# Variation in blood pressure targetachievement in primary care centers 

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#### Abstract

Background: High blood pressure (BP) or hypertension is defined as a systolic and diastolic pressure over $140 / 90 \mathrm{mmHg}$. High blood pressure increases the risk for premature death, and previous research has shown that many patients do not reach targets and that there are differences between primary healthcare centers in the proportion of patient reaching targets. The reasons for these variations, however, are unknown. Aim: To investigate variations in blood pressure target achievement between primary care centers in Stockholm county and how different factors such as practice size, ownership, socioeconomic and antihypertensive drug treatment can influence this diversity. Method(s): This study was designed as a cross-sectional register study with a descriptive quantitative perspective. Data was collected from three sources: National Primary Care Quality register, Care Need Index for healthcare in Stockholm region and Stockholm County Council data warehouse VAL. The study included 179 out of all 227 primary care centers in the region. The proportion of all patients with hypertension reaching targets was assessed each year during 2019-2021, and correlations studied for potential predictors. Results: there was a variation between primary care centers in target blood pressure fulfillment, ranging from $22-66 \%$ during 2021, $23-63 \%$ during 2020 and $33-66 \%$ during 2019, respectively. There was no overall difference between public and private centers in the proportion of patients reaching targets, but a larger practice variation among private centers. No correlation was found between the other studied factors and target blood pressure fulfillment during 2021. Conclusion: There was a variation between primary care centers in the proportion of patients reaching blood pressure targets. Different practices may change ranking between years and other factors than practice size, ownership and socioeconomic appears to explain the variation.


## Populärvetenskaplig sammanfattning

Hypertoni är en av de vanligaste sjukdomarna i befolkningen. Hypertoni ökar risken för förtid död i stroke och hjärtinfarkt, och det finns bra läkemedel som kan minska risken. Nationella och regionala riktlinjer på vårdcentraler och sjukhus som bör följas förespråkar att så många patienter som möjligt bör nå målblodtryck under 140/90 mmHg.

Variationen i måluppfyllelse för blodtryck bland vårdcentraler är inget nytt, men det har saknats kunskap om varför. I denna studie visades att en variation har funnits i Stockholms län de senaste tre åren. Flera vårdcentraler har kunnat behålla sin kvalitet genom åren och andra har förändrat den mellan åren. Topplistan över bästa mottagningar varierar därför mellan åren. Förutom detta, har resultaten visat att det inte finns något direkt samband mellan undersöka faktorer såsom socioekonomi, storlek, driftsform (privat/landsting) och behandling med blodtryckssänkande läkemedel och andelen patienter som når målblodtryck.

Syftet med studien var att undersöka variationen i måluppfyllelse för blodtryck bland vårdcentralerna i Stockholm samt vilka faktorer som gör att det uppstår. Genom att utföra studien som en deskriptiv tvärsnittsstudie med data som är uthämtade ifrån tre källor, nämligen Primärvårds kvalitet (PVQ), Care Need Inedx (CNI) och Stockholmsregionens vårddatabas (VAL), kunde man få ett resultat som besvarar syftet. Denna rapport kan användas som bakgrund för vidare forskning om andra orsaker till variationen såsom vårdorganisation, socioekonomiska faktorer och följsamhet hos enskilda individer.

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## 1. Introduction

High blood pressure (BP) is one of the most common diseases in Sweden. Untreated BP can cause many health problems like heart attack and stroke; therefore, many physicians highlight the importance of treating BP at it first symptom. Fortunately, it is not difficult to treat BP if it is detected at it first signs/symptoms, thus the main problem is that there are variations in the values of target blood pressure between primary care centers [1, 2]. Therefore it is important to investigate the reasons behind this difference [2].

### 1.1 Definition of high blood pressure

High blood pressure (BP) or hypertension is defined by measuring the systolic and diastolic blood pressure. The measurements are often taken by a general practitioner or nurse in primary care, at a practice, as home measurements or with 24 - hour blood pressure measurement $[3,4]$. The target values are $140 / 90 \mathrm{mmHg}$ when measures in primary care, $135 / 86 \mathrm{mmHg}$ at home and $130 / 80 \mathrm{mmHg}$ for 24 -hour blood pressure measurement [3]. An increase in the measurement range of the systolic blood pressure of 20 mm Hg or a diastolic of 10 mm Hg above the 115-75 mmHg level, doubles the risk of dying from cardiovascular disease [4]. However, the blood pressure levels can vary over time and between individuals but with the right treatment the blood pressure levels should be under $140 / 90 \mathrm{mmHg}$ [5]. Although systolic pressure is sometimes difficult to reduce, especially in elderly and as a result, the blood pressure levels commonly stay around $150-160 / 90 \mathrm{mmHg}[5,6]$. However, even further reduction is beneficial. Generally, the target levels of BP for patients with diabetic, kidney disease or a high risk of developing cardiovascular disease should be below $140-130 / 85-80 \mathrm{mmHg}[5,7]$.

