is the rule for children as well (Van der Meijden et al., 2012). Surgical treatment is mostly considered in cases where the fracture is clearly displaced or there is a risk of damage to blood vessels, the lung or the nerve network (brachial plexus) located directly under the clavicle. Surgical treatment can also be considered for young and active patients who need to return quickly to physical activity (Canadian, 2007). Several countries have seen an increase in the number of patients, adolescents and adults alike, who receive surgical treatment for clavicular fractures (Yang et al., 2015). This development is taking place despite the fact that it is debatable whether the benefits of surgical treatment of clavicular fractures outweigh the risks in adolescent patients (Huttunen et al., 2013).

Sample

Clavicular fracture is defined by a primary or secondary diagnosis of ICD-10 code S42.0 (fracture of clavicle).

Surgical treatment is defined by a diagnosed clavicular fracture in combination with one or more of the NCSP procedure codes for external fixation (NBJ22), fixation using bioimplant (NBJ32), fixation using wire, cerclage or pin (NBJ42), fixation using intramedullary nail (NBJ52), fixation using plate and screws (NBJ62), fixation using screws alone (NBJ72), fixation using other or combined methods (NBJ82) or other fracture surgery (NBJ92).

Conservative treatment is defined by a clavicular fracture diagnosis and the absence of procedure codes for surgical treatment as listed above.

Patients of all ages are included in the analyses of clavicular fractures.

In order to arrive at as correct a number of clavicular fractures as possible and avoid counting follow-up appointments as new fractures, only one registered clavicular fracture per patient has been counted during the five-year period. Correspondingly, only one operation per patient is counted to arrive at as correct a number of primary fracture operations as possible.

The surgery and patient rates have been adjusted for gender and age.

Findings

During the period 2012–2016, an average of 4,864 clavicular fractures and 649 operations on patients with clavicular fractures were registered per year, meaning that 13 % of patients with clavicular fractures had surgery (Table 5.9 and Figure 5.72). The highest number of clavicular fractures was found in the age group 0–19 years, and more boys than girls broke their clavicle (Figure 5.67). In all age groups, more men than women were operated for clavicular fractures, and the highest number of operations was found among patients in the age group 40–49 years (Figure 5.68).

There was little variation between hospital referral areas in the number of clavicular fractures per 100,000 population during the period. It was only Møre og Romsdal and Vestre Viken hospital referral areas that had a slightly higher number of clavicular fractures than expected as a result of random variation, assessed on the basis of fracture rates (Figure 5.69).

For Norway as a whole, an average of 13 operations for clavicular fractures were performed per 100,000 population per year (Table 5.9 and Figure 5.70), with the highest number of operations being in Østfold hospital referral area (17) and the lowest in the Fonna area (8). The most common form of surgical treatment was fixation using plate and screws.

The confidence intervals for surgery rates in the different hospital referral areas are wide, and the reason for this is the low number of operations. We can nonetheless see from Figure 5.70 that the differences are greater than can be explained by chance. The hospital referral areas of Østfold, St. Olavs, Ahus and Stavanger are slightly above the national average, while OUS and Fonna are slightly below it. The surgery rates for different years vary quite a lot during the period for most of the hospital referral areas, with the exception of St. Olavs and OUS.

For Helgeland Hospital referral area, the calculations were based on fewer than 40 unique persons, and this makes the rates uncertain. Rates for different years are not provided for the hospital referral areas of Helgeland Hospital and Førde (Figure 5.71) because fewer than six persons were operated on during at least one of the years in question. For Norway as a whole, 13 % of patients with clavicular fractures were operated on during the period. The percentage of patients operated for clavicular fractures was highest in Førde hospital referral area (21 %) and lowest in the OUS area (9 %). We see from Figure 5.72 that the differences between hospital referral areas were greater than can be explained by chance, but the small number of operations means that small changes can have a big impact.

Children under the age of 10 were rarely operated for clavicular fractures. In the age group 10–15 years, 4 % of patients were operated on, while the percentage in the age group 16–19 years was 19 %. In total, 9 % of patients in the age group 10–19 had surgery. We see that surgical treatment is mostly used on patients aged 16 years and older, and that the treatment regime for adolescents is similar to that for adults. We saw no increasing trend in surgical treatment for young patients (10–19 years) with clavicular fractures during the period 2012–2016. However, the period is too short and the patients too few for us to draw any definite conclusions about developments in the use of surgical treatment of adolescents with clavicular fractures.

Comments

There was clear variation in the surgical treatment of clavicular fractures. Twice as many patients per 100,000 population were operated on in Østfold and Førde hospital referral areas as in the Fonna and OUS areas. However, few operations were performed during the period, and a relatively high proportion of the observed variation may be random variation. The number of clavicular fractures did not vary much between hospital referral areas. Following an overall assessment, we have characterised the systematic variation in the surgical treatment of clavicular fractures as moderate (see Chapter 5.5). We cannot rule out the possibility that part of the variation may be unwarranted.

Due to the low surgery volume, clavicular fractures in patients of all ages were analysed together. This is not an optimal approach, given the differences in indications for surgery in adults and children. Adjusted for age, however, the analysis can nevertheless provide a picture of the variation between hospital referral areas in the use of surgical treatment for clavicular fracture in different parts of the country.

There are no national guidelines for the treatment of clavicular fractures.

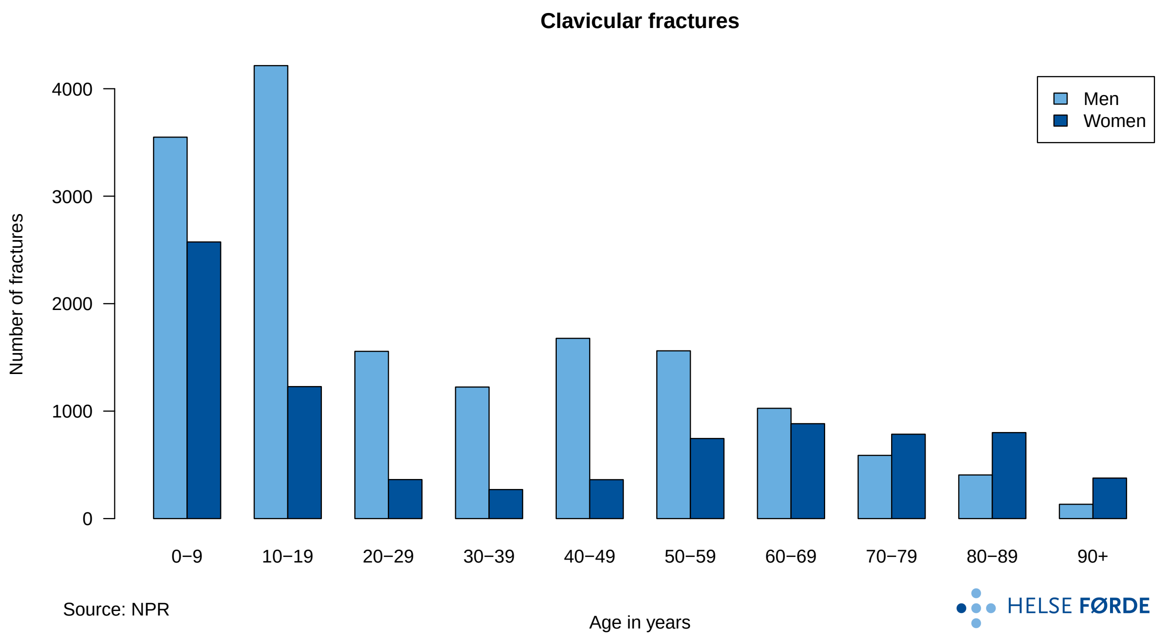


Figure 5.67: Total number of clavicular fractures during the period 2012–2016, for Norway as a whole. The patients have been broken down by gender and age group.

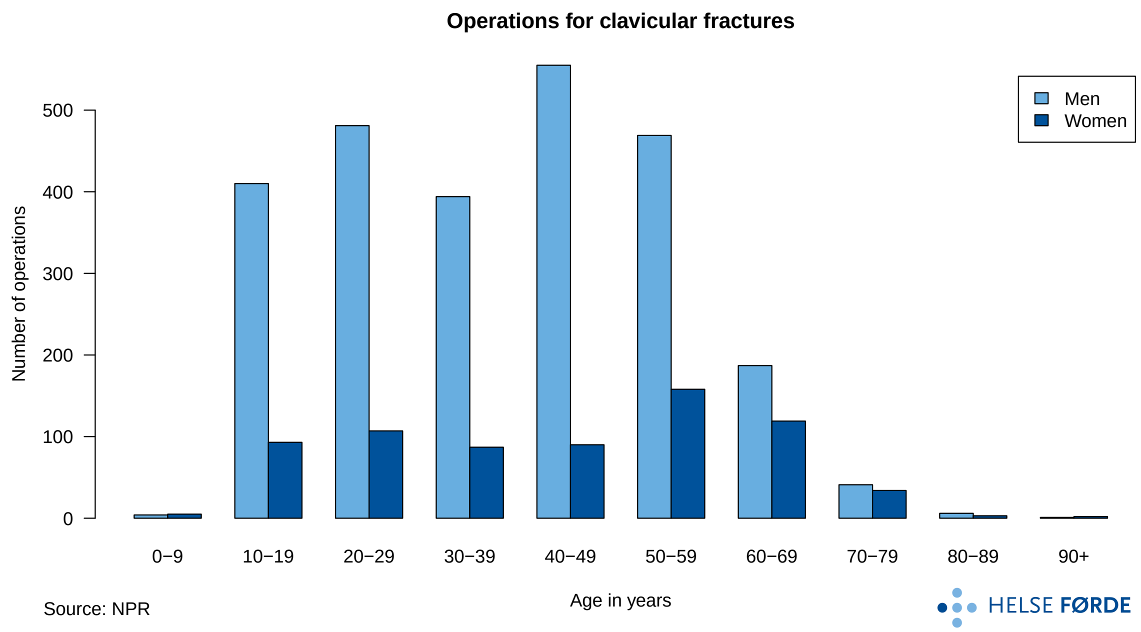


Figure 5.68: Total number of operations for clavicular fractures during the period 2012–2016, for Norway as a whole. The patients have been broken down by gender and age group.

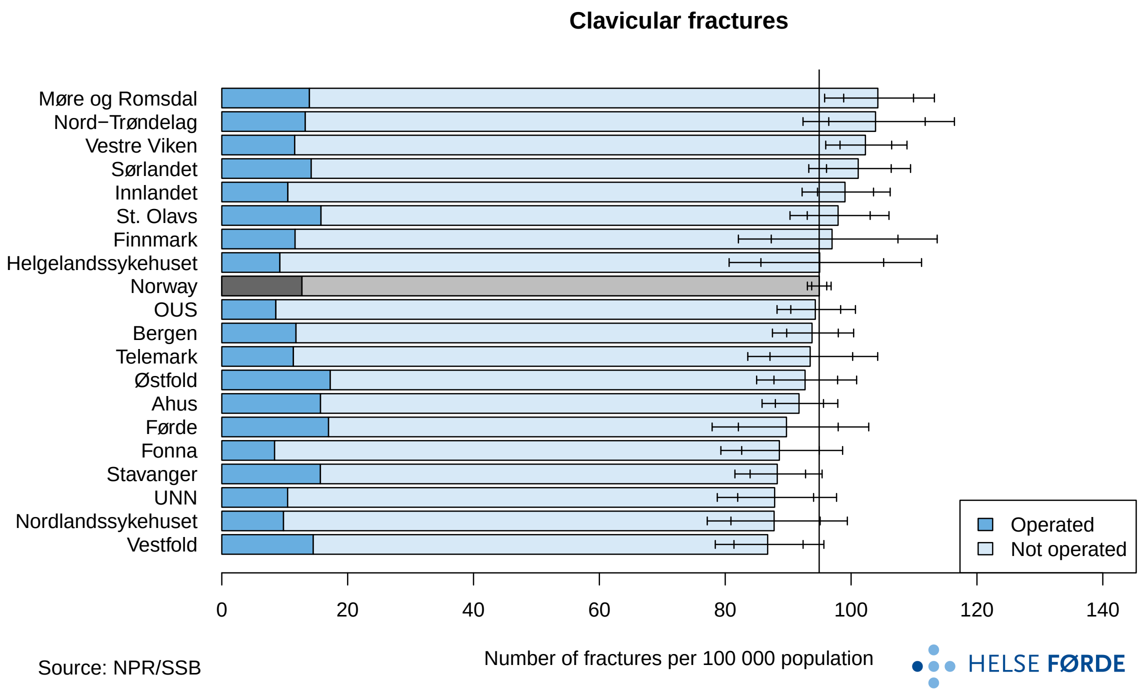


Figure 5.69: Fracture rate: number of clavicular fractures per 100,000 population (2012–2016), broken down by hospital referral area and for Norway as a whole. Bars show average value per year with 95 % and 99.8 % confidence intervals, broken down by operated and non-operated fractures. Vertical line indicates rate for Norway as a whole. Rates have been adjusted for gender and age and concern patients of all ages.

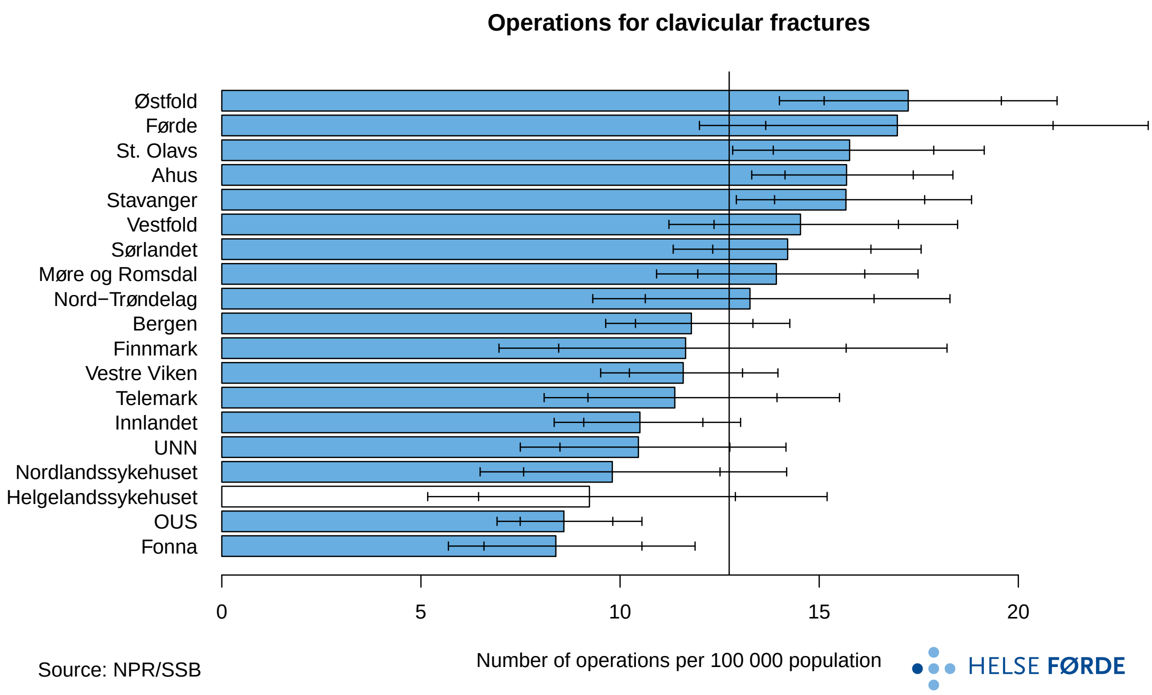


Figure 5.70: Surgery rate: Number of operated clavicular fractures per 100,000 population (all ages), broken down by hospital referral area. Bars show average value per year (2012–2016), with 95 % and 99.8 % confidence intervals. Vertical line indicates average for Norway as a whole. Rates have been adjusted for gender and age. Helgelandssykehuset: the calculation is based on fewer than 40 unique persons, which makes the rate uncertain.

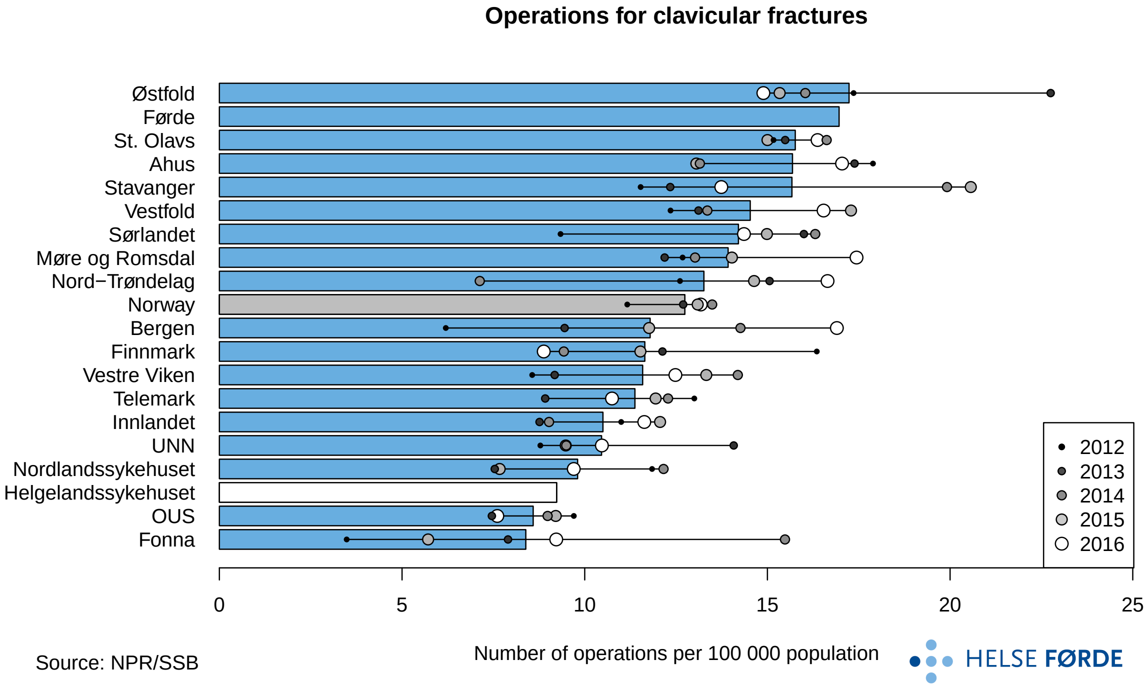


Figure 5.71: Surgery rate: Number of operated clavicular fractures per 100,000 population, broken down by hospital referral area and for Norway as a whole. Bars show average value per year (2012–2016), and dots represent rates for each year. Rates have been adjusted for gender and age. Helgelandsykehuset: the calculation is based on fewer than 40 unique persons. Bar without dots: fewer than six persons were operated on during at least one of the years.

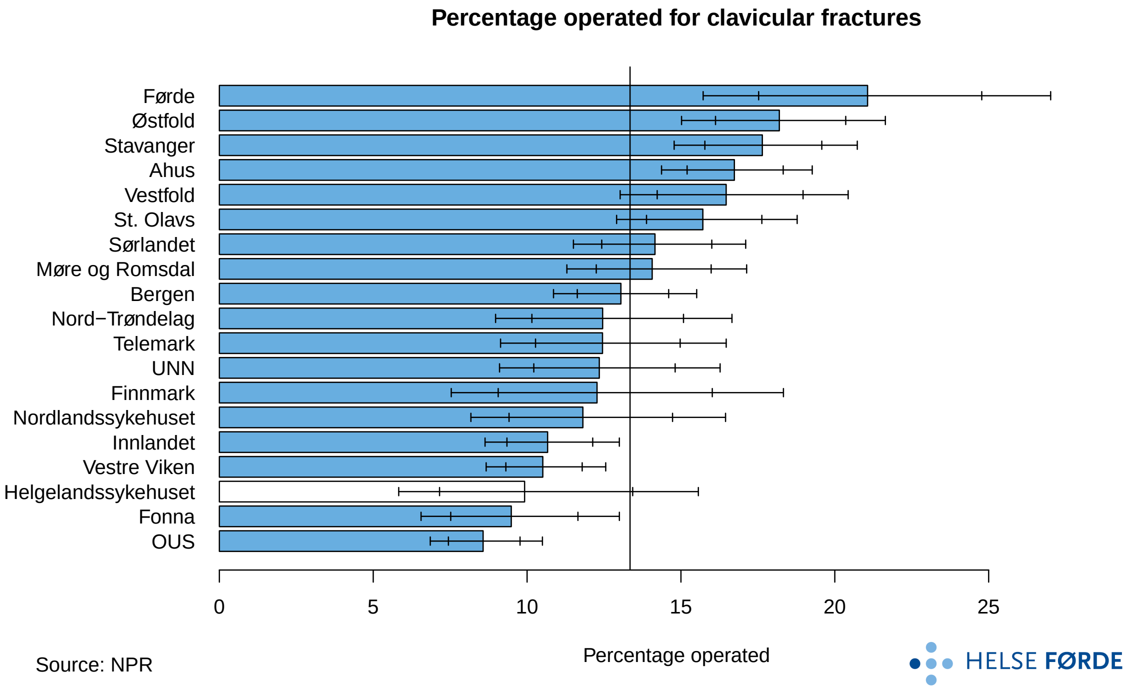


Figure 5.72: Percentage of clavicular fractures operated (2012–2016), with 95 % and 99.8 % confidence intervals, per hospital referral area. Vertical line indicates percentage operated on for Norway as a whole. Percentages have been adjusted for gender and age and concern patients of all ages. Helgelandsykehuset: the calculation is based on fewer than 40 unique persons, which makes the rate uncertain.

Table 5.9: Clavicular fractures. Fracture rate (fractures per 100,000 population), number of fractures, surgery rate (number of operations per 100,000 population), number of operations and the population broken down by hospital referral area and for Norway as a whole. The figures represent the average values per year for the period 2012–2016 and apply to the population of all ages. The rates have been adjusted for gender and age.

