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Social Inequality in Medical Treatment

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This study protocol describes the initial plans and proposals for an epidemiological research project, which was part of a PhD project 'Social Inequality in Medical Treatment' conducted at the Research Unit for General Practice in Aarhus and Department of Public Health, Aarhus University.

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Abstract

Social Inequality in Medical Treatment

Objective: This project investigates the extent and nature of social inequality in potentially inappropriate medication (PIM) among individuals with multimorbidity in two studies.

Study 1: This study identifies the socioeconomic factors associated with PIM among individuals with multimorbidity.

Study 2: This study analyzes geographic and practice-related variations in the use of PIM, using the individual's social position as an indicator.

Design: The project comprises two population-based cohort studies.

Population: The primary study population consists of all Danish residents from January 1, 2014, to December 31, 2021. Participants will be followed until emigration, death, or the end of the study.

Data: The studies will be based on data from Danish national registers, which contain information on individual diagnoses recorded in secondary healthcare, redeemed prescriptions, general practice affiliation, contact patterns in primary and secondary healthcare, as well as geographic, demographic, social, cultural, and economic variables. These data will be retrieved from sources such as the Danish Civil Registration System, the National Patient Register, the Psychiatric Central Research Register, the National Prescription Register, the Health Insurance Register, Statistics Denmark, and the DREAM database.

Variables: PIM will be identified in the registers using a modified version of the START/STOPP criteria, based on ATC and ICD-10 codes, which is a recognized screening tool for identifying PIM. Social inequality, based on Bourdieu's theoretical perspectives, will be operationalized through a set of factors identified by a review of the existing literature and variable lists from the registers. Thus, the analyses will be based on variables representing economic capital (e.g., housing type, assets and debts, lifetime income, ownership), cultural capital (e.g., household educational background, previous employment sector), and social capital (e.g., marital status, children, relationships).

Analysis: The first study will identify economic, cultural, and social risk factors for PIM among multimorbid individuals. The second study will estimate the distribution of PIM across geographic characteristics (rural vs. urban, municipality size, etc.) and general practice characteristics (solo vs. group practice, background population, etc.). The primary analytical approach will be multivariate Poisson regression, allowing for the independent analysis of sub-outcomes with different relevant risk populations, which can then be aggregated into an "observed-to-expected ratio" across practices that can be compared with social position characteristics. In the analysis of geographic and general practice-related characteristics, the study will examine whether characteristics can be identified that have potential significance for the extent of social inequality in the frequency of PIM.

Study 1: Economic, cultural, and social inequalities in potentially inappropriate medication: a nationwide survey- and register-based study in Denmark

1 **Background:**

The number of people living with two or more chronic diseases (multimorbidity) is rapidly increasing, with estimates suggesting that over half of Danes aged 65 and above experience multimorbidity (1-3). Multimorbid individuals often require polypharmacy (typically defined as the use of five or more medications). However, each additional drug increases the risk of potentially inappropriate medication (PIM), which refers to medication with a greater risk of harm than benefit (4). Polypharmacy, particularly excessive polypharmacy (10 or more medications), is associated with higher risks of medication errors, side effects, drug interactions, drug-related hospital admissions, and reduced medication adherence. These risks can lead to a lower quality of life and increased mortality (4-9) and contribute to significant costs for both individuals and society.

Social inequality in health has worsened in Denmark. Compared to other Western European countries, Denmark has seen a marked rise in mortality disparities from diseases that can be effectively treated (10, 11). Despite the Danish healthcare system offering free care at the point of delivery and full reimbursement of medication costs above a threshold of 4320 DKK per year (equivalent to 589.72 EUR), inequalities persist.

Research from similar countries indicates that several aspects of social position are associated with PIM. For example, studies suggest an association between PIM and factors such as lower education levels and residence in deprived areas (12-14). However, the findings are not uniform. For instance, one literature review found a positive association between living alone and PIM use in only three of six included studies.
A theoretical lens, such as Bourdieu's concepts of social, cultural, and economic capital, may offer a more comprehensive understanding of how social position relates to PIM. Bourdieu argues that social position is determined by one's resources (social, cultural, and economic) and the field in which these resources are deployed.

In Denmark, national registers provide extensive data from cradle to grave, including health and social information for the entire population. Using unique personal identification numbers, it is possible to link these registers with other data sources at the individual level (15). This makes it possible to combine register data with the national health survey, offering a unique opportunity to investigate the relationship between social position and the risk of PIM.

Thus, this study aims to investigate the association between social position and inappropriate medical treatment (excessive polypharmacy or PIM) in general practice, using national Danish registers.

Design:
Population-based cohort study using information from the Danish National Health Survey and Danish national registers.

Study Population:
We will include all participants from the Danish National Health Survey 2017 who were above 18 years of age at study entry on January 1, 2017. Participants who emigrated or died during the study period (n = XX) or had incomplete information (n = XX) will be excluded, resulting in a final study population of XX individuals.