### 1.2 Classification

Mild, moderate, and severe hypertension are the three major classifications of hypertension. 60 $\%$ of the 1.8 million individuals with high blood pressure in Sweden have mild hypertension, 30 $\%$ have moderate hypertension, and $10 \%$ have severe hypertension (Tabell 1) [4, 7, 8].

Tabell 1 shows how blood pressure is categorized.

| Categorizations of BT | Systolic BT mmHg | Diastolic BT mmHg |
| :--- | :--- | :--- |
| Optimal BT | $<120$ | $<80$ |
| Normal BT | $120-129$ | $80-84$ |
| High BT | $130-139$ | $85-89$ |
| Hypertension Grad 1(Mild) | $140-159$ | $90-99$ |
| Hypertension Grad 2(Moderate) | $160-179$ | $100-109$ |
| Hypertension Grad 3(Severe) | $\geq 180$ | $\geq 110$ |
| Isolated systolic hypertension | $\geq 140$ | $\geq 90$ |

Moreover, there are two types of hypertension, namely primary hypertension and secondary hypertension. Primary hypertension is the frequent form mostly caused by genetics, age, lifestyle factors as well as other factors[7]. Primary hypertension is responsible for $95 \%$ of all patient cases. Blood pressure has been linked to genes and heredity in studies, although it is still unclear how it is caused. High salt intake, fat consumption, high BMI, high alcoholic consumption, and lack of exercise are examples of lifestyle factors increasing the risk for hypertension. Although there are other factors that can contribute to hypertension, such as stress and caffeine consumption, it is yet unknown how they are linked[7, 9, 10]. Kidney disease, on the other hand, is a common cause of secondary hypertension. Other known endocrine or hormonal causes that might cause secondary hypertension include aldosteronism, Cushing's syndrome, Conn's disease, and a variety of others. Studies have also shown that obesity, pregnancy and certain pharmaceuticals can also induce secondary hypertension $[4,6,9]$.

### 1.3 Pathophysiology

The cardiac output of the human body refers to the amount of blood that each ventricle pumps every minute. Two elements are taken into account while calculating cardiac output. The first factor is the heart rate, which is the number of beats per minute, and is multiplied by the second
factor, the stroke volume, which is the amount of blood pumped by each ventricle with each contraction, $\mathrm{Co}=\mathrm{HR} * \mathrm{SV}$ [10-12].

CO is being used to calculate blood pressure by multiplying it by peripheral resistance $(\mathrm{BP}=\mathrm{CO} * \mathrm{PR})$. Peripheral resistance is the amount of resistance to blood flow, if there is greater resistance to blood flow, it is more difficult for the blood to flow through the vessel, this is an increase in peripheral resistance, and blood pressure will be altered if any of these two parameters is affected. High blood pressure is mostly caused by peripheral resistance. As the blood's ability to pass through certain veins is damaged, blood pressure rises. The primary cause is increased arteriolar vasoconstriction. Constriction or contraction of the smooth muscle layer is caused by increased sympathetic activity (the sympathetic nervous system releases norepinephrine and epinephrine, which is practically adrenalin), causing the lumen of the arteries to narrow, resulting in less space. If the arteries are narrow, there is more resistance to flow, which leads to an increase in peripheral resistance and, as a result, an increase in blood pressure [11, 12].

Blood pressure can be influenced by various factors. Increased peripheral resistance makes it more difficult for blood to flow to the places it needs to go, resulting in decreased blood flow to the kidney and renin release. There are two paths for renin (the renin-angiotensin system). The first is that when the kidney generates renin, angiotensinogen (a liver-produced active protein) is converted into angiotensin 1 . Then there's the AEC enzyme, which will convert angiotensin 1 to angiotensin 2. Angiotensin 2 is the body's most effective vessel constrictor, also an increase in vessel constrictor causes an increase in peripheral resistance. The release of Aldosterone is part of Renin's second pathway. All of this occurs because aldosterone promotes sodium ion reabsorption in the kidney. The kidneys filter blood and produce urine, allowing us to eliminate waste and control the quantity of water we expel from our bodies. As a result of reabsorbing more water, blood volume and cardiac output will increase. As a result of these two variables, blood pressure will rise [7, 11, 12].