Hospital referral area	Fracture rate	Number of fractures	Surgery rate	Number of operations	Population
Ahus	91.7	451	15.7	76	486,003
Helgelandssykehuset	95.0	76	9.2	7	78,180
Bergen	93.8	409	11.8	51	433,322
Finnmark	97.0	74	11.6	9	74,978
Fonna	88.6	163	8.4	15	177,678
Førde	89.7	102	17.0	18	108,913
Nord-Trøndelag	103.9	146	13.3	18	137,006
Møre og Romsdal	104.3	276	13.9	36	259,260
Stavanger	88.3	319	15.7	56	351,637
Innlandet	99.0	391	10.5	40	395,880
Nordlandssykehuset	87.8	121	9.8	13	136,196
Østfold	92.7	264	17.2	48	283,797
Sørlandet	101.1	303	14.2	41	292,260
St. Olavs	97.9	300	15.8	49	306,134
Telemark	93.5	160	11.4	19	171,368
UNN	87.9	166	10.5	20	187,883
Vestfold	86.7	196	14.5	32	225,146
Vestre Viken	102.3	486	11.6	54	470,817
OUS	94.3	461	8.6	47	528,739
Noreg	94.9	4,864	12.7	649	5,105,197

5.3 Back complaints

Back pain is the most common reason for contact with the municipal health service, and most of us will experience troublesome back pain at some point. Back complaints are also the diagnosis that triggers most national insurance payments, and are the reason for almost 15 % of long-term sickness absence and more than 10 % of disability pensions (NEL, 2018a).

Only a small group of patients with lower back pain need surgical treatment. Patients with severe or long-term pain may be referred to the specialist health service. The most common types of back pain treated by orthopaedic surgeons are disc herniation (approx. 10 %) and spinal stenosis of the lower back, or a combination of the two (NEL, 2016e; Best Practice, 2018e). Surgical treatment is only an option for some of these patients, and professional judgement is part of the assessment of whether a patient will benefit from surgery.

Patients with other types of back pain, i.e. back pain where surgical treatment is not relevant, often make up a large proportion an orthopaedic department's patients, and they are therefore included in the analysis.

5.3.1 Lumbar disc herniation (with sciatica)

Back pain resulting from lumbar disc herniation (bulging or slipped disc in the lower back) is common. Both women and men are at risk of developing lumbar disc herniation with sciatica at between 30 and 50 years of age, and the risk is slightly higher for men.

Lumbar disc herniation is an age-related change caused by wear and tear, and it causes the intervertebral disc to bulge. If the bulging disc presses on the nerve roots, that can cause pain that radiates down the leg (sciatica). However, only a small minority of people with age-related changes to intervertebral discs experience sciatica (Hsu et al., 2017). Risk factors for disc herniation include jobs involving repetitive physical strain, obesity, smoking and participation in sports such as weightlifting (NEL, 2016e).

The goal of treatment is to relieve pain and prevent neurological damage. Most patients improve spontaneously within a few months, and conservative treatment will often suffice (Hsu et al., 2017). Surgical treatment may be an option for patients with persistent sciatic pain that impairs function. In rare cases, emergency surgery within 24 hours may be required to prevent permanent nerve damage. The majority of patients return to work following their operations (80 %) and are satisfied with the outcome (90 %) (NEL, 2016e).

Sample

Lumbar disc herniation is defined by a primary or secondary diagnosis of ICD-10 code M51.1 (intervertebral disc disorders with radiculopathy), M51.2 (other specified intervertebral disc displacement), M51.3 (other specified intervertebral disc degeneration), M51.8 (other specified intervertebral disc disorders) or M51.9 (unspecified intervertebral disc disorder).

Surgical treatment is defined by diagnosis of lumbar disc herniation in combination with one or more of the NCSP procedure codes for lumbar and lumbosacral decompression (ABC07, ABC16, ABC26, ABC36, ABC40, ABC56) and fusion (NAG34, NAG36, NAG44, NAG46, NAG54, NAG56, NAG64, NAG66, NAG74, NAG76).

Operations must be at least 90 days apart to count as separate procedures. This requirement was set in order to arrive at as correct a number of operations as possible and avoid follow-up appointments or re-operations being counted as (new) operations.

Only patients aged 18 years or older are included in the sample, except in the figures that show the gender and age distribution of patients with lumbar disc herniation (Figure 5.73) and the gender and age distribution of patients who have been operated for lumbar disc herniation (Figure 5.74).

The surgery and patient rates have been adjusted for gender and age.

Findings

During the period, an average of 3,198 operations on patients with lumbar disc herniation were registered per year (Table 5.10). The number of lumbar disc herniation operations increases with age until peaking in the age group 40–49 years and then decreasing (Figures 5.73 and 5.74). A majority of the patients operated on were men.

For Norway as a whole, an average of 80 patients with lumbar disc herniation were operated on per year per 100,000 population, but there was considerable variation between hospital referral areas (Table 5.10 and Figure 5.75). The surgery rate was highest in Nord-Trøndelag hospital referral area (124) and lowest in the Telemark area (49). The surgery rate for Norway as a whole remained relatively stable, but the rates for individual hospital referral areas varied considerably. The change in rates between years was greatest in Førde hospital referral area, where the number of operations per year seems to be increasing (Figure 5.76).

In Figure 5.77, we found that patients with lumbar disc herniation resident in the hospital referral areas of St. Olavs, Stavanger and Bergen were nearly always operated on at public hospitals in their own area. Patients resident in the hospital referral areas of Finnmark, Nordland Hospital and Helgeland Hospital, on the other hand, always or nearly always had their operations at a public hospital in another hospital referral area or at a private hospital under public funding contracts not subject to competitive tendering. The highest percentage of patients operated at private hospitals under public funding contracts subject to competitive tendering and/or renegotiation were found in the Oslo region, in the hospital referral areas of OUS, Ahus and Østfold.

More men than women were in contact with the specialist health service in connection with lumbar disc herniation (Figure 5.73). For the country as a whole, an average of 273 patients per 100,000 population per year were in contact with the specialist health service. There was clear variation between hospital referral areas, with most patients per 100,000 population in Nord-Trøndelag hospital referral area (388) and fewest in the Nordland Hospital area (221) (Table 5.10 and Figure 5.78). Of the patients who were in contact with the specialist health service, 27 % had surgery (Figure 5.79).

Comments

There was relatively high variation in surgical treatment for lumbar disc herniation during the period 2012–2016 (see Chapter 5.5). Nord-Trøndelag hospital referral area stood out with a particularly high surgery rate; surgical treatment was more than twice as common as in the Telemark area. We have deemed the variation in surgery rates to be unwarranted because there is no known corresponding geographical variation in the prevalence of lumbar disc herniation in Norway.

There was clear variation between hospital referral areas, both in the number of patients with lumbar disc herniation per 100,000 population who were in contact with the specialist health service and in the percentage of patients operated on. We believe that this could reflect differences in practice in terms of how hospitals handle referrals, but it could also reflect an absence of strong guidelines.

At some hospitals, lumbar disc herniation surgery is performed by neurosurgeons. Our analyses do not distinguish between operations performed by orthopaedic surgeons and neurosurgeons, nor have we investigated what bearing this might have on the variation. All operations are included in the sample in order to shed light on any differences in the use of surgical treatment for the condition.

There are no national guidelines for the treatment of lumbar disc herniation, but the outcomes of surgical treatment are documented in the Norwegian Registry for Spine Surgery. [27]

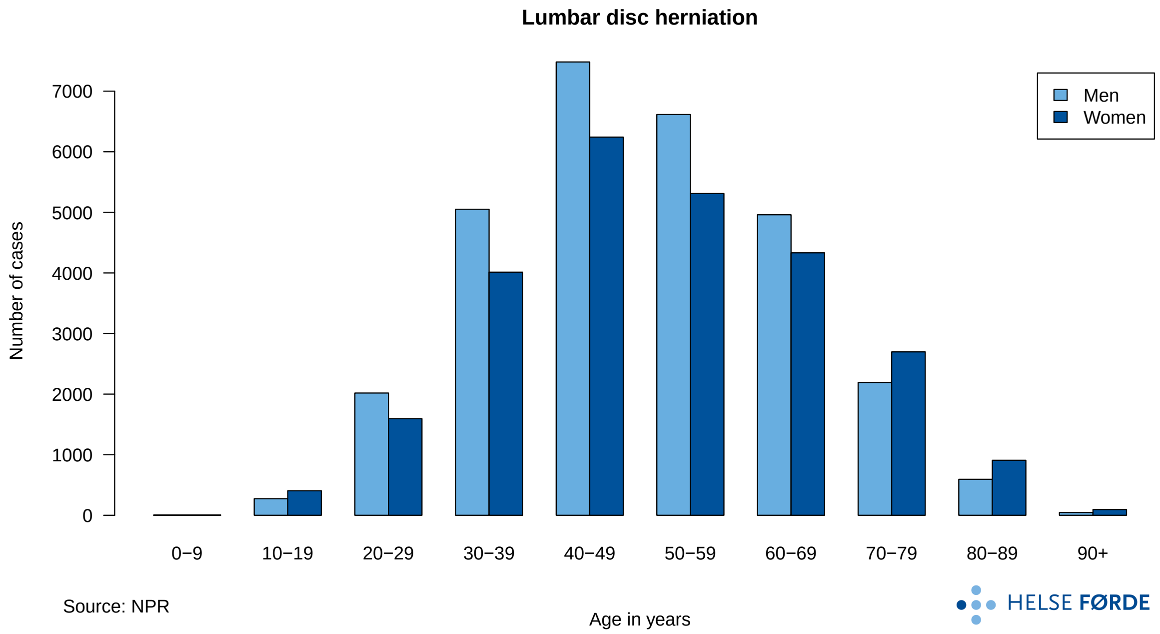


Figure 5.73: Total number of patients with lumbar disc herniation who were in contact with the specialist health service during the period 2012–2016, for Norway as a whole. The patients have been broken down by gender and age group.

[27] https://www.kvalitetsregistre.no/registers/nasjonalt-kvalitetsregister-ryggkirurgi

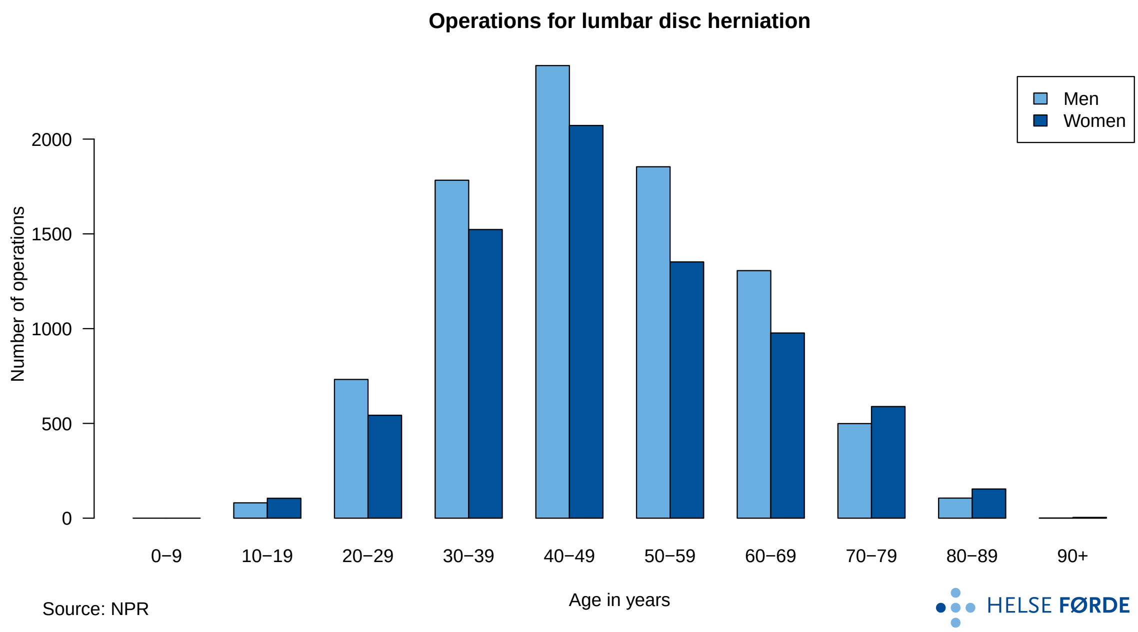


Figure 5.74: Total number of operations for lumbar disc herniation during the period 2012–2016, for Norway as a whole. The patients have been broken down by gender and age group.

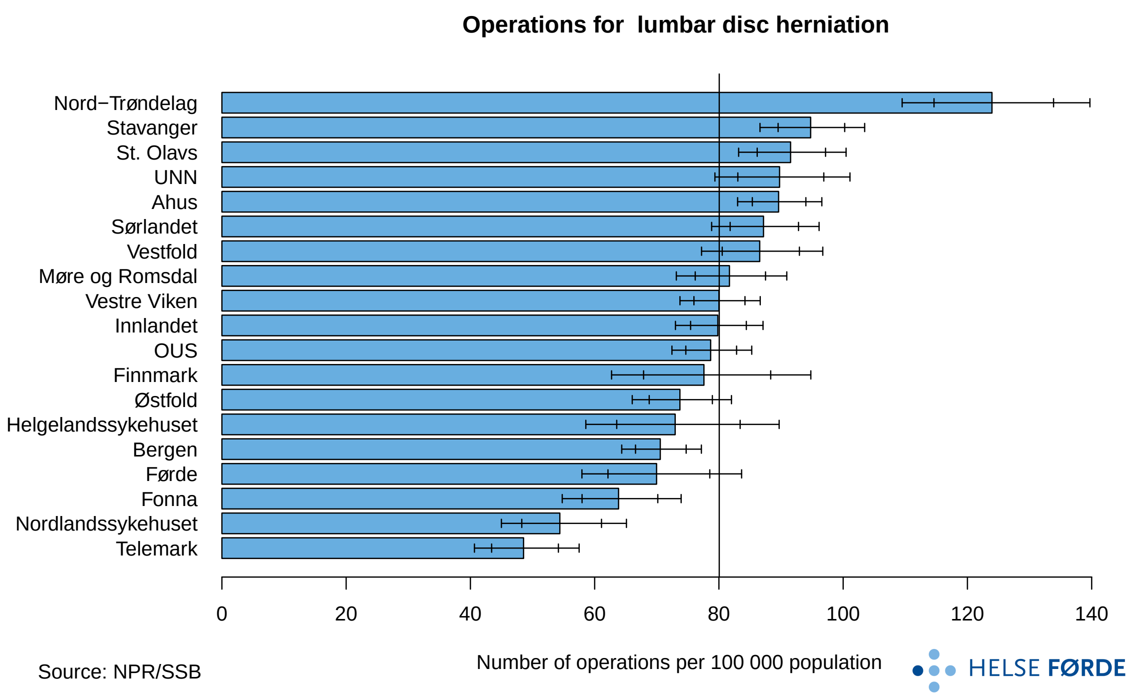


Figure 5.75: Surgery rate: Number of operations for lumbar disc herniation per 100,000 population (18 years and older), broken down by hospital referral area. The bars show the average value per year for the period 2012–2016, with pertaining 95 % and 99.8 % confidence intervals. The vertical line indicates the average for Norway as a whole. The rates have been adjusted for gender and age.

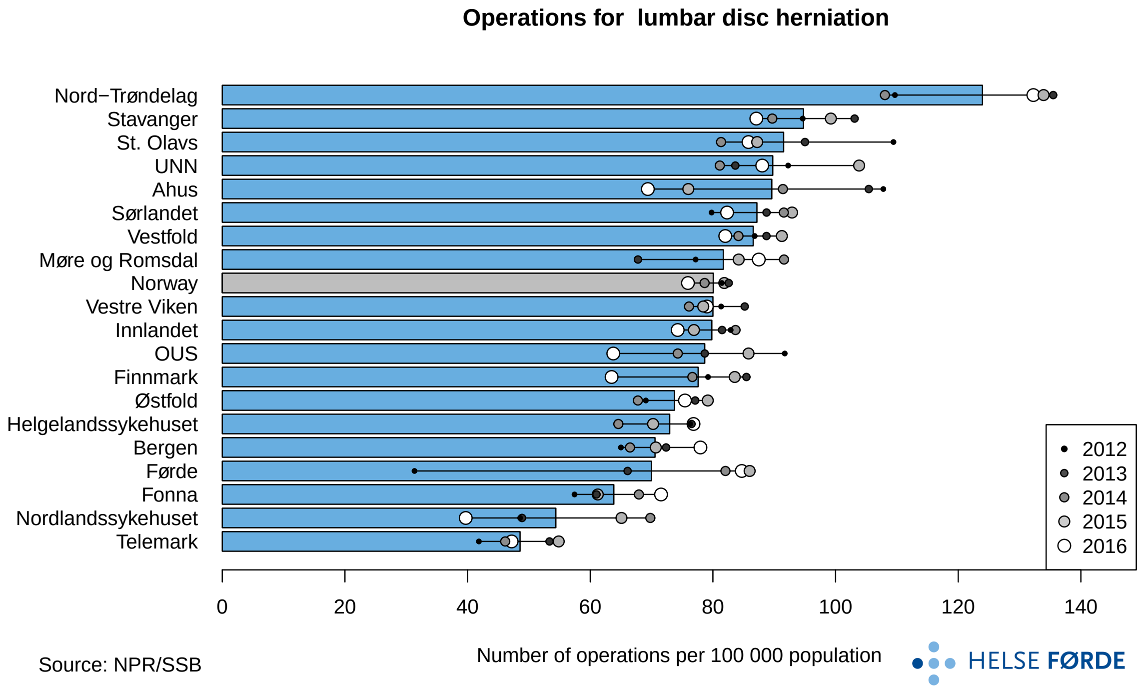


Figure 5.76: Surgery rate: Number of operations for lumbar disc herniation per 100,000 population (18 years and older), broken down by hospital referral area and for Norway as a whole. Bars show average value per year during 2012–2016, and dots represent rates for each year. Rates have been adjusted for gender and age.

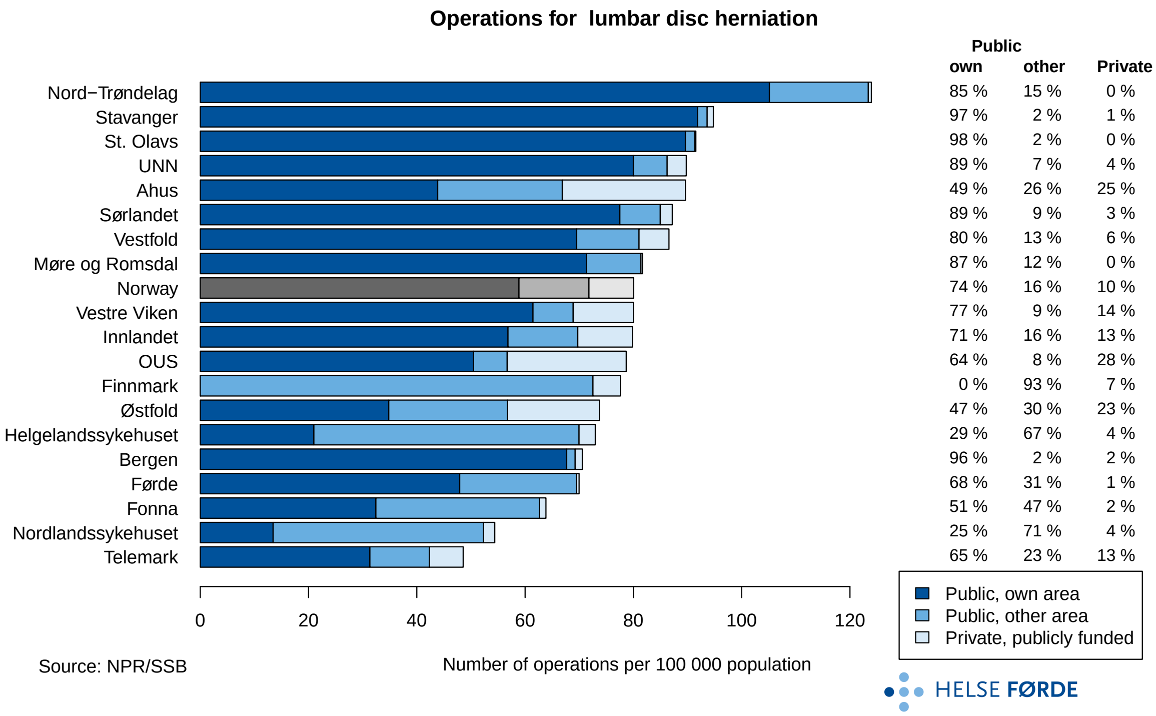


Figure 5.77: Surgery rate: Number of operations for lumbar disc herniation per 100,000 population (18 years and older), broken down by hospital referral area. The rates have been adjusted for gender and age. The bars show the average value per year for the period 2012–2016, with the percentage distribution broken down by where the patients had surgery.

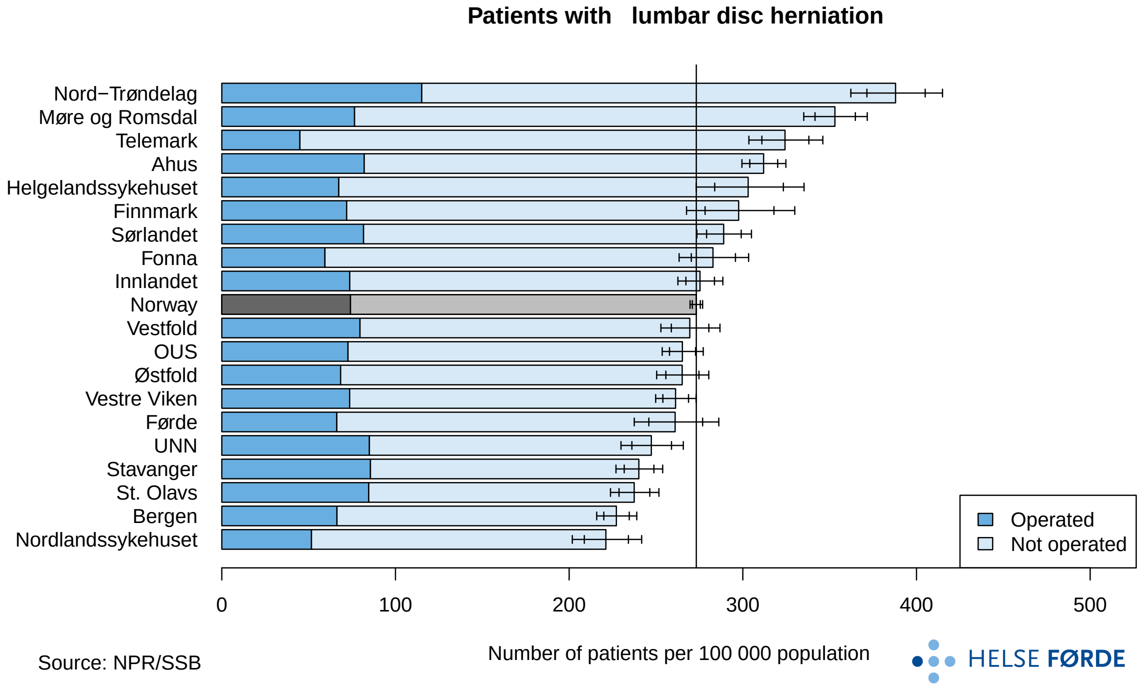


Figure 5.78: Patient rate: number of patients with lumbar disc herniation (in contact with the specialist health service), per 100,000 population (18 years and older), broken down by hospital referral area and Norway. The whole bar represents an average patient rate (2012–2016), with 95 % and 99.8 % confidence intervals, and is broken down by patients operated (dark blue) and not operated (light blue). Rates have been adjusted for gender and age.