Possible outcome Variables:
- Suboptimal Pharmacological Treatment (PIM): Risk time with potentially inappropriate medications (defined using ATC/ICD-10 coding (16)). The PIM rate will be calculated as the total time spent with PIM divided by the total time spent at risk. PIM will be operationalized based on Ribe et al 2021.
- Excessive Polypharmacy: Risk time with more than XX medications (defined using ATC coding).

Exposure Variables:
Economic Capital:
- Equivalent wealth in the family unit (assets and debt) during the study period.
- Equivalent income in the family unit during the study period.

Cultural Capital:
- Highest attained education at study entry (for the family).
- Education field at study entry. Health educations entail: Medicine (anatomy, epidemiology, cytology, physiology, immunology and immunohaematology, pathology, anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, neurology, psychiatry, radiology, ophthalmology), medical services (public health services, hygiene, pharmacy, pharmacology, therapeutics, rehabilitation, prosthetics, optometry, nutrition) and nursing (basic nursing, midwifery) and dental services (dental assisting, dental hygienist, dental).
- Ethnicity: Danish, non-Western, Western; or migration status (Danish, first generation, second generation).

Social Capital:
- Social Network: Frequency of interaction with (A) friends, (B) acquaintances, (c) family members not currently living with them. For each group: (17) (1. Daily or almost daily, 2. Once or twice per week, 3. Once or twice per month, 4. Less than once per month)
- Social Support: “Do you have someone to talk to when experiencing problems or in need of support?” (1. Yes, often, 2. Yes, mostly, 3. Yes, occasionally, 4. No)
- Practical Support: “If you become ill and need practical help (e.g., cooking, shopping, cleaning), can you count on others for help?” (Only available in regional questionnaire – 30.000 respondents) (1. Yes, 2. Maybe, 3. No)

- Cohabitation: Living alone or with others.

Covariates:

- Multimorbidity: Measured using a multimorbidity index (18), assessing whether individuals have two or more long-term diseases. Categories: 0 (no condition), 1, 2, 3, or 4+ conditions.
- Basic Information: Age, gender.
- Geographic Region and Urban/Rural Status: Models will control for geographic region and urban/rural status, which may influence access to healthcare and practice patterns.
- Year: Baseline data from 2017 will be used, with outcome data from 2018 to account for changes in medication availability and evidence over time.
- GP Visits: The number of visits to the GP clinic may be included, if possible.

Statistical Analyses:

We will apply Poisson regression or negative binomial regression to analyze the incidence rate ratio for PIM by different indicators of social position. This will help determine associations between risk and various social positions while controlling for diagnoses, age, gender, and geography. Each attribute of social position (social, cultural, and economic capital) will be analyzed independently for comparison.

We will consider weighted analysis and take into account the selection bias (would cause bias if non-responders are different from participants in terms of both dependent, PIM, and independent, social position, variables). It is possible to do inverse probability weighting, where you calculate a prediction model based on, e.g. gender. We will consider calculating the etiological fraction (would be affected by potential selection bias) or risk differences.

Study 2: Variation in the use of potentially inappropriate medication in Danish general practice.

2 **Objectives:**

We aimed to assess the prescriber-related and geographical variation in PIM prevalence independently of the social position of the patient population.

Design:

Nationwide register-based cohort study.

Setting:

General practice.

Participants:

The xx million adults listed with general practitioner (GP) clinics in Denmark (n=xx) in 2021.

Data period:

1.1.2021-31.12-2021

Main outcome measures:
The tendency to prescribe PIM in GP clinics

Exposure variables:
- Overall social position of the patient population (DADI index)
- Overall multimorbidity (physical, mental) of the patient population /disease burden
- City size: Urban/suburban
- Number of patients
- Practice organisation: Solo/collaboration/group practice
- Longevity (e.g. how long time has the GPs on average been in the clinics? How long time has the clinic existed? How long time has the longest-working GP been there?)

Statistical analyses:
We will estimate the patients' time with PIMs by using 39 register-operationalized START and STOPP
criteria linking GP clinics and redeemed prescriptions. For each GP clinic, we will calculate ratios between the observed PIM time and that predicted by multivariate Poisson regressions based on the patients' socioeconomic characteristics. The observed variation will be measured as the $90^{th}/10^{th}$ percentile ratios of these ratios. The GP-related excess variation will be calculated as the ratio between the observed variation and sampled variation. The linear correlation between the observed/expected ratio for each of the criteria and the observed/expected ratio of total PIM time (for each clinic) will be measured by Pearson's rho.

Potential presentation of results:
Table 1: Basic characteristics
Model 1: Observed variation / Expected variation + random variation graph.
These variables form the basis for a graph illustrating the variation in the use of PIM in practice compared to what is expected (O/E ratio). Based on this distribution, practice is divided into three groups: low, medium, and high PIM usage in practice, considering the patient population.
Model 2: Forest plot between high, medium, and low variation. Middle group as reference. Association between practice variation in PIM and the overall social position of the population.
Model 3: Map of municipalities are assigned a color based on the practices in the given municipality

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