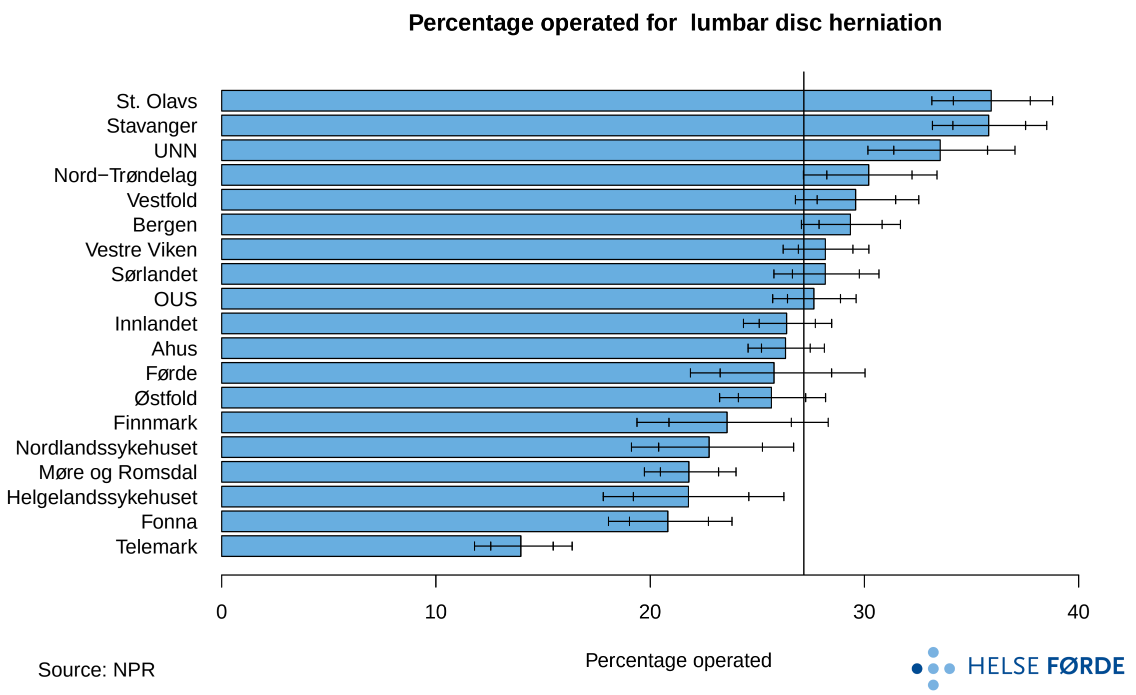


Figure 5.79: Percentage of patients with lumbar disc herniation operated on during the period 2012–2016. The bars show, with 95 % and 99.8 % confidence intervals, how many per cent of patients with lumbar disc herniation were operated on per hospital referral area. The vertical line indicates the percentage operated on for Norway as a whole. Adjusted for gender and age, patients aged 18 years and older.

Table 5.10: Lumbar disc herniation. Patient rate, number of patients, surgery rate, number of operations and population, broken down by hospital referral area and for Norway as a whole. Average values per year for the period 2012–2016, the population aged 18 years and older. The rates have been adjusted for gender and age.

Hospital referral area	Patient rate	Number of patients	Surgery rate	Number of operations	Population
Ahus	312.0	1,177	89.6	340	370,737
Helgelandssykehuset	303.1	187	73.0	44	61,456
Bergen	227.2	749	70.6	235	335,924
Finnmark	297.6	177	77.6	46	58,702
Fonna	282.8	385	63.8	87	135,469
Førde	261.0	224	70.0	58	84,077
Nord-Trøndelag	387.9	420	124.0	132	106,072
Møre og Romsdal	353.0	720	81.7	164	201,630
Stavanger	240.1	624	94.8	249	265,081
Innlandet	275.3	884	79.8	251	315,870
Nordlandssykehuset	221.1	238	54.4	57	106,963
Østfold	265.1	603	73.7	166	222,700
Sørlandet	289.0	651	87.2	196	224,372
St. Olavs	237.5	559	91.5	217	240,031
Telemark	324.3	451	48.6	65	135,860
UNN	247.3	366	89.8	132	147,894
Vestfold	269.5	486	86.6	153	176,835
Vestre Viken	261.3	973	80.0	298	363,780
OUS	265.2	1,020	78.7	307	427,887
Norway	273.2	10,894	80.1	3,198	3,981,340

5.3.2 Lumbar spinal stenosis

Lumbar spinal stenosis, a narrowing of the spinal canal, is an age-related condition caused by wear and tear. It causes back pain in nearly 10 % of the population, and sometimes also pain and muscle weakness in the legs (Schroeder et al., 2016). Back pain caused by spinal stenosis is most common at around 50 or 60 years of age, and the prevalence will probably increase as the elderly population grows (Best Practice, 2018f; NEL, 2018e).

The narrowing of the spinal canal is often a combination of several types, primarily age-related changes caused by wear and tear; osteoarthritis of the spine, changes in the intervertebral disc, instability caused by wear and tear, congenital defects of the vertebral arch, or a combination of several of these types.

The goal of treatment is to relieve symptoms. Conservative treatment will suffice in most cases, but surgical treatment may be an option for selected patients with intense symptoms. The surgery involves removing structures that cause the narrowing of the spinal canal and press on the spinal cord or nerve roots (decompression), and joining vertebrae (spinal fusion) may be an option (Levin, 2014; Best Practice, 2018f).

With conservative treatment, meaning that the patient does not have surgery, 25 % will improve over time, 25 % will deteriorate, while the condition will remain unchanged in the remaining 50 % (Best Practice, 2018f). Patients who have surgery experience a marked improvement in function, quality of life and capacity for work, but many will have residual symptoms after surgery (Solberg & Olsen, 2016).

Sample

Lumbar spinal stenosis is defined by a primary or secondary diagnosis of one or more of the ICD-10 codes M48.0 (spinal stenosis), M43.1 (spondylolisthesis), M47.2 (other spondylosis with radiculopathy), M99.3 (osseous stenosis of neural canal) and M99.6 (osseous and subluxation stenosis of intervertebral foramina).

Surgical treatment is defined by a diagnosis of lumbar spinal stenosis in combination with one or more of the NCSP procedure codes for decompression (ABC07, ABC16, ABC26, ABC36, ABC40, ABC56, ABC66 and ABC99) and fusion (NAG34, NAG36, NAG44, NAG46, NAG54, NAG56, NAG64, NAG66, NAG74, NAG76, NAG94 and NAG96).

Operations must be at least 90 days apart to count as separate procedures. This requirement was set in order to arrive at as correct a number of operations as possible and avoid follow-up appointments and re-operations being counted as (new) operations. Only patients aged 18 years or older are included in the sample, except in the figures that show the gender and age distribution of patients with spinal stenosis (Figure 5.80) and the gender and age distribution of patients who have been operated for spinal stenosis (Figure 5.81).

The surgery and patient rates have been adjusted for gender and age.

Findings

During the period, an average of 3,213 operations on patients with lumbar disc herniation were registered per year (Table 5.11).Most of the patients were over 50 years old, and most of the patients operated on were in the age group 60–80 years (Figures 5.80 and 5.81). More than half of the patients who were operated on were women, but the gender distribution was relatively even in the age group 40–70 years.

For Norway as a whole, the average number of operations for spinal stenosis was 82 per year per 100,000 population (Table 5.11. Vestre Viken hospital referral area had the highest average surgery rate at 115 operations, while Finnmark had the lowest rate at 56 operations (Table 5.11 and Figure 5.82). The variation in surgery rates was greater than we would expect based on chance. From 2012 to 2016, we saw a slight increase in the surgery rate per year for Norway as a whole, and some hospital referral areas' surgery rates varied markedly during the period (Figure 5.83).

There were relatively significant differences in where patients with spinal stenosis had surgery. Of the patients resident in St. Olavs hospital referral area, 98 % had their operation in their own area, while no patients who were resident in the Finnmark area were operated there (Figure 5.84). The highest percentage of patients operated at private hospitals under public funding contracts subject to competitive tendering and/or renegotiation was found in Bergen hospital referral area (35 %).

There was relatively little variation between hospital referral areas in the surgical techniques used on patients with spinal stenosis. We see in Figure 5.85 that decompression alone was the most common technique. It was used in approx. 85 % of operations, and its use increased somewhat during the period (Figure 5.86). Decompression in combination with spinal fusion was used in approx. 15 % of operations, and its use remained stable over time.

For Norway as a whole, an average of 225 patients per 100,000 population per year with spinal stenosis were in contact with the specialist health service. There was clear variation between hospital referral areas, with most patients per 100,000 population in Finnmark hospital referral area (290) and fewest in the St. Olavs area (155) (Table 5.11 and Figure 5.87). For Norway as a whole, 33 % of patients had surgery during the period 2012–2016 (Figure 5.88).

Comments

There was considerable variation in surgical treatment for spinal stenosis during the period 2012–2016 (see Chapter 5.5). Surgical treatment was more than twice as common in Vestre Viken hospital referral area as in the Finnmark area during the period 2012–2016. The variation is characterised as unwarranted because there is no known corresponding geographical variation in the prevalence of spinal stenosis in Norway.

We also found variation in both the number of patients with spinal stenosis per 100,000 population who were in contact with the specialist health service and in the percentage of these patients that had surgery. Much of this variation probably reflects the complexity of the condition and the lack of both a classification system for the condition and guidelines for its treatment. This means that the assessment of the need for referral and surgery involves a significant degree of professional judgement. However, when it comes to the choice of surgical technique, i.e. decompression with or without fusion, there was little variation between hospital referral areas and there seems to be a relatively high degree of professional consensus.

There are no national guidelines for the treatment of lumbar spinal stenosis, but the outcomes of surgical treatment are documented in the Norwegian Registry for Spine Surgery.[28]

[28] https://www.kvalitetsregistre.no/registers/nasjonalt-kvalitetsregister-ryggkirurgi

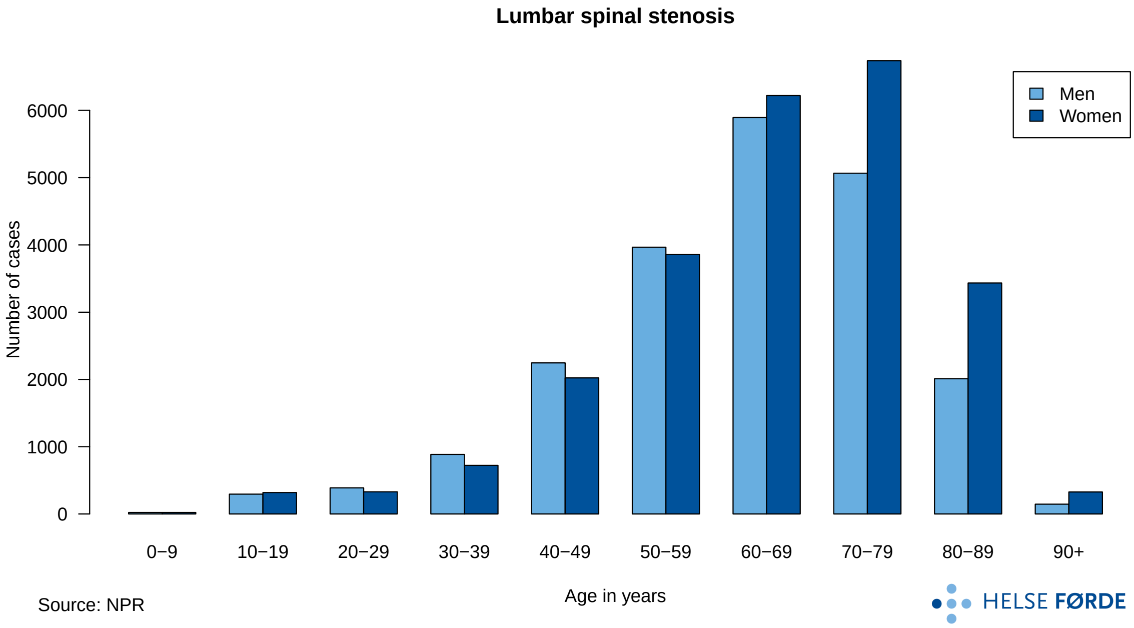


Figure 5.80: Total number of patients with lumbar spinal stenosis who were in contact with the specialist health service during the period 2012–2016, for Norway as a whole. The patients have been broken down by gender and age group.

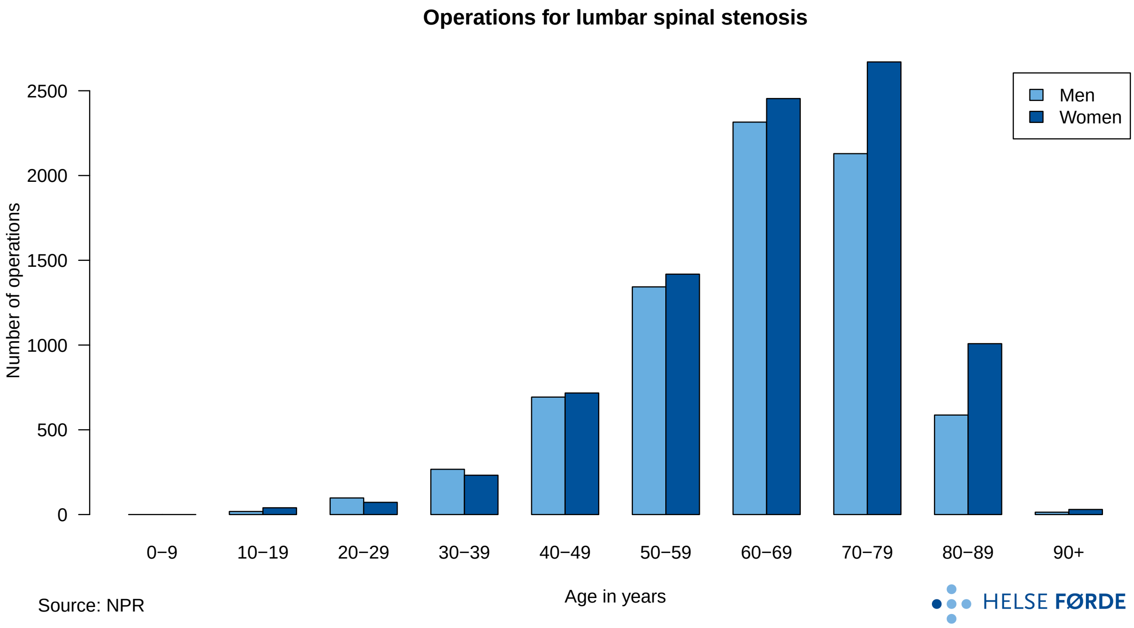


Figure 5.81: Total number of operations for lumbar spinal stenosis during the period 2012–2016, for Norway as a whole. The patients have been broken down by gender and age group.

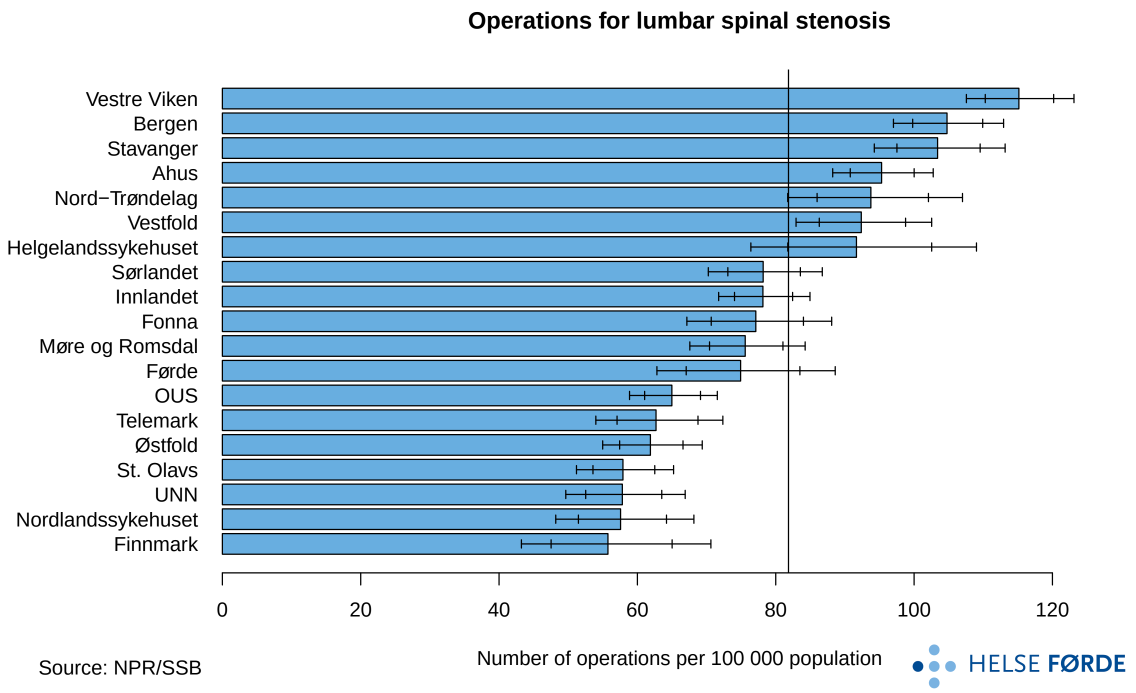


Figure 5.82: Surgery rate: Number of operations for lumbar spinal stenosis per 100,000 population (18 years and older), broken down by hospital referral area. The bars show the average value per year for the period 2012–2016, with pertaining 95 % and 99.8 % confidence intervals. The vertical line indicates the average for Norway as a whole. The rates have been adjusted for gender and age.

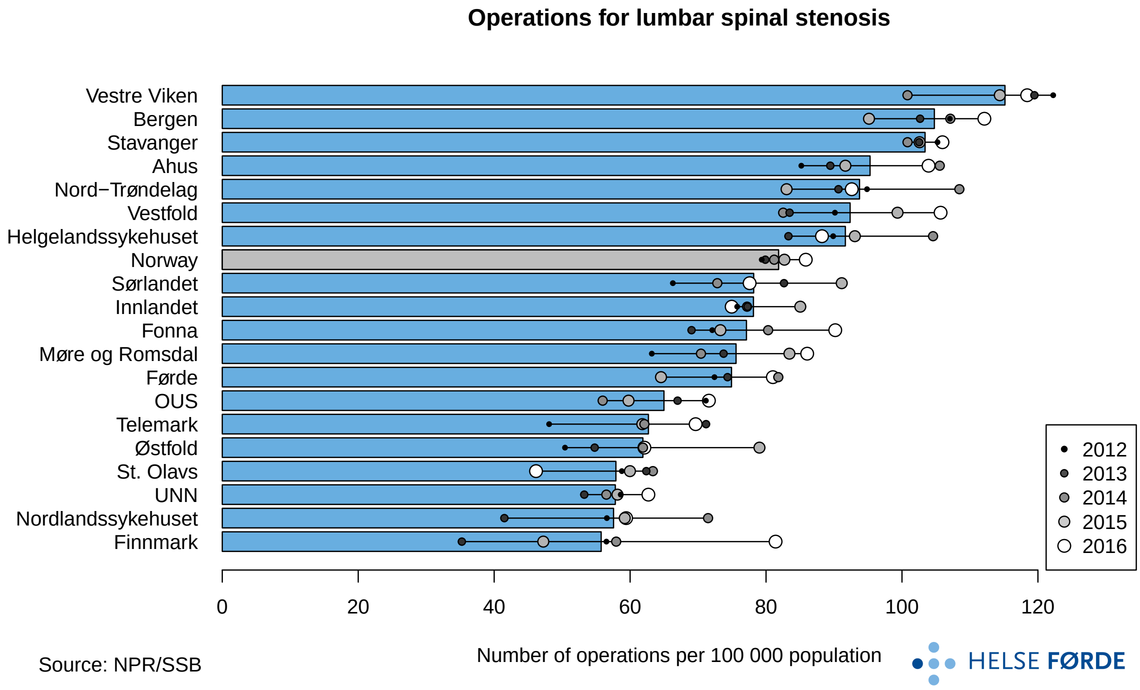


Figure 5.83: Surgery rate: Number of operations for lumbar spinal stenosis per 100,000 population (18 years and older), broken down by hospital referral area and for Norway as a whole. The bars show the average value per year during the period 2012–2016, and the dots represent the rates for each year. The rates have been adjusted for gender and age.

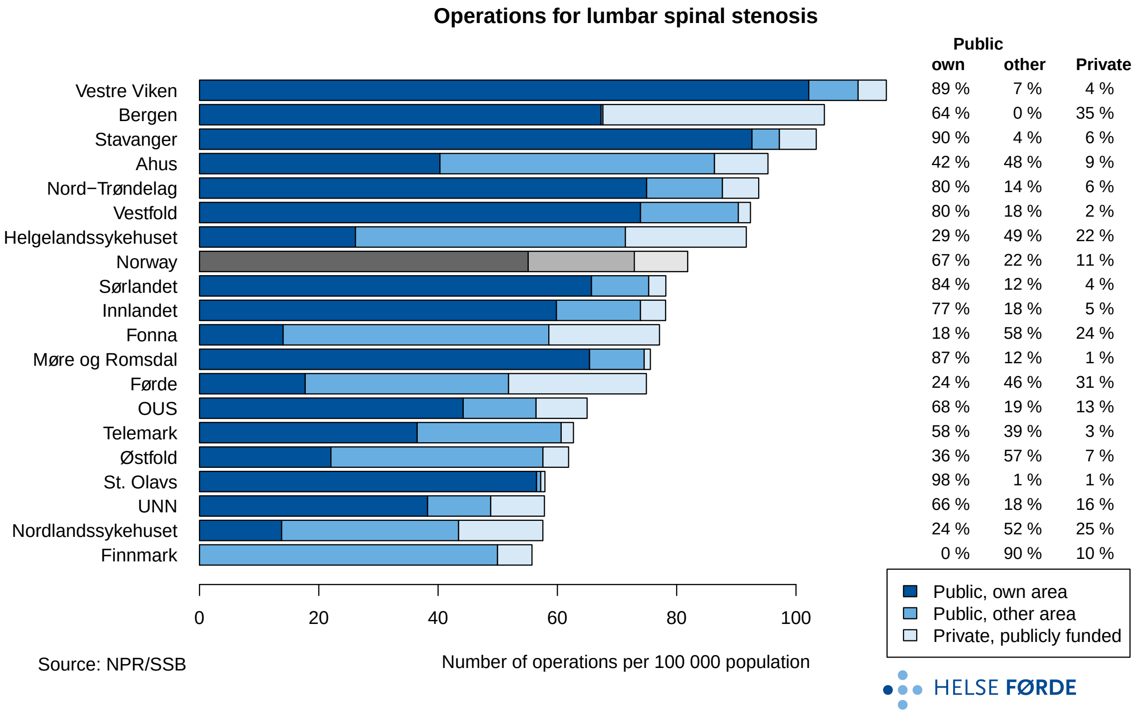


Figure 5.84: Surgery rate: Number of operations for lumbar spinal stenosis per 100,000 population (18 years and older), broken down by hospital referral area. The rates have been adjusted for gender and age. The bars show the average value per year for the period 2012–2016, with the percentage distribution broken down by where the patients had surgery.

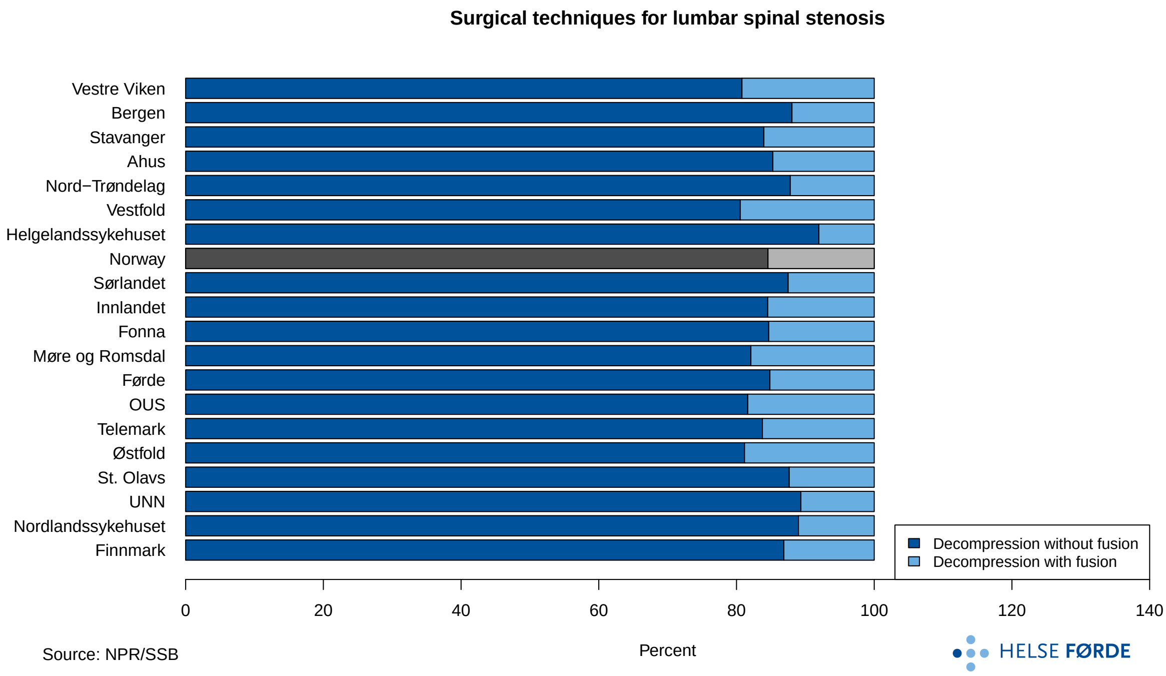


Figure 5.85: Surgical techniques for treating lumbar spinal stenosis, broken down by decompression without fusion (ABC codes) and decompression with fusion (NAG codes). The figure shows the percentage distribution of the different surgical techniques broken down by hospital referral area and Norway as a whole, for the period 2012–2016 for patients aged 18 years and older.

Table 5.11: Lumbar spinal stenosis. Patient rate (number of patients per 100,000 population), number of patients, surgery rate (number of operations per 100,000 population), number of operations and the population, broken down by hospital referral area and for Norway as a whole. The figures represent average values per year during the period 2012–2016 and apply to the population aged 18 years and older. The rates have been adjusted for gender and age.

Hospital referral area	Patient rate	Number of patients	Surgery rate	Number of operations	Population
Ahus	266.4	937	95.3	334	370,737
Helgelandssykehuset	231.9	155	91.7	62	61,456
Bergen	273.4	875	104.8	336	335,924
Finnmark	290.0	170	55.7	33	58,702
Fonna	237.8	327	77.1	106	135,469
Førde	197.6	179	74.9	67	84,077
Nord-Trøndelag	231.2	266	93.8	108	106,072
Møre og Romsdal	223.9	476	75.6	160	201,630
Stavanger	212.4	486	103.4	234	265,081
Innlandet	228.1	795	78.1	274	315,870
Nordlandssykehuset	192.2	216	57.6	65	106,963
Østfold	216.4	504	61.9	144	222,700
Sørlandet	218.4	488	78.2	174	224,372
St. Olavs	155.1	356	57.9	132	240,031
Telemark	190.5	280	62.7	91	135,860
UNN	223.5	336	57.8	87	147,894
Vestfold	222.9	415	92.4	172	176,835
Vestre Viken	270.0	994	115.2	423	363,780
OUS	185.6	617	65.0	210	427,887
Norway	225.4	8,874	81.8	3,213	3,981,340

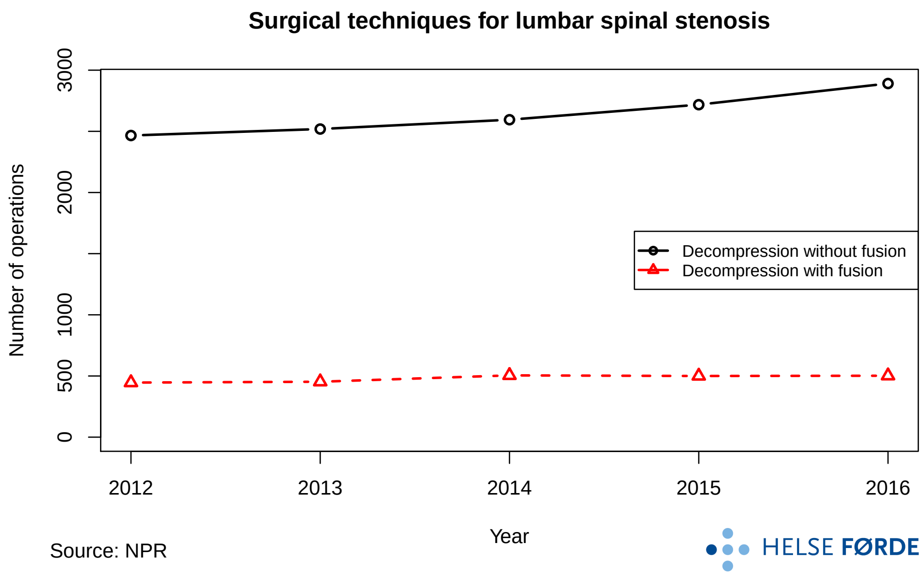


Figure 5.86: Surgical techniques for treating lumbar spinal stenosis, development over time. Total number of operations for Norway for the period 2012–2016, patients aged 18 years and older, broken down by decompression without fusion (ABC codes) and decompression with fusion (NAG codes).

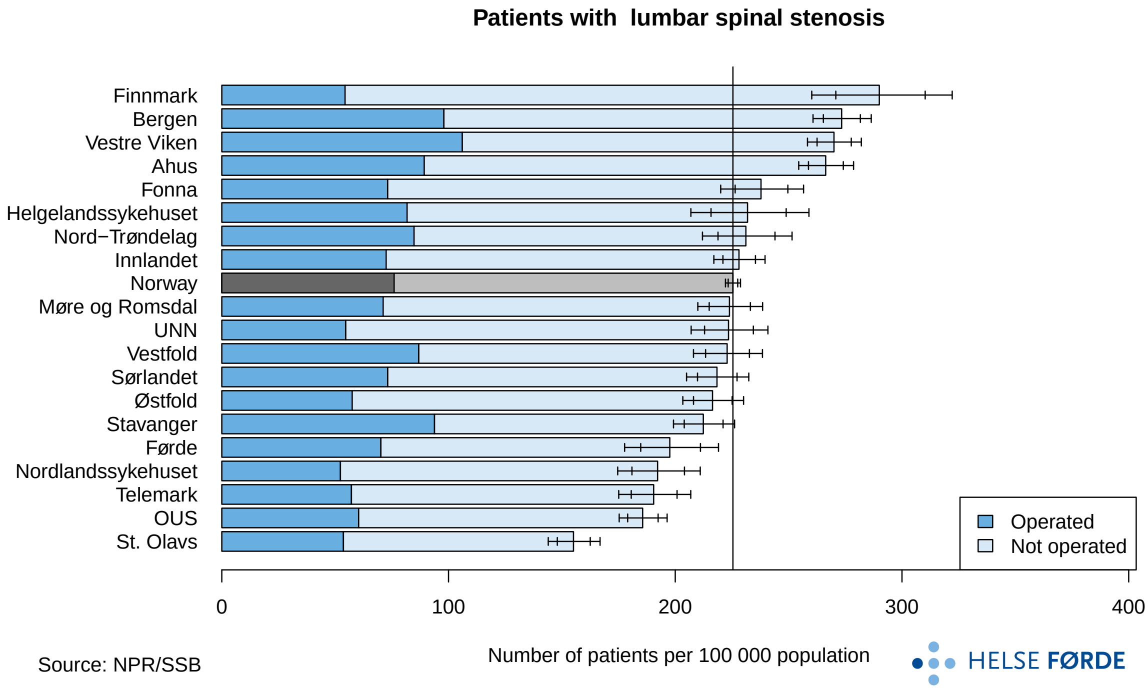


Figure 5.87: Patient rate: number of patients with spinal stenosis per 100,000 population (18 years and older), broken down by hospital referral area and for Norway as a whole. The patient rate (the whole bar) represents an average for the period 2012–2016, with 95 % and 99.8 % confidence intervals, and it is broken down by patients operated on (dark blue) and patients not operated on (light blue). The rates have been adjusted for gender and age.

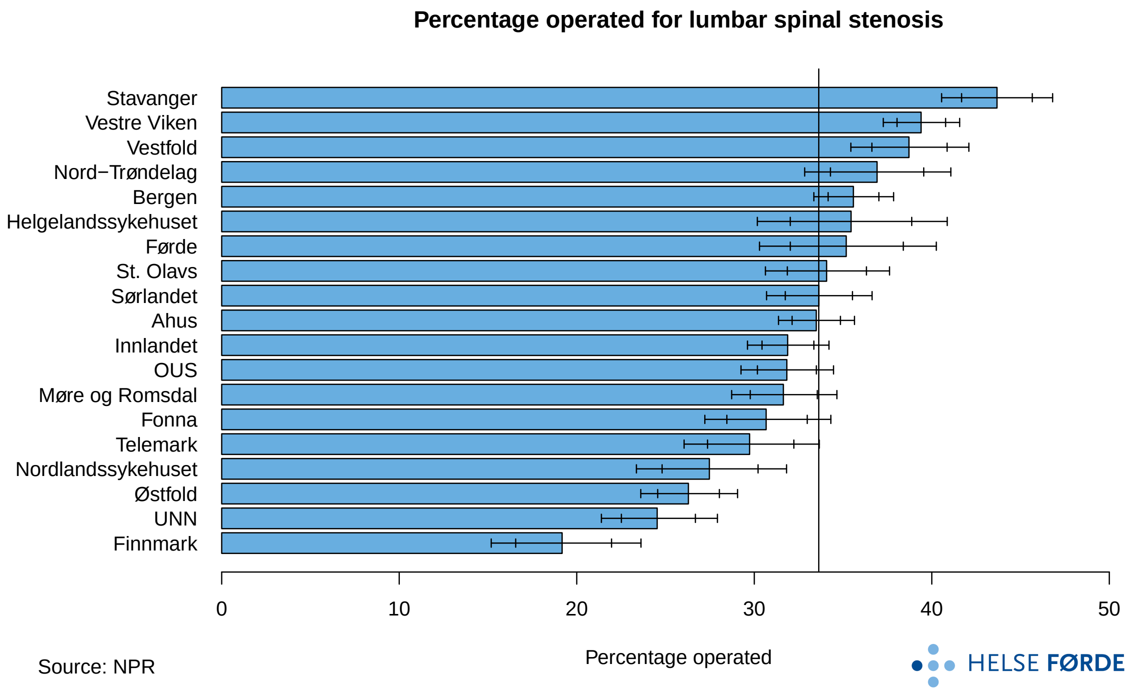


Figure 5.88: Percentage of patients with lumbar spinal stenosis operated on during the period 2012–2016. The bars show, with 95 % and 99.8 % confidence intervals, how many per cent of patients with lumbar spinal stenosis were operated on per hospital referral area. The vertical line indicates the percentage operated on for Norway as a whole. The percentages have been adjusted for gender and age and concern patients aged 18 years and older.

5.3.3 Other lower back pain

By other lower back pain (lumbago) we mean back pain where surgery is not an option. Patients with such pain make up a relatively high percentage of patients admitted to orthopaedic departments. Hospital admission may be necessary in order to provide sufficient pharmacological pain relief and to investigate the cause of the pain with a view to further treatment. If surgery is not indicated and the patient is at risk of developing long-term back pain, referral to physiotherapy or physical medicine treatment for the provision of supervised exercise, information and treatment may be an option (Knight et al., 2017).

Most patients with lower back pain recover within a few months, but approx. 40 % experience another episode of back pain within six months. Approx. 1 % of people with first-time back pain will suffer long-term pain (NEL, 2018d).

Sample

Other back pain is defined by a primary diagnosis of ICD-10 code M54.4 (lumbago with sciatica), M54.5 (low back pain), M54.8 (other dorsalgia) or M54.9 (dorsalgia, unspecified).

Admission is defined in Chapter 4.4 Other definitions. The admission rates have been adjusted for gender and age.

Only patients aged 18 years or older are included in the sample, except in the figure that shows the gender and age distribution of patients of all ages admitted for other lower back pain (Figure 5.89).

Findings

During the period 2012–2016, an average of 2,484 patients per year were admitted, while the total number of admissions was 2,692 (Table 5.12). The number of patients admitted for back problems increased steadily with age, peaking in the age group 40–49 years, and then decreased fairly steadily (Figure 5.89). The age distribution is similar to lumbar disc herniation, except that a small majority of patients with lower back pain were women.

An average of 67 patients per 100,000 population per year were admitted for lower back pain. Førde hospital referral area had the highest admission rate at 106, while the OUS area had the lowest rate at 45 admissions per 100,000 population per year (Table 5.12 and Figure 5.90). We found that variation between hospital referral areas is greater than can be due to random variation.

The admission rate per year for Norway as a whole seems to be decreasing, and a particularly marked decrease was seen in Telemark and Vestfold hospital referral areas during the period (Figure 5.91).

Comments

There was considerable variation in admission rates for lower back pain during the period 2012–2016 (see Chapter 5.5). More than twice as many patients per 100,000 population were admitted in the Førde and Nord-Trøndelag areas as in OUS and Ahus hospital referral areas. We have deemed the variation in admission rates to be unwarranted because there is no known corresponding geographical variation in the prevalence of lower back pain in Norway.

It has been documented that the use of MRI scans varies between different parts of Norway and that this is probably due to differences in access to this service (Lysdahl & Børretzen, 2007). This could be one reason for the variation we found between hospital referral areas in terms of admissions of patients with lower back pain. It is not known whether, e.g., long distance to a treatment centre had a bearing on the observed variation, and it has not been possible to analyse possible causes of variation in admission rates based on the data available to us.

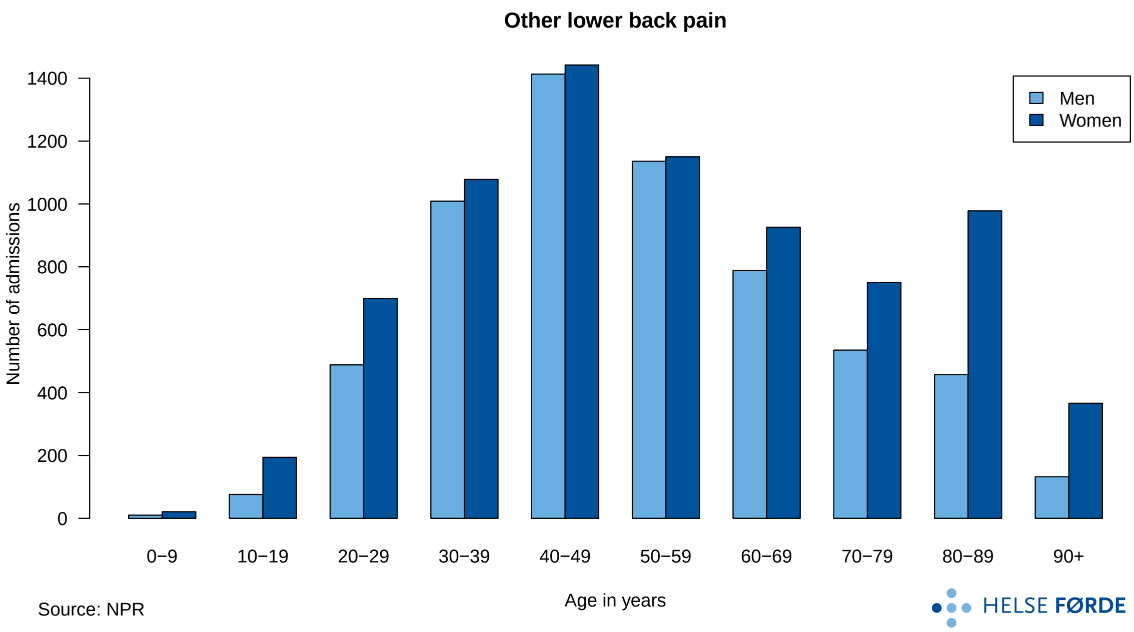


Figure 5.89: Total number of hospital admissions for other lower back pain during the period 2012–2016, for Norway as a whole. The patients have been broken down by gender and age group.

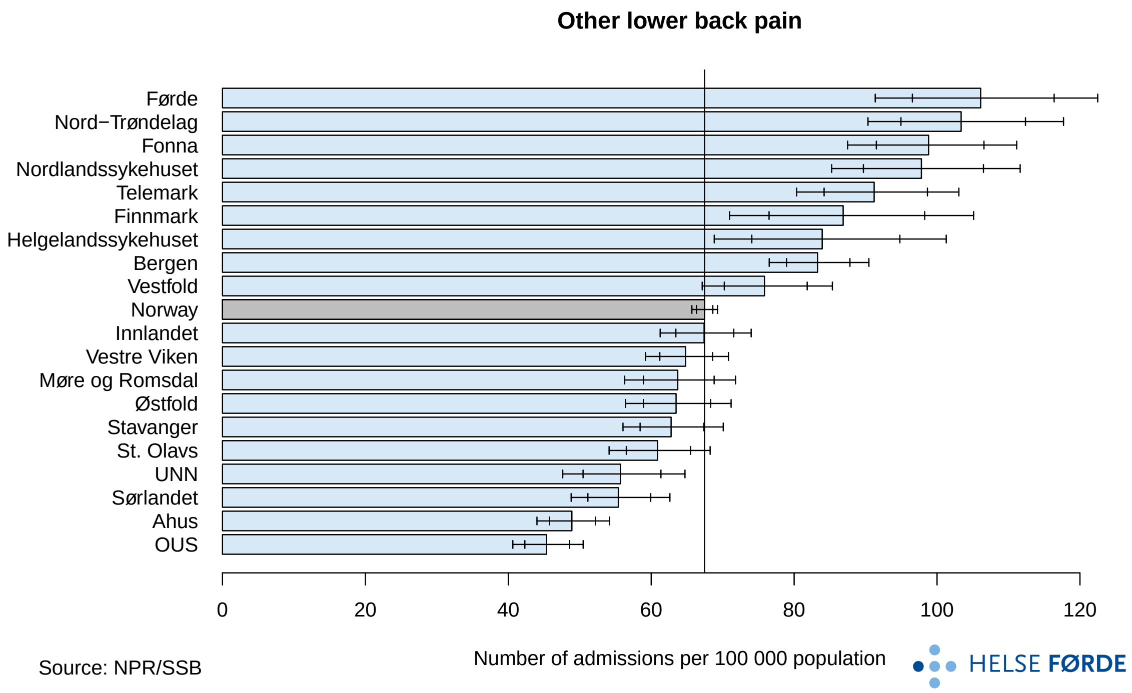


Figure 5.90: Admission rate: Number of admissions for other back pain per 100,000 population (18 years and older), broken down by hospital referral area and for Norway as a whole. The admission rates are the average for the period 2012–2016 with pertaining 95 % and 99.8 % confidence intervals. The rates have been adjusted for gender and age.

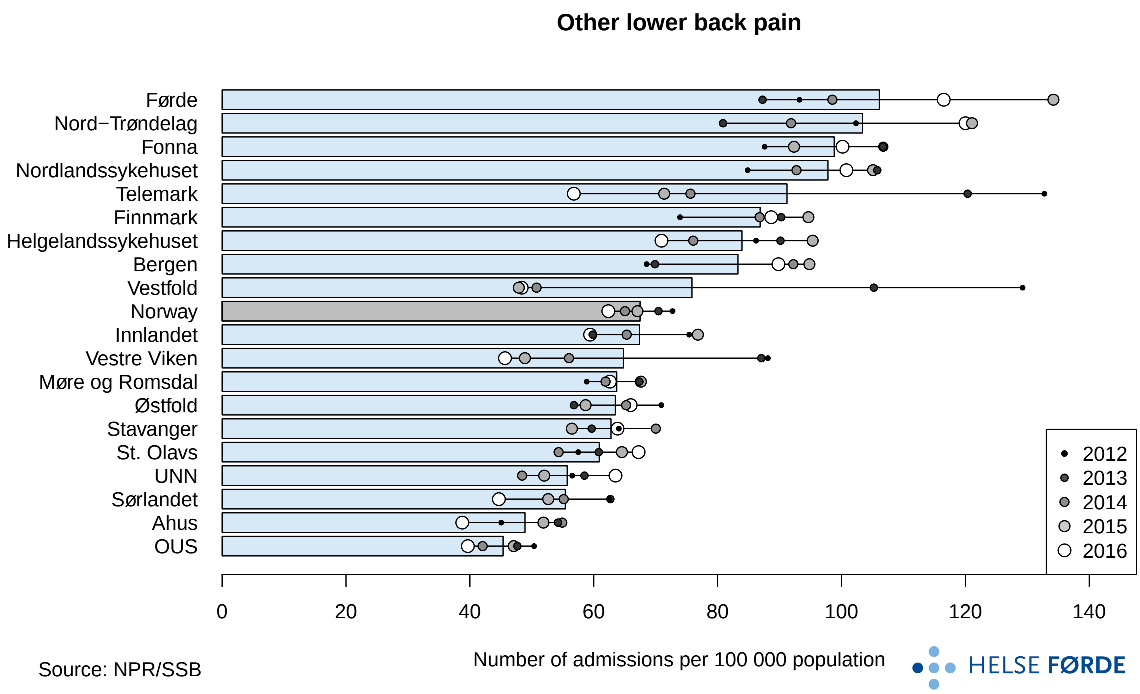


Figure 5.91: Admission rate: Number of admissions for other back pain per 100,000 population (18 years and older), broken down by hospital referral area and for Norway as a whole. The bars show the average value per year for the period 2012–2016, and the dots represent the rates for each years. The rates have been adjusted for gender and age.

Table 5.12: Other lower back pain. Admission rate (number of admissions per 100,000 population), number of admissions, number of patients and population, broken down by hospital referral area and for Norway as a whole. The figures represent the average values per year for the period 2012–2016 and concern the population aged 18 years and older. The rates have been adjusted for gender and age.

Hospital referral area	Admission rate	Number of admissions	Number of patients	Population
Ahus	48.9	182	170	370,737
Helgelandssykehuset	83.9	53	49	61,456
Bergen	83.3	276	257	335,924
Finnmark	86.9	51	47	58,702
Fonna	98.8	135	127	135,469
Førde	106.1	92	79	84,077
Nord-Trøndelag	103.4	112	99	106,072
Møre og Romsdal	63.7	131	120	201,630
Stavanger	62.8	158	147	265,081
Innlandet	67.4	221	201	315,870
Nordlandssykehuset	97.8	108	97	106,963
Østfold	63.5	144	132	222,700
Sørlandet	55.4	125	115	224,372
St. Olavs	60.9	144	131	240,031
Telemark	91.2	127	121	135,860
UNN	55.7	83	76	147,894
Vestfold	75.9	135	127	176,835
Vestre Viken	64.8	241	222	363,780
OUS	45.4	174	166	427,887
Norway	67.5	2,692	2,484	3,981,340

5.4 Other conditions

5.4.1 Anterior cruciate ligament injury

Anterior cruciate ligament injury is the most common serious knee injury worldwide (NEL, 2017b). There are about 4,000 cruciate ligament injuries in Norway each year, and about half of these patients undergo surgery (Korsbåndregisteret, 2018a). This injury primarily affects younger age groups, and the average age of patients at the time of their operation is 29 years. Slightly more men (56 %) than women are operated on, and approx. 70 % of injuries occur in connection with sports, often football, handball or alpine skiing (Korsbåndregisteret, 2018b).

Anterior cruciate ligament injuries cause pain, swelling, instability of the knee, and loss of function. The goal of treatment is to relieve symptoms, restore function and limit complications. Conservative treatment in the form of physiotherapy, exercise, a knee brace and change of activity level may be sufficient.

The purpose of surgical treatment is to improve the stability of the knee and reduce the risk of subsequent osteoarthritis (Best Practice, 2018b).The most common surgical technique is to replace the torn cruciate ligament with a tendon from the patient's own body, and the replacement tendon is normally taken from the tendon running between the kneecap and the shin bone (patellar tendon graft) or from the muscles at the back of the thigh (hamstring graft). It is also possible to reconstruct the cruciate ligament using synthetic materials. More and more such operations are performed as day surgery; approx. 75 % in 2017 (Korsbåndregisteret, 2018b).

The prognosis after surgery is good, and 85–90 % of patients who have surgery find that their knee functions normally after the operation and they can go back to participating in sports at the same level as before their injury. The reconstructed cruciate ligament remains intact after 8 years in approx. 94 % of patients operated on. When a new operation is required, the reason is usually that the new cruciate ligament is not functioning properly (47 %) or that the patient has suffered a new trauma (42 %). Approx. 9 % of all cruciate ligament operations are revision surgery, i.e. a new operation on a cruciate ligament that has already been operated on (Korsbåndregisteret, 2018b).

Sample

Anterior cruciate ligament injury is defined as a primary or secondary diagnosis of ICD-10 code S83.5 (sprain and strain involving anterior/posterior cruciate ligament of knee), S83.7 (injury to multiple structures of knee), M23.5 (chronic instability of knee) or M23.51 (chronic instability of knee, anterior cruciate ligament).

Surgical treatment is defined by a diagnosed anterior cruciate ligament injury in combination with one or more of the following NCSP procedure codes: transcision or excision of anterior cruciate ligament (NGE11, NGE15), suture or reinsertion of anterior cruciate ligament (NGE21, NGE25), transposition of anterior cruciate ligament (NGE31, NGE35), reconstruction of anterior cruciate ligament not using prosthetic material (NGE41, NGE45) or using prosthetic material (NGE51 or NGE55) or other operation on anterior cruciate ligament (NGE91, NGE95). No distinction has been drawn between first-time and revision surgery, since the NCSP codes do not contain this information.

Operations must be at least 180 days apart to count as separate procedures. This requirement was set in order to arrive at as correct a number of operations as possible and avoid follow-up appointments and re-operations being counted as (new) operations.

Patients of all ages are included in the sample. The surgery rates have been adjusted for gender and age.

Findings

During the period, an average of 1,579 anterior cruciate ligament operations per year were registered (Table 5.13). The age group 20–29 years had most operations, and the majority of the patients were men, except in the age group 10–19 years (Figure 5.92).

For Norway as a whole, an average of 31 operations per 100,000 population were performed. The hospital referral areas with the highest surgery rates were Førde (51), Bergen (47) and St. Olavs (47), while the area with the lowest surgery rate was Telemark (13). The confidence intervals show that the variation was greater than we would expect based on chance (Table 5.13 and Figure 5.93).

We see from Figure 5.94 that the number of operations was low in 2012. That year, fewer operations performed by specialists in private practice under public funding contracts were registered. The reason for this is probably a change in the funding system that made cruciate ligament operations unprofitable for specialists in private practice under public funding contracts during this period. If we disregard 2012, the surgery rate for Norway as a whole was relatively stable during the period, although rates for individual hospital referral areas varied from year to year. The number of operations in this category is relatively small, and it is important to note that small changes in the number of operations from one year to the next can have a big impact on the variation.

For Norway as a whole, one in four operations were performed at private hospitals under public funding contracts subject to competitive tendering and/or renegotiation or by specialists in private practice under public funding contracts (Figure 5.95). In Østfold, such providers performed more than half of the operations (55 %), and the percentage exceeded 40 % in several other hospital referral areas. Bergen hospital referral area had the highest percentage of patients who had their operations at a public hospital in their own area (87 %), while in other areas, including Helgeland Hospital (17 %), this was only the case for a small minority of patients.

Comments

The observed variation in surgical treatment of anterior cruciate ligament injuries was particularly high. Surgical treatment was four times as common in Førde hospital referral area as in the Telemark area during the period 2012–2016. However, with a relatively small number of operations during the period, a relatively high proportion of the observed variation could be random, and the element of systematic variation is uncertain. Following an overall assessment, we have characterised the systematic variation in the surgical treatment of anterior cruciate ligament injuries as high and unwarranted (see Chapter 5.5). We have deemed the variation in surgery rates to be unwarranted because there is no known corresponding geographical variation in the incidence of anterior cruciate ligament injuries in Norway.

Surgical treatment of anterior cruciate ligament injuries in children is controversial. In Norway, the accepted practice has been relatively restrictive in order to avoid the risk of damaging bones that are still growing, while more emphasis is placed on the benefits of surgical treatment in other parts of the world (Fabricant et al., 2016; Gicquel et al., 2018). For Norway as a whole during the period 2012–2016, we found that most of the patients in the age group 10–19 years who had surgery were between 16 and 19 years old (82 %). There was no increasing trend in surgical treatment, but the period was too short and the patients too few for us to draw any definite conclusions about developments.

Due to the small volume of surgery, the treatment of anterior cruciate ligament injuries has been analysed for all age groups together. This is not an optimal approach, given the differences in indications for surgery in adults and children. It is nonetheless possible that the analysis, adjusted for age, can give us a picture of the variation between hospital referral areas in the use of surgical treatment for anterior cruciate ligament injuries.

There are no national guidelines for the treatment of anterior cruciate ligament injuries in children and adults, but the outcomes of surgical treatment are documented in the Norwegian Cruciate Ligament Register.[29]

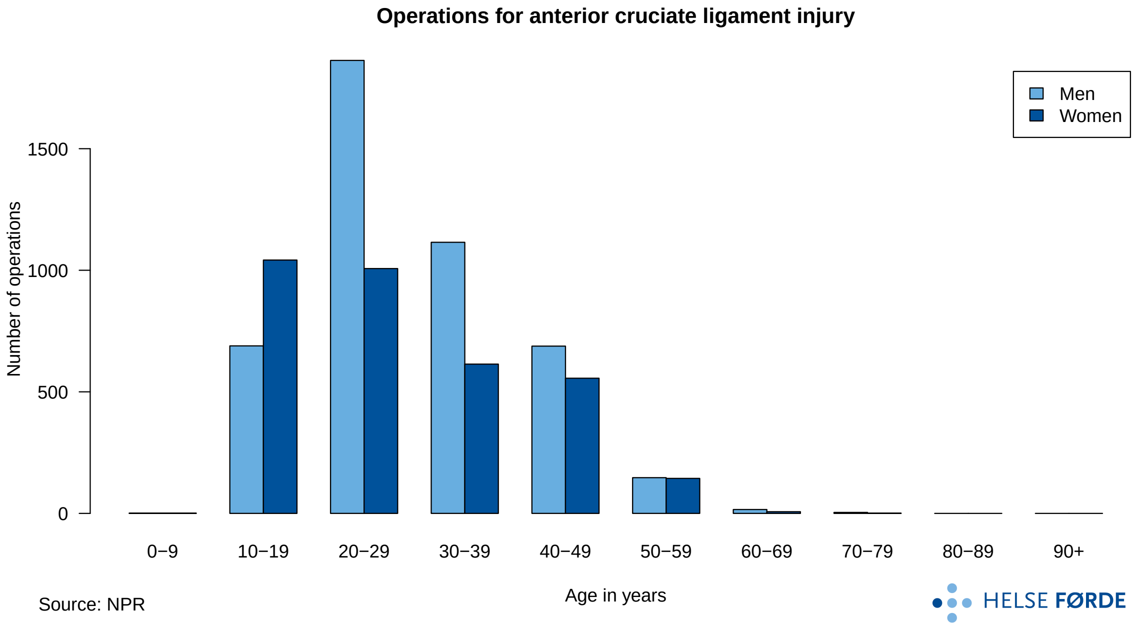


Figure 5.92: Total number of operations for anterior cruciate ligament injuries during the period 2012–2016, for Norway as a whole. The patients have been broken down by gender and age group.

[29] https://www.kvalitetsregistre.no/registers/527/resultater

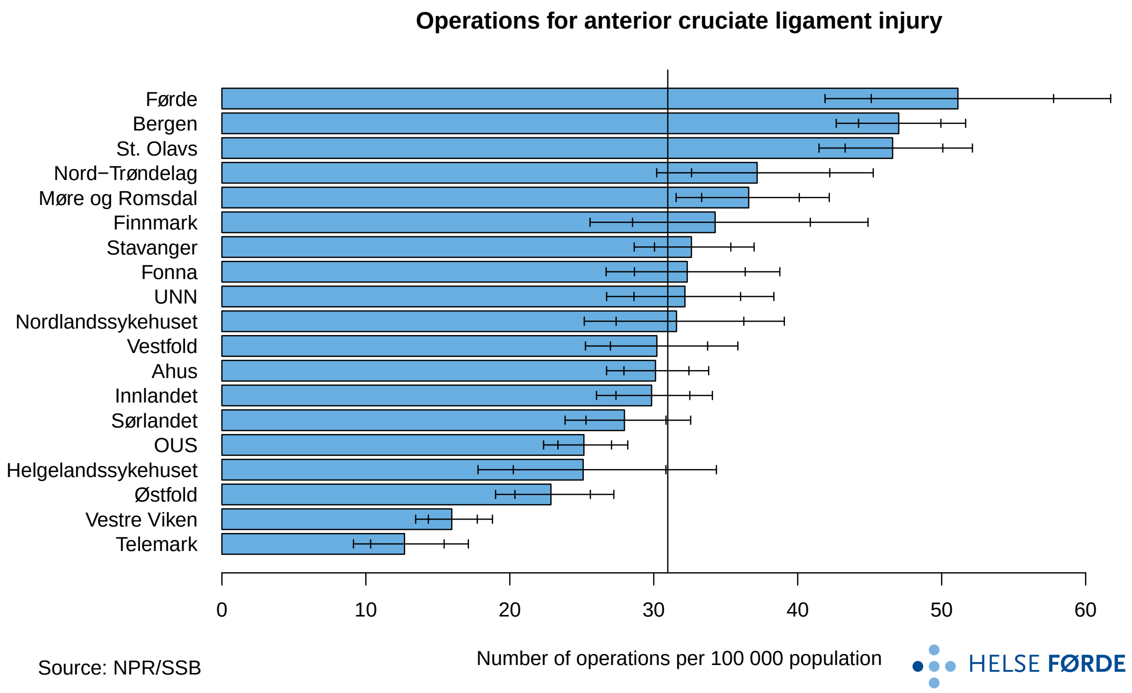


Figure 5.93: Surgery rate: Number of operations for anterior cruciate ligament injuries per 100,000 population (all ages), broken down by hospital referral area. The bars show the average value per year for the period 2012–2016, with pertaining 95 % and 99.8 % confidence intervals. The vertical line indicates the average for Norway as a whole. The rates have been adjusted for gender and age.

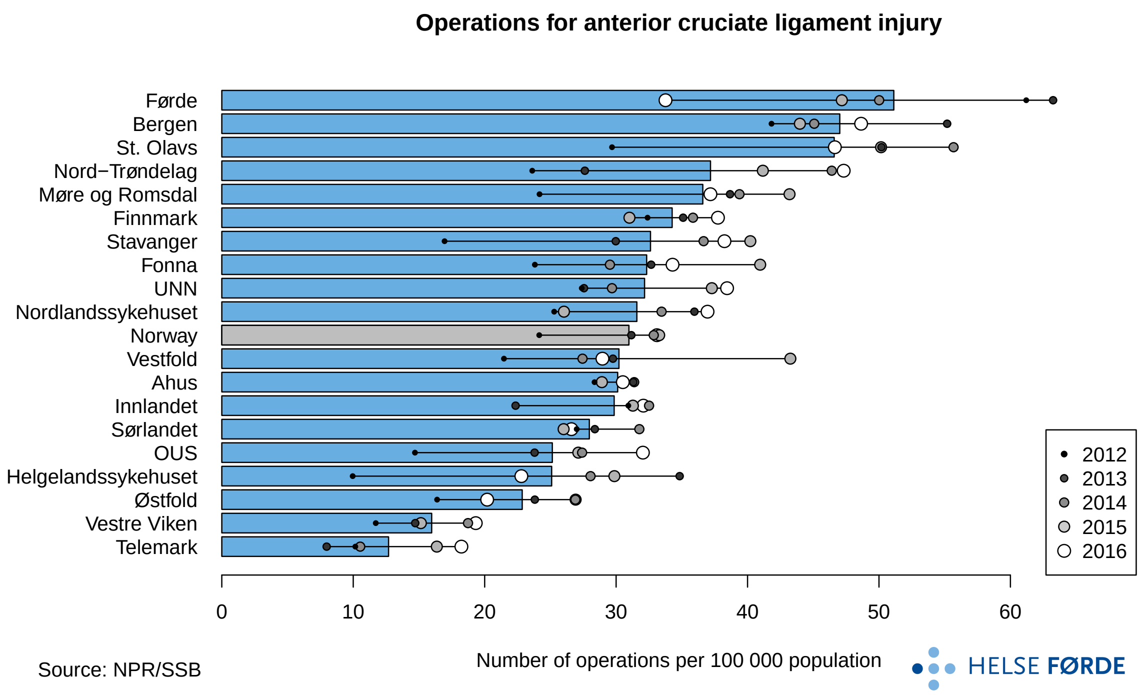


Figure 5.94: Surgery rate: Number of operations for anterior cruciate ligament injuries per 100,000 population (all ages), broken down by hospital referral area and for Norway as a whole. The bars show the average value per year during the period 2012–2016, and the dots represent the rates for each year. The rates have been adjusted for gender and age.

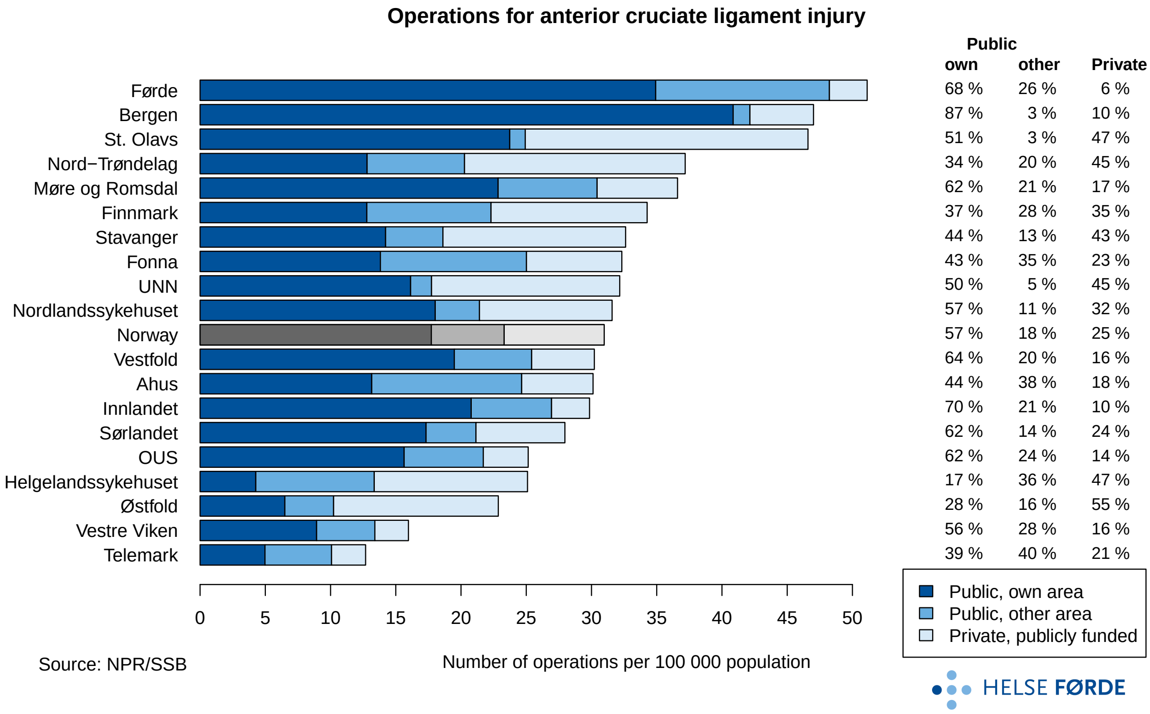


Figure 5.95: Surgery rate: Number of operations for anterior cruciate ligament injuries per 100,000 population (all ages), broken down by hospital referral area. Rates have been adjusted for gender and age. Bars show average value per year (2012–2016), with percentage distribution broken down by where patients had surgery.

Table 5.13: Operations for anterior cruciate ligament injuries. Surgery rate, number of operations and population, broken down by hospital referral area and for Norway as a whole. Figures represent average values per year (2012–2016) and apply to the population of all ages. Rates have been adjusted for gender and age.

Hospital referral area	Surgery rate	Number of operations	Population
Ahus	30.1	141	486,003
Helgelandssykehuset	25.1	19	78,180
Bergen	47.0	212	433,322
Finnmark	34.3	25	74,978
Fonna	32.3	57	177,678
Førde	51.1	53	108,913
Nord-Trøndelag	37.2	49	137,006
Møre og Romsdal	36.6	93	259,260
Stavanger	32.6	120	351,637
Innlandet	29.9	109	395,880
Nordlandssykehuset	31.6	41	136,196
Østfold	22.9	61	283,797
Sørlandet	28.0	80	292,260
St. Olavs	46.6	149	306,134
Telemark	12.7	20	171,368
UNN	32.2	60	187,883
Vestfold	30.2	64	225,146
Vestre Viken	16.0	71	470,817
OUS	25.1	155	528,739
Norway	31.0	1,579	5,105,197

5.4.2 Concussion

Concussion (commotio cerebri) is not an orthopaedic condition, but it is included in the Orthopaedic Healthcare Atlas because patients with concussion who are admitted to hospital are often admitted to an orthopaedics department. However, the analyses do not distinguish between patients based on which department they were admitted to, and all patients with concussion admitted to hospital are included.

Common causes of concussion include road traffic accidents, sports, assault and falls (Best Practice, 2018c). As the name indicates, the symptoms of concussion are caused by the brain being shaken. In addition to loss of consciousness, the patient can experience memory loss, problems concentrating, headache, dizziness, nausea, retching or vomiting.

The symptoms are usually temporary. Intracranial bleeding (bleeding inside the skull) can occur in rare cases, and entails a risk of permanent brain damage. Patients deemed to be at risk of such an injury may be given a CT scan or admitted to hospital for observation (Sundstrøm et al., 2013; NEL, 2018c).

Scandinavian guidelines have been drawn up for the acute management of minimal, mild or moderate head injuries (Sundstrøm et al., 2013). Concussion is a diagnosis that provides little information about the severity of the head injury and the patient's risk of complications, and the recommendation is to instead categorise head injuries as minimal, mild, moderate or severe (NEL, 2018c). The guidelines state how long patients should be kept under observation, whether they should be admitted to hospital for observation, and when CT scans should be used. One of the goals of these guidelines is to reduce the use of CT scans on patients with a low risk of bleeding. This applies to children in particular, and the reason is concern that high radiation doses may represent a risk.

For the majority of patients, it is sufficient to have some physical and cognitive rest and then return gradually to their normal level of activity. Symptoms will normally disappear in between one week and one month, but 15 % of patients may experience long-term symptoms known as post-concussion syndrome (Gjerstad, 2009; Best Practice, 2018c).

Sample

Concussion is defined by a primary diagnosis of ICD-10 code S06.0 (concussion, with or without open wound). Admission is defined in Chapter **??** Other definitions.

Only patients aged 18 years or older are included in the sample, except in the figure that shows the gender and age distribution of patients who have been admitted with concussion (Figure 5.96).

The admission rates have been adjusted for gender and age.

Findings

During the period, an average of 2,843 adult patients (18 years and older) per year were admitted, while the total number of admissions was 2,943. The majority of the patients were men (Figure 5.96). The national average was 74 admissions per 100,000 population per year, with the highest admission rate in Stavanger hospital referral area (108) and the lowest admission rate in the St. Olavs area (35) (Figure 5.97 and Table 5.14).

This picture changed somewhat when we looked at adults under 67 years of age (Figure 5.99). There were fewer admissions for concussion for Norway as a whole (56), with the highest admission rates found in the hospital referral areas of Nordland Hospital (84) and Stavanger (83). The area with the lowest rate was St. Olavs (27).

Elderly people (67 years or older) were clearly admitted for concussion more often (Figure 5.99). For Norway as a whole, we found 152 admissions per 100,000 population per year. The highest admission rates were found in the hospital referral areas of OUS (230) and Stavanger (225), while the area with the lowest rate was again St. Olavs (71). The number of admissions for concussion varied more between hospital referral areas than can be explained by chance, both when we looked at the entire adult population and for adults younger than 67 years and the elderly.

The number of admissions per 100,000 population changed considerably from year to year for some hospital referral areas, but remained stable for Norway as a whole. There was no clear trend in admission rates (Figure 5.98).

Comments

There was considerable variation in the admission rate for concussion during the period 2012–2016 (see Chapter 5.5). There were three times as many admissions per 100,000 population in Stavanger hospital referral area as in the St. Olavs area. The variation exceeded what can be explained by chance also when we split up the sample into persons aged 18–66 years and persons aged 67 years and older with concussion.

The Scandinavian guidelines for the management of minimal, mild or moderate head injuries were first published in 2000 and were updated in 2013 (Sundstrøm et al., 2013). This means that there is a basis for uniform practice. We have only analysed variation in admission rates in the specialist health service. It is possible that different ways of organising the provision of health services and variations in access to municipal and intermunicipal observation beds can explain some of the observed variation in admission rates.

It is therefore difficult to assess to what extent the observed variation in admissions is due to actual differences in the treatment of adults patients with concussion, but unwarranted variation cannot be ruled out.

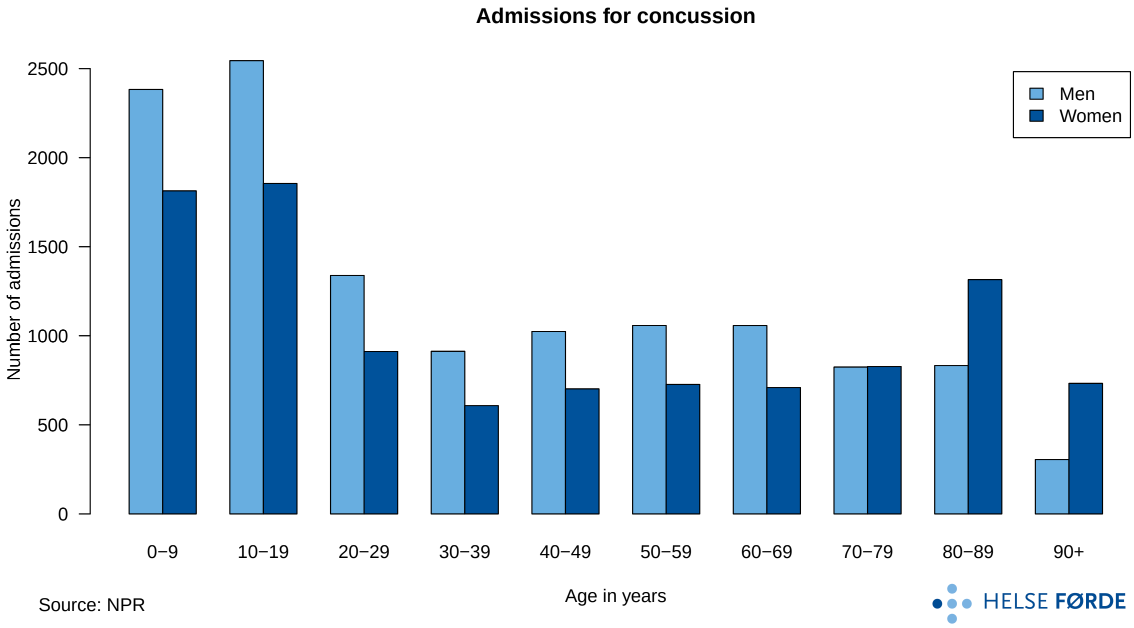


Figure 5.96: Total number of admissions of patients with concussion during the period 2012–2016, for Norway as a whole. The patients have been broken down by gender and age group.

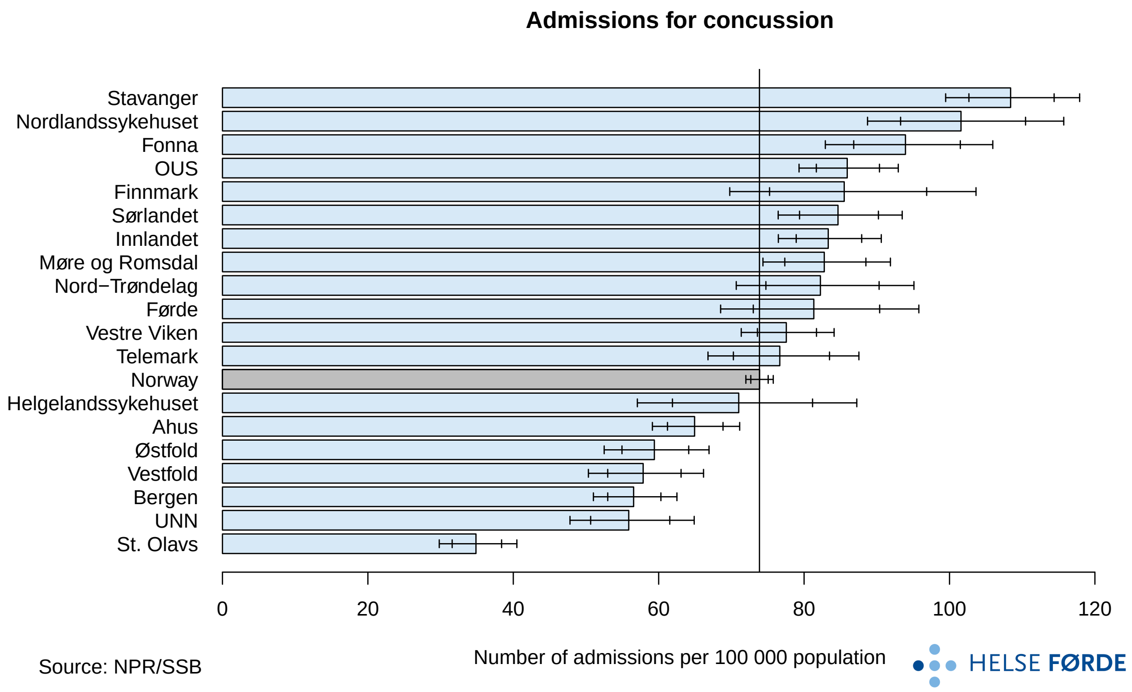


Figure 5.97: Admission rate: Number of admissions for concussion per 100,000 population (18 years and older), broken down by hospital referral area. The bars show the average value per year for the period 2012–2016, with pertaining 95 % and 99.8 % confidence intervals. The vertical line indicates the average for Norway as a whole. The rates have been adjusted for gender and age.

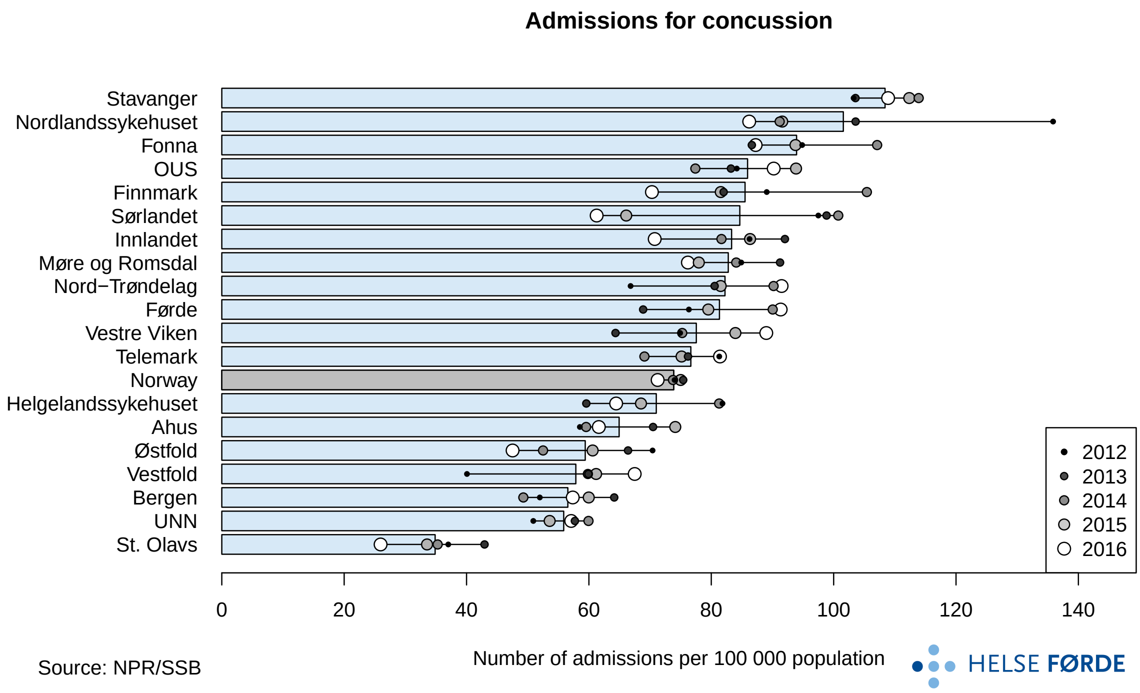
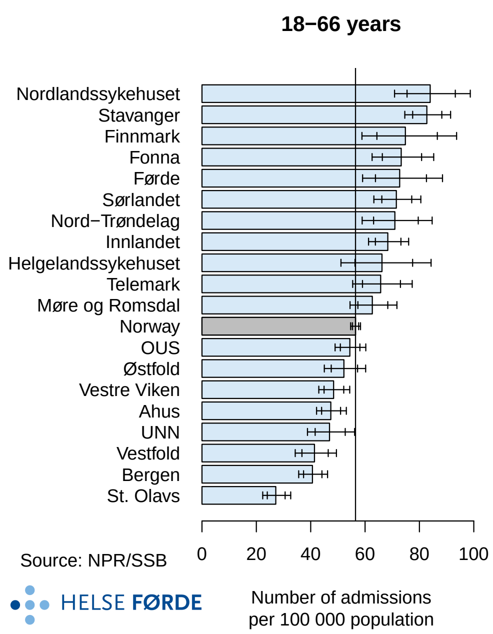
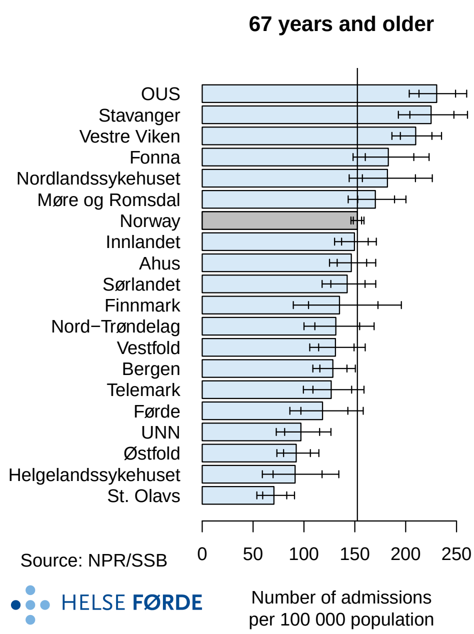


Figure 5.98: Admission rate: Number of admissions for concussion per 100,000 population (18 years and older), broken down by hospital referral area and for Norway as a whole. The bars show the average value per year during the period 2012–2016, and the dots represent the rates for each year. The rates have been adjusted for gender and age.



(a) Admission rate for adults under 67 years



(b) Admission rate for the elderly, 67 years and older

Figure 5.99: Admission rate: Number of admissions for concussion per 100,000 population in two age groups, broken down by hospital referral area. The bars show the average value per year for the hospital referral areas for the period 2012–2016, with 95 % and 99.8 % confidence intervals. The vertical lines indicate the average values for Norway as a whole. Adjusted for gender and age.

Table 5.14: Concussion. Admission rate (number of admissions per 100,000 population), number of admissions, number of patients and the population, broken down by hospital referral area and for Norway as a whole. The figures represent the average values per year for the period 2012–2016 and concern the population aged 18 years and older. The rates have been adjusted for gender and age.

Hospital referral area	Admission rate	Number of admissions	Number of patients	Population
Ahus	64.9	229	220	370,737
Helgelandssykehuset	71.0	44	44	61,456
Bergen	56.6	188	183	335,924
Finnmark	85.5	50	49	58,702
Fonna	93.9	129	127	135,469
Førde	81.3	71	68	84,077
Nord-Trøndelag	82.2	89	87	106,072
Møre og Romsdal	82.8	174	169	201,630
Stavanger	108.4	273	257	265,081
Innlandet	83.3	274	266	315,870
Nordlandssykehuset	101.6	111	107	106,963
Østfold	59.4	132	129	222,700
Sørlandet	84.7	190	185	224,372
St. Olavs	34.9	83	81	240,031
Telemark	76.7	107	105	135,860
UNN	55.9	83	82	147,894
Vestfold	57.9	104	102	176,835
Vestre Viken	77.6	286	271	363,780
OUS	85.9	324	311	427,887
Norway	73.9	2,943	2,843	3,981,340

5.5 Assessment of variation

We found significantly higher variation between hospital referral areas than we would expect based on chance for all of the conditions we have looked at. All the figures show some 99.8 % confidence intervals that do not overlap with the national rate. This suggests systematic variation between hospital referral areas for all of the conditions.

In the Orthopaedic Healthcare Atlas for Norway, we have attached great importance to the figures with confidence intervals in our assessment of the magnitude of the variation in surgery and admission rates between hospital referral areas. We have also assessed the ratios, the coefficient of variation (CV) and the systematic component of variation (SCV) in relation to the number of operations or admissions for each condition (see Chapter 4.6.6). Tables 5.15 and 5.16 show the statistics on which our assessments are based. In our assessments, we have also looked at how variations are categorised, and proposed interpretations, based on the SCV values alone (Appleby et al., 2011), oand we have exercised professional judgement.

Table 5.15: Statistical basis for assessment of variation in operations for the conditions. Total numbers for Norway during the period 2012–2016. N is the number of operations. N_{min} is the number of operations in the hospital referral areas with the fewest operations, and N_{maks} is the number in the area with the most operations. The rates show the surgery rates for the hospital referral areas with the highest and lowest rate. The rates have been adjusted for gender and age.

	Number of operations			Rates		Ratios			100·	100·
	N	N_{min}	N_{max}	lowest	highest	FT	FT_2	FT_3	SCV	CV
Hip fractures	44,460	521	4,506	197	242	1.2	1.2	1.1	0.2	5
Osteoarthritis of the hip	37,298	461	3,873	158	228	1.4	1.3	1.2	0.8	9
Deg. knee disease	33,621	500	3,294	147	670	4.5	2.4	2.0	10.3	30
Osteoarthritis of the knee	28,539	373	2,736	120	224	1.9	1.5	1.4	2.6	16
Wrist fractures	19,061	203	1,922	63	148	2.4	2.0	1.5	4.6	22
Lumbar spinal stenosis	16,064	164	2,115	56	115	2.1	1.8	1.8	4.9	23
Lumbar disc herniation	15,991	219	1,701	49	124	2.6	1.7	1.4	3.8	20
Ankle fractures	15,346	219	1,464	58	93	1.6	1.3	1.2	0.9	10
Anterior cruciate ligament	7,895	94	1,061	13	51	4.0	2.9	2.0	8.9	30
Shoulder fractures	4,327	31	461	11	33	3.1	2.3	1.9	6.5	27
Osteoarthritis of the thumb	4,191	46	433	12	37	3.0	2.6	2.0	9.8	32
Clavicular fractures	3,246	36	380	8	17	2.1	2.0	1.7	3.9	22

The variation between hospital referral areas was particularly high for arthroscopies for degenerative knee disease. This assessment is based on Figure 5.20, where the confidence intervals are far removed from the national rate and are fairly narrow. Random variation accounts for a small part of the observed variation. This indicates that the systematic variation is particularly high for arthroscopy rates. It is also our assessment, based on Table 5.15, that the ratios, SCV and CV for degenerative knee diseases are high given the high number of arthroscopies.

Compared with other conditions with a corresponding number of operations (see Table 5.15), our assessment is that the surgery rates for osteoarthrosis of the knee show moderate variation (Figure 5.12), for osteoarthrosis of the hip relatively low variation (Figure 5.3) and for hip fractures low variation between hospital referral areas (Figure 5.49).

We have also looked at the variation between hospital referral areas for conditions with somewhat fewer operations or admissions than those mentioned above, but still a fairly large number, in context. The figures show high systematic variation between hospital referral areas in the surgery rates for wrist fractures (Figure 5.37), lumbar spinal stenosis (Figure 5.82) and lumbar disc herniation (Figure 5.75), as well as in admission rates for concussion (Figure 5.97) and other lower back pain (Figure 5.90). The ratios, SCV and CV in Tables 5.15 and 5.16 are fairly high for these conditions. As regards ankle fractures, Figure 5.45 5.45 indicates that the variation is moderate to low, and the ratios, SCV and CV in Table 5.15 are lower than for the above-mentioned conditions.

Table 5.16: Statistical basis for assessment of variation in admissions for the conditions. Total numbers for Norway during the period 2012–2016. N is the number of admissions. N_{min} is the number of admissions in the hospital referral area with the fewest admissions, and N_{max} is the number in the area with the most admissions. The rates show the admission rates for the hospital referral areas with the highest and lowest rate. The rates have been adjusted for gender and age.

	Number of admissions			Rates		Ratios			100·	100·
	N	N_{min}	N_{max}	lowest	highest	FT	FT_2	FT_3	SCV	CV
Concussion	14,717	221	1,619	35	108	3.1	1.8	1.7	5.2	23
Lower back pain	13,461	254	1,381	45	106	2.3	2.1	1.8	8.3	25

For some of the conditions we have looked at (anterior cruciate ligament injury, osteoarthritis of the thumb and clavicular fracture), the number of operations during the five-year period was quite low (fewer than 8,000). Anterior cruciate ligament injuries stood out among these conditions as the condition with the highest number of operations, the highest ratio, SCV and high CV (Table 5.15). We have characterised the variation between hospital referral areas in operations for such knee injuries as high (see also Figure 5.93).

The number of operations performed for shoulder fractures (Figure 5.64), osteoarthritis of the thumb (Figure 5.27) and clavicular fractures (Figure 5.70) was also low during the period 2012–2016. Confidence intervals are wide for these operations, which means that a large proportion of the observed variation could be random. Some hospital referral areas operated fewer than 40 patients for clavicular fractures and shoulder fractures, so the ratios must be interpreted with caution. The ratios and SCV are lower than for anterior cruciate ligament injuries (Table 5.15). Due to the low number of patients and high level of uncertainty associated with the surgery rates for these three conditions, we have chosen to be cautious in our interpretations. Following an overall assessment, we have categorised the variation in surgery rates for osteoarthritis of the thumb and shoulder fractures as moderate to high, and for clavicular fractures as moderate.

Chapter 6

Discussion

6.1 Main findings

The main findings of the *Orthopaedic Healthcare Atlas for Norway* can be summarised as follows:

- There was little variation between hospital referral areas in surgical treatment of patients with hip fractures, which can be categorised as effective care. There was otherwise moderate variation in the treatment of patients with fractures, with the exception of patients with wrist fractures, for which there was high systematic variation.
- The systematic variation in the treatment of patients with osteoarthritis of the knee was moderate. Arthroscopy for degenerative knee disease stood out with particularly high variation between hospital referral areas. Patients with osteoarthritis of the hip were more uniformly treated in different parts of Norway, while the systematic variation in surgical treatment for osteoarthritis of the thumb was characterised as moderate to high.
- There was considerable variation in the treatment of patients with back complaints, both in surgical treatment of lumbar disc herniation and lumbar spinal stenosis, but also for admission for other lower back pain.
- The systematic variation was also assessed as high both for surgical treatment of patients with anterior cruciate ligament injuries and for hospital admission of patients with concussion.

6.2 Discussion of the method

6.2.1 The data

Coding

The main source of the data on which the analyses in this healthcare atlas are based is the Norwegian Patient Registry (NPR), a national health register that contains information about all patients treated by the Norwegian specialist health service. NPR was primarily developed for administrative purposes. In the atlas, we use the information to assess whether there is variation in the population's use of specialist health services in different parts of Norway. One of the challenges we encounter when analysing this type of data, is whether the quality of coding is adequate. The Office of the Auditor General of Norway's investigation of medical coding practice in the health trusts, which looked at patients with pneumonia and hip prostheses, showed that the quality of medical coding was poor. Of the patients who had undergone prosthetic replacement of the hip, 5 % were given a new primary diagnosis following the coding audit (Riksrevisjonen, 2017b). Coding quality deficiencies will give rise to errors in the description of the specialist health service's activities.

A lot of effort has gone into improving and harmonising coding practices, but we cannot rule out the possibility that our data set could contain some coding errors, which means that the data will not provide an entirely accurate picture of what activities have actually taken place in the specialist health service. In order to minimise the challenge represented by incorrect coding, we have taken time to adjust and check the quality of the data set received from NPR, and we have looked for coding errors and differences in coding practices. Coding errors in the data set can be considered random errors equally distributed throughout the country, which will not have any significant impact on our conclusions concerning variation. Differences in coding practices between hospital referral areas, on the other hand, could skew the data on which the analyses are based. Different departments or hospitals could code a procedure or an activity in different ways, and different surgical techniques can be used to treat the same condition. The procedures we have used when defining samples in the Orthopaedic Healthcare Atlas were used to minimise the effects of differences in coding practice (see Chapter 4.2 Sample). We cannot entirely rule out the possibility that there may be unidentified differences in coding practice. We have nevertheless concluded that the results contain as few errors as possible based on the available data, and that the conclusions drawn concerning variation between hospital referral areas will stand up to verification of the analyses.

Privately funded health services

Treatment funded by private individuals or health insurance companies is not included in the analyses because such activities are not reported to NPR. Health services that are fully privately funded seem to account for an increasing proportion of health services. However, it is not easy to find information about the volume (Uleberg et al., 2018). Differences between hospital referral areas in the use of privately funded health services could give us a different picture of variation in the use of health services than our analyses of publicly funded health services, but we do not know what the impact would be.

The medical quality registers do register information about treatment by private providers, but they do not differentiate between publicly and privately funded treatment. Moreover, the quality registers have lower coverage than NPR. These circumstances make it difficult to determine what proportion of treatment is privately funded.

There is also some uncertainty about whether specialists in private practice under public funding contracts report all their activities to NPR. For the Orthopaedics Healthcare Atlas, we have checked whether we have received data from all the specialists in private practice under public funding contracts that were supposed to report to NPR during the period. We have seen that the volume of reported activities was relatively stable throughout the period, although some of the specialists did not report activities for all years.

We do not have a complete picture of the population's use of orthopaedic surgery during the period 2012–2016. The reasons for this are a lack of information about the use of health services that are fully privately funded, potentially incomplete reporting from specialists in private practice under public funding contracts, and the fact that we have no information about patients' use of orthopaedic health services abroad. However, we believe that we have a good overview of the population's use of publicly funded specialist health services.

6.2.2 Analyses of variation

The confidence intervals were calculated based on the assumption that the events we are studying are independent of each other. In several of the cases we are looking at, one patient could have more than one event, i.e. more than one operation, fracture or admission. In such case, the events are no longer independent, and random variation will be higher than shown in the confidence intervals in the figures. For the conditions we are looking at, relatively few patients were registered with more than one event. The effect is therefore small. We have checked that this will not have any significant bearing on the results.

The way in which we have chosen to calculate the rates could alter the ranking of hospital referral areas slightly. For example, counting unique patients with fractures could result in a slightly different order than if we count all the fractures. This will not change the main findings, however. The variation and the confidence intervals will be more or less the same. The same hospital referral areas stand out with significantly higher or lower rates than Norway as a whole, even though the order could change somewhat in some cases. This is one of the reasons why it is important not to focus too much on the exact order in which the hospital referral areas are presented. It is better to focus on whether the observed variation is high and whether the hospital referral area you are interested in is significantly above or below the national rate.

Ranking the systematic variation in the use of health services from low to high in precisely defined categories is not straightforward, and there is no consensus that there is any one method that is right for the purpose. It is a challenge that the number of patients, operations or admissions can have a bearing on the methods. In the Orthopaedic Healthcare Atlas, we have taken a broad approach to the issue as described in Method (Chapter 4.6) and Results (Chapter 5.5). In Tables 5.15 and 5.16, we present statistics that, together with the medical assessments, form the basis for our assessment of variation. To summarise the overall assessments we have used wording such as low, moderate, moderate to high and similar to describe variation. These terms and categories are open for discussion. In our opinion, they serve to show that the systematic variation is not the same for all the surgery rates and admission rates we have looked at. We believe that this could be useful when knowledge from this atlas is used in the work on ensuring more equitable services for patients.

6.3 Discussion of the results

6.3.1 Degenerative joint disease

With the exception of arthroscopy, we found no variation in surgical treatment of degenerative joint disease that was unquestionably high (see Chapter 5.5).). In other words, the proportion of patients with osteoarthritis of the hip or knee who had surgery was relatively similar in different parts of Norway. Although there are no national guidelines for the treatment of these conditions, the Norwegian Arthroplasty Register has a strong advisory role in the medical community when it comes to treatment practice.

Patients with osteoarthritis of the knee were still treated with arthroscopy, despite the fact that it has been known for a long time that the effect of such procedures is no better than of conservative treatment. During the period 2012–2016, it seems that patients from hospital referral areas with a relatively low surgery rate for prosthetic knee replacement also had a correspondingly low arthroscopy rate for degenerative knee disease (osteoarthritis and meniscal injuries). There was clear variation in the use of surgical treatment for osteoarthritis of the knee depending on the patient's area of residence.

The consensus on the assessment of patients and indications for surgery seems to be stronger for osteoarthritis of the hip than of the knee. The variation in surgery rates was lower for osteoarthritis of the hip than for osteoarthritis of the knee, and prosthetic replacement was far more common for patients who were in contact with the specialist health service for osteoarthritis of the hip (50 %) than for patients with osteoarthritis of the knee (25 %). The anatomy of the hip and knee joints presents different challenges in relation to surgical treatment, and this could influence the choice of treatment in different ways.

Nonetheless, the variation between hospital referral areas in the use of arthroscopy for degenerative knee disease was exceptionally high (Chapter 5.5 and Figure 5.20). There has long been a strong focus on this procedure, and we saw a change during the period 2012–2016. The number of arthroscopies dropped by half. However, the variation between hospital referral areas clearly shows that there was no professional consensus on the indications for this procedure at the national level.

The analyses give us a picture of the variation in the use of surgical treatment for degenerative joint disease during the period. However, they do not provide a detailed picture of all the factors that have a bearing on the need for surgery. We do not know what phase of the disease the patients with degenerative joint disease in our sample were in. The prioritisation guide[30] distinguishes between severe and moderate symptoms of osteoarthritis of the hip and knee. Whether the patient is entitled to healthcare in the specialist health service is decided on the basis of an assessment of the degree of pain and functional impairment (in particular pain at rest and at night), whether conservative treatment proves ineffective, and agreement between clinical and objective findings (conventional radiography). If the condition's severity varied between hospital referral areas, that could have a bearing on the need for, e.g., prosthetic joint replacement.

Expertise and services offered by other and cooperating professional groups can also have a bearing on surgery rates. Active living with OsteoArthritis (ActiveOA)[31] is one example of a structured, evidence-based conservative treatment programme for osteoarthritis of the hip and knee. The programme offers patients physiotherapy with the emphasis on information, exercise and weight loss under the auspices of the municipal health service. In addition, ActiveOA includes a programme of education for physiotherapists working in the municipal health service and a quality register that registers patient-reported

[30] https://helsedirektoratet.no/retningslinjer/ortopedi

[31] http://aktivmedartrose.no/

symptoms, complaints, quality of life, coping and physical functioning. Data from Active OA show that the number of patients who made use of conservative treatment via ActiveOA in 2017 varied between hospital referral areas (Figure 6.1). The figures do not include other conservative treatment provided by the municipal health service for patients with osteoarthritis of the hip and knee.

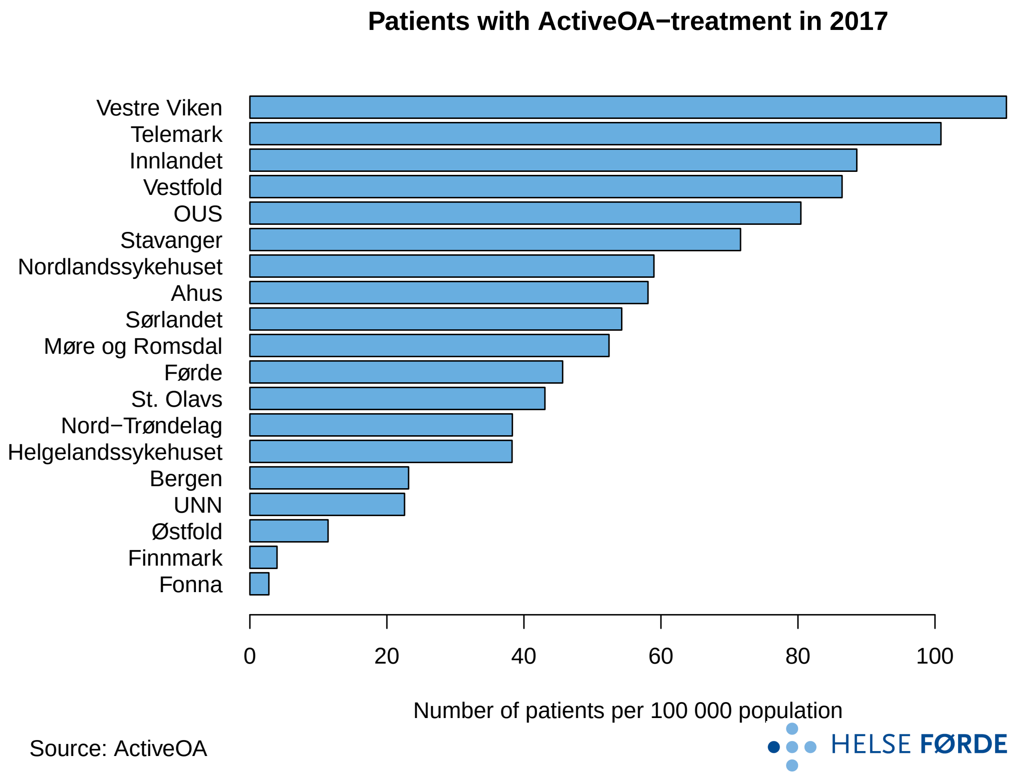


Figure 6.1: Patient rate. Number of patients aged 18 years or older per 100,000 population who received treatment through the ActiveOA programme in 2017. The patients are assigned to the different areas on the basis of where they received treatment (the address of the physiotherapist/clinic). In other words, the numbers are based on the address of the treatment centre. The rates have not been adjusted for gender and age.

6.3.2 Fractures

The variation in surgical treatment for patients with fractures was relatively moderate during the period 2012–2016 (Chapter 5.5). The high systematic variation in surgical treatment of patients with wrist fractures was an exception to this rule (Figure 5.37). The guidelines for treating wrist fractures were published during the period, and we see that their publication had a certain harmonising effect on practice towards the end of the period. The treatment of patients with hip fractures differed from other treatment of fractures because surgical treatment is considered necessary, and we found little variation in surgery rates between hospital referral areas. This is as expected, and the observed variation in surgery rates is seen as a reflection of the variation between hospital referral areas in the incidence of hip fractures during the period.

Assessing the need for surgery following a fracture is specialised care, and nearly all fractures are treated by the specialist health service. We can therefore consider the number of fractures to be close to the incidence of fractures during the period. The fracture rate, i.e. the number of fractures per 100,000 population, shows that the variation in incidence between hospital referral areas was relatively low (Chapter 5.2).

Fractures of the clavicle, shoulder, wrist and ankle

Treatment of fractures can be categorised as effective care. However, the analyses suggest that the choice of treatment – surgical or conservative – was more preference-sensitive, perhaps even supply-sensitive, for these types of fractures than for hip fractures. It is known that the treatment of fractures varies, for example between the Scandinavian countries and Germany, where surgical treatment is used far more. The orthopaedic community in Norway is relatively small, and some hospitals have a small number of orthopaedic surgeons. This means that the education, background and preferences of individual orthopaedic surgeons can play a greater role and be more likely to manifest themselves as variation in surgery rates between hospital referral areas. The patient's level of activity and bone quality are also factors that have a bearing on the choice between conservative and surgical treatment, as is the complexity of the fracture. It is not possible to adjust for these factors in the data on which the analyses in this atlas are based, and the analyses therefore do not uncover any differences in their distribution between geographical areas. We must assume that they are relatively evenly distributed throughout Norway.

The process of choosing the surgical technique includes an assessment of factors relating to the patient and the fracture seen in relation to the patient's preferences. The treatment provider's individual expertise will also have a bearing on the decision-making process. National guidelines are lacking for most types of fractures, and there is not always consensus on what is the best treatment method. This is particularly pronounced for shoulder fractures, but could result in considerable variation for other types of fractures as well, both in terms of surgical technique and the choice between surgical and conservative treatment. For example, we see that the percentage of fractures operated on was highest for wrist fractures, and that the same hospital referral areas had both the highest percentage operated on and high surgery rates. We interpret this to mean that different indications for surgery were applied for this condition during the period, despite the introduction of national guidelines in 2013.

Surgical treatment of adolescent patients with clavicular fractures is controversial, and practice has varied over time. This has also been highlighted as a procedure with an uncertain knowledge base. However, there were few adolescent patients with clavicular fractures during the period analysed, and it is not possible to obtain good data about the possible variation between hospital referral areas. We have therefore chosen to include patients of all ages in our analyses, which, when adjusted for age, gives us a picture of variation in surgical treatment in general.

Hip fractures

The surgery rates for hip fractures did not vary much between hospital referral areas (Chapter 5.5 and Figure 5.49), and there is general consensus that patients should be treated in hospital and should not have to wait a long time for surgery. The quality indicators *Proportion of patients operated on within 24 and 48 hours of being admitted* and *30-day survival after admission*[32] were established to ensure good quality and equitable services for patients throughout Norway.

The duration of hospital stays for patients with hip fractures differed depending on where they lived (Figure 5.51). We found that the average length of stay per episode of care was nearly 6 days for the country as a whole, but varied by 3 days between the hospital referral area with the shortest and the area with the longest stays. Time spent in rehabilitation institutions is not included because we lack good data. The Office of the Auditor General of Norway (Riksrevisjonen, 2017a), SKDE through the Healthcare Atlas for the Elderly in Norway (Balteskard et al., 2017) and the Norwegian Directorate of Health (Helsedirektoratet, 2017) have all found, as did this healthcare atlas, that the length of stay for hip fractures has decreased somewhat. The differences in the average number of bed days could be due to different calculation methods. The Healthcare Atlas for the Elderly in Norway questioned whether we, in recent years, have reached a lower limit for length of stay for patients with hip fractures, who are often elderly people with several medical conditions. The length of stay is linked to operating costs and resource use for the health trusts, but also to quality of treatment.

The Norwegian guidelines for interdisciplinary treatment of hip fractures (*Norske retningslinjer for tverrfaglig behandling av hoftebrudd*) build on research-based knowledge and concern elderly patients with hip fractures (Legeforeningen, 2018). They point out that, through structured cooperation between specialists from different medical fields and other healthcare professionals, patients with hip fractures can be treated in a way that results in improved survival, shorter stays, lower costs and fewer patients being discharged to institutions. The purpose of these guidelines is to ensure high quality and proper prioritisation in the treatment of elderly people with hip fractures, and to avoid unwarranted variation between health trusts (Legeforeningen, 2018). The introduction of these guidelines can probably contribute to more uniform practice, treatment pathways that are more beneficial to patients, and socioeconomic benefits.

6.3.3 Back complaints

There was considerable variation between hospital referral areas in both surgical treatment and admissions of patients with back complaints during the period 2012–2016 (Chapter 5.5) .

The data do not show how advanced the condition of patients with back complaints was, nor to what extent conservative treatment had been tried and, if relevant, found to be insufficient. The prioritisation guide[33] highlights the degree of pain and functional impairment, whether conservative treatment has proved ineffective and agreement between clinical and objective findings (conventional radiography and MRI) as factors in the assessment of healthcare for patients diagnosed with lumbar disc herniation and degenerative back disease with and without neurological deficit. Increasing paresis and cauda equina syndrome should be treated as emergency care cases. Our analyses are based on the assumption that morbidity is evenly distributed throughout Norway. If there were differences in morbidity between geographical areas, however, this would of course have a bearing on the need for surgical treatment of back complaints.

[32] https://helsenorge.no/Kvalitetsindikatorer/behandling-av-sykdom-og-overlevelse
[33] https://helsedirektoratet.no/retningslinjer/ortopedi

Although analyses of the treatment of patients with back complaints were divided into treatment for lumbar disc herniation, lumbar spinal stenosis and other back pain, we know that a patient's back pain could be a combination of these three groups. The data show that approx. 10 % of patients with disc herniation also suffer from spinal stenosis and are therefore included in both samples. It is a challenge to limit patient samples when their condition is complex, and we have chosen to present figures for each condition without excluding patients with complex back problems.

Access to MR scans could influence the treatment of back complaints. For patients to have a right to healthcare, disc herniation should as a rule be confirmed by an MR scan. This examination is also important when considering surgical treatment for patients with spinal stenosis and investigating the cause of other back pain. It appears that access to MR scans is not equitably distributed in Norway, and this could have a bearing on the services and treatment offered to patients in different hospital referral areas – in particular on admissions of patients with other back pain in cases where a final diagnosis may not be available due to long waiting times for MR scans and the patients needs hospital treatment in the meantime. The supply of 'beds' can also have an effect on variation. Differences in the organisation of an access to MR scans can drive variation between hospital referral areas.

Not all hospital referral areas have access to treatment performed by spine surgeons. For example, we see that patients from Finnmark hospital referral area were operated for disc herniation and spinal stenosis by private treatment providers or in other hospital referral areas. We also see that the percentage of patients who had their operation in their own area was low in some hospital referral areas. We do not know to what extent long distances raise the threshold for surgical treatment, but it is conceivable that access to spine surgeons is one of the factors behind the variation in the use of surgical treatment for back complaints.

6.3.4 Other conditions

Anterior cruciate ligament injury

The systematic variation is deemed to be high for surgical treatment of anterior cruciate ligament injuries (Chapter 5.5 and Figure 5.93).

Surgical treatment of anterior cruciate ligament injuries in young patients is controversial as regards the benefit versus the potential risk. The prioritisation guide[34] also emphasises whether conservative treatment has been tried in its assessment of healthcare.

Originally, we planned to only investigate the variation in the use of surgical treatment in young patients with anterior cruciate ligament injuries. The number of young patients with this condition operated by the specialist health service turned out to be low, and it was not possible to conduct a good statistical assessment. We have therefore chosen to include patients of all ages with an anterior cruciate ligament injury in our analyses. This is not optimal, but it is our assessment that, with age adjustment, we can say something about the variation between hospital referral areas in the use of surgical treatment for this patient group. At the national level, we see that surgical treatment was used for patients aged 15 years and older.

Many patients with an anterior cruciate ligament injury are operated by private treatment providers, often funded through health insurance policies. The operations are registered in the Norwegian Cruciate Ligament Register,[35], but data for privately funded treatment are not easily accessible and are

[34] https://helsedirektoratet.no/retningslinjer/ortopedi
[35] https://www.kvalitetsregistre.no/registers/nasjonalt-korsbandregister

therefore not included in our analyses. This is a shortcoming. We found high variation between hospital referral areas in the use of surgical treatment, and we believe that the inclusion of privately funded operations could influence the variation. There is reason to believe that the variation is unwarranted. It will be up to the specialist community and the health authorities to consider measures to facilitate more equitable provision of health services for this patient group.

Concussion

Analysing differences in the use of health services by patients with concussion is not without challenges. The term concussion as used in the ICD-10 coding system does not provide any details about the patient's condition. The prioritisation guide emphasises that all conditions must be individually assessed.[36] The recommended approach is to define the condition as a minimal, mild or moderate brain injury and clarify which risk factors are present. This approach is also used in the Scandinavian guidelines, which have been in use for nearly 20 years (Sundstrøm et al., 2013). The purpose of the guidelines is to avoid serious late effects. Patients are observed in order to ensure that any bleeding is detected. The SB100 blood test or CT scans can also be used for selected patients. This applies to a minority of patients with concussion.

The data provide little information about the use of health services in relation to the guidelines. Observation starts from the time of the injury, and our data do not include this information. Nor do we have information about the use of blood tests or radiological examinations. However, we have used data about admissions of patients with concussion to form a rough picture of this patient group's use of health services and any differences between hospital referral areas.

There was considerable variation between hospital referral areas in terms of admission of patients with concussion (Chapter 5.5 and Figure 5.97).The variation was high for the adult population as a whole, but also when we distinguished between adults under and over the age of 67 years (Figure 5.99). Whether the observed variation is due to differences in how the health services are organised or differences in practice between hospital referral areas is not clear from our analyses. It will be up to the medical community and the regional health authorities and health trusts to consider this in more depth.

6.4 General reflections

The explanations for the variation in surgery rates may be many and complex. We have not investigated them. Nevertheless, during the course of our work we have formed the impression that both the expertise and preferences of individual surgeons and the culture at each hospital had a bearing on the treatment provided. The assessments made by individual treatment providers, including to what extent they apply new knowledge, i.e. from the quality registers, can also have an effect on variation.

The impressions we have formed during our work on this healthcare atlas are supported and supplemented by the summary in South-Eastern Norway Regional Health Authority's group audit of the discipline of orthopaedics, performed in autumn 2018. The starting point for the audit was 28 case histories concerning patients with foot, ankle or knee problems (personal communication). Among other things, the findings showed that most of the patients referred to the specialist health services were deemed to be entitled to healthcare. In half the case histories, there was consensus about the content of further healthcare, while in the others, there were considerable variation in the recommendations. The assessments were primarily based on clinical examinations, patient history and X-ray findings, and internal arenas where people could meet were the most important means of establishing a common

[36] https://helsedirektoratet.no/retningslinjer/sykmelderveileder/seksjon?Tittel=nervesystemet-n-2483hjernerystelse-(n79)

practice. This study made an important contribution to understanding the variation. Correspondingly, the systematic review by Grove et al. (2016) shows that medical socialisation and culture are strong drivers of variation in orthopaedic surgery.

For most of the conditions, information about the number of patients who were in contact with the specialist health service during the period 2012–2016 was included and patient rates (number of patients per 100,000 population) calculated for each hospital referral area. However, the patient rates for degenerative joint disease, disc herniation and spinal stenosis cannot be taken to be identical to the prevalence of the conditions, since many patients could have the conditions in question without contacting the specialist health service during the period in question. The patient rates only show the volume of diagnosed patients who were in contact with the specialist health service. On the other hand, the fracture rates (number of fractures per 100,000 population) represent values that are closer to the incidence of fractures, since nearly all patients are treated by the specialist health service.

The patient rates for degenerative joint disease, lumbar disc herniation and spinal stenosis displayed higher variation than can be explained by chance, which means that the probability of contact with the specialist health service also depended on where the patients lived. There were probably several reasons for the variation in patient rates, such as differences in how services are organised, services offered by the municipal health service, referral practice and cooperation between the municipal and specialist health services, priorities and indications for surgery and capacity in the specialist health service. The patients' and the municipal health service's expectations as regards treatment effect and the extent to which GPs and emergency primary healthcare services referred patients to the specialist health service probably also had a bearing on whether or not patients were in contact with the specialist health service (Legeforeningen, 2016).

It can appear that the use of surgery is supply-driven for several of the conditions studied in this healthcare atlas. Access to specialists, operating theatre capacity and many other factors can have a bearing on the use of surgery, in this case the surgery rates. We see that some hospital referral areas had a high surgery rate for knee surgery, while other areas had high rates for back surgery, without any known corresponding variation in morbidity. When assessing what the correct level of surgery rates is in different hospital referral areas, it is also important to be aware of any differences in morbidity. Further analyses are required in order to answer the question of to what extent surgical treatment is supply-driven.

Chapter 7

Summary and conclusion

Systematic variations have been identified in the orthopaedic treatment received by people living in different parts of Norway during the period from 2012 to 2016.

The analyses show that the variation in the use of health services was particularly high for arthroscopy as treatment for degenerative knee disease (osteoarthritis and meniscal injuries). This procedure is known to have little effect on patients aged 50 years and older, and we found that the number of arthroscopies was halved during the period. However, the high variation between hospital referral areas shows that no professional consensus existed on the indications for this procedure.

We found considerable variation in surgical treatment of wrist fractures, lumbar disc herniation, lumbar spinal stenosis and anterior cruciate ligament injuries. Private treatment providers (institutions under contracts subject to competitive tendering and/or renegotiation and specialists in private practice under public funding agreements) were used for operations for back complaints, anterior cruciate ligament injuries and arthroscopies for degenerative knee complaints in particular. The extent to which patients with lower back pain and concussion were admitted to hospital varied greatly. There is no known corresponding variation in the incidence of these conditions, and the variation was therefore deemed to be unwarranted.

The variation in surgery rates for osteoarthritis of the knee and ankle fractures was moderate, while the variation was relatively low for osteoarthritis of the hip. Hip fracture was the diagnosis that showed the least variation between hospital referral areas. The observed variation reflects the incidence of hip fractures and is thus desirable. The average number of bed days per episode of care, on the other hand, varied considerably for hip fracture patients.

The number of operations for shoulder fractures, osteoarthritis of the thumb and clavicular fractures performed during the period was relatively low. The variation between hospital referral areas might seem high at first glance, but it was characterised as moderate because the surgery rates may have a large element of random variation.

The results in this healthcare atlas provide a basis for reflection on central areas of orthopaedics. The atlas can also form the basis for further investigation with a view to understanding the variations and their consequences for patients and for the health service. Cooperation between health personnel, patients, managers and the health authorities will be important in change work aimed at providing more equitable services to patients regardless of where they live.

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Appendix

Appendix A

Experts consulted

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Appendix B

Method

B.1 Sample

During the work on developing a healthcare atlas for important orthopaedic conditions, the data or selection from NPR's database was defined in such a way that all patients registered with at least one of the diagnosis, procedure or tariff codes listed in Appendix B.1, B.2 and B.3 were included.

Table B.1: Diagnosis codes (ICD-10)

Chapter	*Codes*	*Description*
II	C40-C41	Malignant neoplasms of bone and articular cartilage
	D16	Benign neoplasms of bone and articular cartilage
VI	G50-G59	Nerve, nerve root and plexus disorders
	G80-83	Cerebral palsy and other paralytic syndromes
XIII	M00-M99	Diseases of the musculoskeletal system and connective tissue
XVII	Q65-Q79	Congenital malformations and deformations of the musculoskeletal system
XIX	S00-S99	Injuries
	T00-T14	Injuries
	T80-T88	Complications
	T90-T98	Sequelae
XX	Y4n-Y84	Complications of medical and surgical care

Table B.2: Procedure codes: surgical (NCSP) and medical (NCMP)

Chapter	*Description*
A	Nervous system
N	Musculoskeletal system[1]
O	Habilitation and rehabilitation in the specialist health service, including private rehabilitation institutions under contract[2]

[1] *Including codes that formerly started with T, but that now start with N.*
[2] *Codes from this chapter can be used by all disciplines and for children as well as adults.*

Table B.3: Tariff codes (from the Norwegian Medical Association's normal tariff for specialists in private practice under public funding contracts)

Description	*Codes*
Special surgical tariffs:	K05a, K05b, K05c.
General procedures:	106a, 106b.
Surgery:	134a, 134b, 134e, 134f, 137e, 140a, 140b, 140c, 140d, 140g, 140h, 140i, 140j, 140k, 143e.
Laboratory investigations and tests:	722
Radiology:	801-807, 813-818, 870.

B.2 Length of stay in connection with hip fractures

When calculating the length of hospital stays for patients who have undergone surgery for a hip fracture, we have added up the bed days from all a patient's department stays, from admission to discharge. Patients with hip fractures may have stays at several departments and hospitals. We have therefore added together bed days from department stays less than eight hours apart that we assume to be related to the first stay; the one where the patient was operated for hip fracture. The sum of the department stays is what we call an 'episode of care' (EOC) in accordance with the model used by the Norwegian Knowledge Centre for the Health Services to calculate lengths of stay (Hassani et al., 2015). For our purpose, the number of bed days is thus the number per episode of care.

The first department stay included is the one where the patient was operated for the hip fracture. The other department stays come after the 'operation stay'. The patient sample and operations are described in Chapter 5.2.3.

All department stays where less than eight hours elapse between discharge and readmission are included in the length of stay of an episode of care, regardless of the diagnosis or procedure codes registered for subsequent stays. The 'new' stay was also included in cases where the patient was transferred to another hospital. When a patient has been registered with two or more department stays at the same time, we have deleted duplicate bed days so as not to count two stays within the same period. We have not included bed days from stays at publicly funded private rehabilitation institutions.

After each patient's bed days had been calculated, the data were checked for the distribution of bed days. Boxplot was used to see whether there were any outliers in the data set (Dawson, 2011). In order to avoid removing a high number of admissions from the main analysis where we compared the average number of bed days between hospital referral areas, we decided to delete extreme outliers, defined as data with values higher than the third quartile plus three times the difference between the first and the third quartile (25th and 75th percentiles), known as the 'interquartile range' (IQR)(Seo, 2006). The same method was used to calculate the trip point to distinguish between normal and long stays in the activity-based funding of the specialist health service.[37]

In our preliminary analysis, we found the following: median = 5, Q1 = 4, Q3 = 8. That means that IQR = 4. On the basis of these findings, episodes of care lasting 21 days or more were deemed to be extreme outliers and eliminated from the data analysed in order to compare the average number of bed days between hospital referral areas. The distribution of such outliers between hospital referral areas was analysed separately.

The average number of bed days was calculated by adding the bed days for all episodes of care and dividing the total by the number of episodes of care. Adjustment for age, gender and comorbidity is

[37] https://volven.no/begrep.asp?id=505&catID=12

discussed in Chapter 4.5.

B.3 Directly standardised rates

The gender and age adjustment was done by dividing both genders into five age groups. The age groups differ between different conditions because of the differences between them in terms of which age group dominates. When the group has been divided into five age groups for each gender, we have ten gender and age groups. First we calculated *gender- and age-specific rates* for each gender and age group i i in each hospital referral area k. K is the number of hospital referral areas, while I is the number of gender and age groups.

Each gender- and age-specific rate was then weighted based on the proportion that each group makes up of the population of Norway as a whole based on the standard population: the population of Norway as of 1 January 2016. Finally, the weighted rates for all the gender and age groups were added up. See below.

For each area $k, k = 1, 2, \ldots K$, we find the number of cases and the population:

O_{ikt} Number of cases in gender and age group i, $i = 1, 2, \ldots, I$, for area k, during year t, $t = 2012, \ldots, 2016$.

N_{ikt} Population in gender and age group i, $i = 1, 2, \ldots, I$, for area k, 1 January of year $t, t = 2012, \ldots, 2016$.

We used the following variables from the standard population (the population of Norway as of 1 January 2016) to calculate the weights:

N_i Population in Norway as a whole in gender and age group i, $i = 1, 2, \ldots, I$, 1 January 2016.

N Total population in Norway as of 1 January 2016.

The total number of cases during the period 2012–2016, for gender and age group i in area k, is given by

$$O_{ik} = \sum_t O_{ikt}$$

The sum of population per year during the period 2012–2016, (*person years*) in area k, for gender and age group i, is given by

$$N_{ik} = \sum_t N_{ikt}$$

The standardised rate R_k per 100,000 population for area k is then given by

$$R_k = \sum_{i=1}^{I} \left[\left(\frac{O_{ik}}{N_{ik}} \right) \left(\frac{N_i}{N} \right) \right] \cdot 100\,000$$

Appendix C

Definition of hospital referral areas

Table C.1: Definition of hospital referral areas

Hospital referral area	Short name		Municipality
Finnmark Hospital Trust	Finnmark	2002	Vardø
		2003	Vadsø
		2004	Hammerfest
		2011	Guovdageaidnu Kautokeino
		2012	Alta
		2014	Loppa
		2015	Hasvik
		2017	Kvalsund
		2018	Måsøy
		2019	Nordkapp
		2020	Porsanger Porsángu Porsanki
		2021	Kárásjohka Karasjok
		2022	Lebesby
		2023	Gamvik
		2024	Berlevåg
		2025	Deatnu Tana
		2027	Unjárga Nesseby
		2028	Båtsfjord
		2030	Sør-Varanger
University Hospital of Northern Norway Trust	UNN	1805	Narvik
		1851	Lødingen
		1852	Tjeldsund
		1853	Evenes
		1854	Ballangen
		1902	Tromsø
		1903	Harstad
		1911	Kvæfjord
		1913	Skånland
		1917	Ibestad
		1919	Gratangen
		1920	Lavangen

Continues on next page

Hospital referral area	Short name		Municipality
		1922	Bardu
		1923	Salangen
		1924	Målselv
		1925	Sørreisa
		1926	Dyrøy
		1927	Tranøy
		1928	Torsken
		1929	Berg
		1931	Lenvik
		1933	Balsfjord
		1936	Karlsøy
		1938	Lyngen
		1939	Storfjord
		1940	Gáivuotna Kåfjord
		1941	Skjervøy
		1942	Nordreisa
		1943	Kvænangen
Nordland Hospital Trust	Nordlandssykehuset	1804	Bodø
		1837	Meløy
		1838	Gildeskål
		1839	Beiarn
		1840	Saltdal
		1841	Fauske
		1845	Sørfold
		1848	Steigen
		1849	Hamarøy
		1850	Tysfjord
		1856	Røst
		1857	Værøy
		1859	Flakstad
		1860	Vestvågøy
		1865	Vågan
		1866	Hadsel
		1867	Bø
		1868	Øksnes
		1870	Sortland
		1871	Andøy
		1874	Moskenes
Helgeland Hospital Trust	Helgelandssykehuset	1811	Bindal
		1812	Sømna
		1813	Brønnøy
		1815	Vega
		1816	Vevelstad
		1818	Herøy
		1820	Alstahaug
		1822	Leirfjord

Continues on next page

Hospital referral area	Short name		Municipality
		1824	Vefsn
		1825	Grane
		1826	Hattfjelldal
		1827	Dønna
		1828	Nesna
		1832	Hemnes
		1833	Rana
		1834	Lurøy
		1835	Træna
		1836	Rødøy
Helse Nord-Trøndelag health trust	Nord-Trøndelag	1632	Roan
		1633	Osen
		1702	Steinkjer
		1703	Namsos
		1711	Meråker
		1714	Stjørdal
		1717	Frosta
		1718	Leksvik
		1719	Levanger
		1721	Verdal
		1724	Verran
		1725	Namdalseid
		1736	Snåsa
		1738	Lierne
		1739	Røyrvik
		1740	Namsskogan
		1742	Grong
		1743	Høylandet
		1744	Overhalla
		1748	Fosnes
		1749	Flatanger
		1750	Vikna
		1751	Nærøy
		1755	Leka
		1756	Inderøy
St. Olavs Hospital Trust	St. Olavs	1567	Rindal
		1601	Trondheim
		1612	Hemne
		1613	Snillfjord
		1617	Hitra
		1620	Frøya
		1621	Ørland
		1622	Agdenes
		1624	Rissa
		1627	Bjugn
		1630	Åfjord

Continues on next page

Hospital referral area	Short name		Municipality
		1634	Oppdal
		1635	Rennebu
		1636	Meldal
		1638	Orkdal
		1640	Røros
		1644	Holtålen
		1648	Midtre Gauldal
		1653	Melhus
		1657	Skaun
		1662	Klæbu
		1663	Malvik
		1664	Selbu
		1665	Tydal
Helse Møre og Romsdal health trust	Møre og Romsdal	1502	Molde
		1504	Ålesund
		1505	Kristiansund
		1511	Vanylven
		1514	Sande
		1515	Herøy
		1516	Ulstein
		1517	Hareid
		1519	Volda
		1520	Ørsta
		1523	Ørskog
		1524	Norddal
		1525	Stranda
		1526	Stordal
		1528	Sykkylven
		1529	Skodje
		1531	Sula
		1532	Giske
		1534	Haram
		1535	Vestnes
		1539	Rauma
		1543	Nesset
		1545	Midsund
		1546	Sandøy
		1547	Aukra
		1548	Fræna
		1551	Eide
		1554	Averøy
		1557	Gjemnes
		1560	Tingvoll
		1563	Sunndal
		1566	Surnadal
		1571	Halsa

Continues on next page

Hospital referral area	Short name		Municipality
		1573	Smøla
		1576	Aure
Helse Førde health trust	Førde	1401	Flora
		1411	Gulen
		1412	Solund
		1413	Hyllestad
		1416	Høyanger
		1417	Vik
		1418	Balestrand
		1419	Leikanger
		1420	Sogndal
		1421	Aurland
		1422	Lærdal
		1424	Årdal
		1426	Luster
		1428	Askvoll
		1429	Fjaler
		1430	Gaular
		1431	Jølster
		1432	Førde
		1433	Naustdal
		1438	Bremanger
		1439	Vågsøy
		1441	Selje
		1443	Eid
		1444	Hornindal
		1445	Gloppen
		1449	Stryn
Helse Bergen health trust	Bergen	1201	Bergen
		1233	Ulvik
		1234	Granvin
		1235	Voss
		1238	Kvam
		1241	Fusa
		1242	Samnanger
		1243	Os
		1244	Austevoll
		1245	Sund
		1246	Fjell
		1247	Askøy
		1251	Vaksdal
		1252	Modalen
		1253	Osterøy
		1256	Meland
		1259	Øygarden
		1260	Radøy

Continues on next page

Hospital referral area	Short name		Municipality
		1263	Lindås
		1264	Austrheim
		1265	Fedje
		1266	Masfjorden
Helse Fonna health trust	Fonna	1106	Haugesund
		1134	Suldal
		1135	Sauda
		1145	Bokn
		1146	Tysvær
		1149	Karmøy
		1151	Utsira
		1160	Vindafjord
		1211	Etne
		1216	Sveio
		1219	Bømlo
		1221	Stord
		1222	Fitjar
		1223	Tysnes
		1224	Kvinnherad
		1227	Jondal
		1228	Odda
		1231	Ullensvang
		1232	Eidfjord
Helse Stavanger health trust	Stavanger	1101	Eigersund
		1102	Sandnes
		1103	Stavanger
		1111	Sokndal
		1112	Lund
		1114	Bjerkreim
		1119	Hå
		1120	Klepp
		1121	Time
		1122	Gjesdal
		1124	Sola
		1127	Randaberg
		1129	Forsand
		1130	Strand
		1133	Hjelmeland
		1141	Finnøy
		1142	Rennesøy
		1144	Kvitsøy
Østfold Hospital Trust	Østfold	0101	Halden
		0104	Moss
		0105	Sarpsborg
		0106	Fredrikstad
		0111	Hvaler

Continues on next page

Hospital referral area	Short name		Municipality	
		0118	Aremark	
		0119	Marker	
		0122	Trøgstad	
		0123	Spydeberg	
		0124	Askim	
		0125	Eidsberg	
		0127	Skiptvet	
		0128	Rakkestad	
		0135	Råde	
		0136	Rygge	
		0137	Våler	
		0138	Hobøl	
Oslo University Hospital Trust	OUS	0301	Oslo	Gamle Oslo
				Grünerløkka
				Sagene
				St.Hanshaugen
				Frogner
				Ullern
				Vestre Aker
				Nordre Aker
				Bjerke
				Østensjø
				Nordstrand
				Søndre Nordstrand
				Sentrum
				Marka
Akershus University Hospital Trust	Ahus	0121	Rømskog	
		0211	Vestby	
		0213	Ski	
		0214	Ås	
		0215	Frogn	
		0216	Nesodden	
		0217	Oppegård	
		0221	Aurskog-Høland	
		0226	Sørum	
		0227	Fet	
		0228	Rælingen	
		0229	Enebakk	
		0230	Lørenskog	
		0231	Skedsmo	
		0233	Nittedal	
		0234	Gjerdrum	
		0235	Ullensaker	
		0237	Eidsvoll	
		0238	Nannestad	
		0239	Hurdal	

Continues on next page

Hospital referral area	Short name		Municipality
		0301	Oslo Grorud Stovner Alna
Innlandet Hospital Trust	Innlandet	0236	Nes
		0402	Kongsvinger
		0403	Hamar
		0412	Ringsaker
		0415	Løten
		0417	Stange
		0418	Nord-Odal
		0419	Sør-Odal
		0420	Eidskog
		0423	Grue
		0425	Åsnes
		0426	Våler
		0427	Elverum
		0428	Trysil
		0429	Åmot
		0430	Stor-Elvdal
		0432	Rendalen
		0434	Engerdal
		0436	Tolga
		0437	Tynset
		0438	Alvdal
		0439	Folldal
		0441	Os
		0501	Lillehammer
		0502	Gjøvik
		0511	Dovre
		0512	Lesja
		0513	Skjåk
		0514	Lom
		0515	Vågå
		0516	Nord-Fron
		0517	Sel
		0519	Sør-Fron
		0520	Ringebu
		0521	Øyer
		0522	Gausdal
		0528	Østre Toten
		0529	Vestre Toten
		0533	Lunner
		0534	Gran
		0536	Søndre Land
		0538	Nordre Land
		0540	Sør-Aurdal

Continues on next page

Hospital referral area	Short name	Municipality	
		0541	Etnedal
		0542	Nord-Aurdal
		0543	Vestre Slidre
		0544	Øystre Slidre
		0545	Vang
Vestre Viken Hospital Trust	Vestre Viken	0219	Bærum
		0220	Asker
		0532	Jevnaker
		0602	Drammen
		0604	Kongsberg
		0605	Ringerike
		0612	Hole
		0615	Flå
		0616	Nes
		0617	Gol
		0618	Hemsedal
		0619	Ål
		0620	Hol
		0621	Sigdal
		0622	Krødsherad
		0623	Modum
		0624	Øvre Eiker
		0625	Nedre Eiker
		0626	Lier
		0627	Røyken
		0628	Hurum
		0631	Flesberg
		0632	Rollag
		0633	Nore og Uvdal
		0711	Svelvik
		0713	Sande
Vestfold Hospital Trust	Vestfold	0701	Horten
		0702	Holmestrand
		0704	Tønsberg
		0709	Larvik
		0714	Hof
		0716	Re
		0722	Nøtterøy
		0723	Tjøme
		0728	Lardal
Telemark Hospital Trust	Telemark	0805	Porsgrunn
		0806	Skien
		0807	Notodden
		0811	Siljan
		0814	Bamble
		0815	Kragerø

Continues on next page

Hospital referral area	Short name		Municipality
		0817	Drangedal
		0819	Nome
		0821	Bø
		0822	Sauherad
		0826	Tinn
		0827	Hjartdal
		0828	Seljord
		0829	Kviteseid
		0830	Nissedal
		0831	Fyresdal
		0833	Tokke
		0834	Vinje
Sørlandet Hospital Trust	Sørlandet	0901	Risør
		0904	Grimstad
		0906	Arendal
		0911	Gjerstad
		0912	Vegårshei
		0914	Tvedestrand
		0919	Froland
		0926	Lillesand
		0928	Birkenes
		0929	Åmli
		0935	Iveland
		0937	Evje og Hornnes
		0938	Bygland
		0940	Valle
		0941	Bykle
		1001	Kristiansand
		1002	Mandal
		1003	Farsund
		1004	Flekkefjord
		1014	Vennesla
		1017	Songdalen
		1018	Søgne
		1021	Marnardal
		1026	Åseral
		1027	Audnedal
		1029	Lindesnes
		1032	Lyngdal
		1034	Hægebostad
		1037	Kvinesdal
		1046	Sirdal

Changes between versions

10 December 2018

Printed version

11 January 2019

- Correction of the definition of surgical treatment for osteoarthritis of the thumb (Chapter 5.1.4). The selection of procedure codes on which the figures for surgical treatment are based also includes figures from code blocks NDK, NDE, NDF and NDL.
- Figures for surgical techniques for trochanteric fractures (Chapter 5.2.3) have been modified due to the identification of variation in the coding of fixation using sliding hip screw.

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