### 1.4 Consequences of high blood pressure

One of the main complications which occurs due to hypertension is the risk for cardiovascular diseases, such as atherosclerosis, stroke, heart diseases, dementia and kidney failure. An increase in the measurement range of the systolic blood pressure of 20 mm Hg or a diastolic of 10 mm Hg above the $115-75 \mathrm{~mm} \mathrm{Hg}$ level, doubles the risk of dying from cardiovascular disease.

Atherosclerosis affects the coronary arteries of the heart and the large common carotid arteries, causing heart attack and heart failure. Another complication of hypertension is stroke, leading to intracranial hemorrhage. Tabell 2 shows the risk evaluation. However, there are other risk factors that increase the complications of developing cardiovascular diseases with hypertension, obesity, diabetes, smoking, alcohol consumption and many more. Men are more likely than women to develop cardiovascular disease, according to a study conducted in over 27 countries involving over 160,000 people. The main reason for this is that men have more risk factors, such as more smokers, high blood fat, and many healthy women do take preventative medication [4, 13, 14].

Tabell 2. Risk evaluation based on European hypertension recommendations published in 2003

| Risk factors | Normal Blood <br> pressure | High Blood <br> pressure | GRAD 1 <br> hypertension | GRAD 2 <br> hypertension | GRAD 3 <br> hypertension |
| :--- | :--- | :--- | :--- | :--- | :--- |
| Without risk <br> factors | Low | Low | Low | Low |  |
| $1-2$ risk <br> factors | Low | Low | Moderate | Moderate | High |
| 3> risk <br> factors, <br> including <br> organ <br> dysfunction | Moderate | High | High | High | Very High |

*The risk defines by having a stroke or heart attack during the next 10 years.
** Risk factors are including obesity, smoking, hypercholesterolemia, age and cvd heredity

### 1.5 Treatment of hypertension

The main goal for treatment with blood pressure medication is to reduce the diastolic and systolic blood pressures. It is recommended to identify patients early in order to achieve the best results and the treatment objective of hypertension. Depending on which classification the patient belongs to the right treatment is to be selected. For patients with Grade 1 hypertension with no organ damage or atherosclerosis and younger than 65 , pharmacological treatment should be initiated after lifestyle changes like smoking cessation if the patient is a smoker or increased physical activity or weight reduction etc. If lifestyle adjustments fail to produce benefits, antihypertensive medicine is required. Yet, if the patient is highly likely to have risk factors, organ damage or atherosclerosis, the patient should immediately begin with pharmacological treatment as well as lifestyle intervention. When it comes to patients with Grade 2 and 3 hypertension, pharmacological treatment should start immediately depending on how severe the condition is, follow up in a few days or weeks as well. There are several antihypertensive drugs that lower blood pressure and in most cases a combination of two or more antihypertensive drugs is required. ACE inhibitors, calcium channel blockers, beta-receptor blockers, angiotensin receptor blockers and diuretics are the most used antihypertensive medication in Sweden (Figure1) [4, 8, 15].


Figure 1 present most commonly dispensed antihypertensive drugs in Sweden during 2020. Source: Swedish Prescribed Drug Register, National Board of Health and Welfare. Dispensed prescriptions overall, all indications.

### 1.6 Pathophysiology of various antihypertensive drug classes

Antihypertensive drugs are used to lower the blood pressure and to reduce the risk of developing a myocardial infarction and stroke. It is important that patients follow the physician recommendation and use the drug regularly as it prescribed. However, one of the common reasons to not reaching target blood pressure is that many patients have poor compliance and do not to take their medications[16].

There are five major antihypertensive drug classes used in Sweden presented below:

- Diuretics
- Beta-blockers
- ACE inhibitors
- Angiotensin II receptor blockers
- Calcium channel blockers


### 1.6.1 Beta blockers

Beta blockers are a class of antihypertensive drug used to treat high blood pressure and irregular heartbeats. They function by reducing cardiac output and frequency. Baroreceptors, which give signals to the brain to maintain a balanced blood pressure in the body, are the principal regulators of blood pressure. Beta blockers are competitive antagonists, meaning that they prevent norepinephrine and adrenaline from binding to the adrenergic receptor, causing it to bind to beta blockers instead. They are normally used as a complement to other hypertension medication, although they are the first line of treatment for migraines, cardiac rhythm abnormalities, and heart failure[17] [15].

### 1.6.2 Angiotensin II receptor blockers

ARB can be used as a first-line treatment in hypertension. High blood pressure can be reduced by inhibiting angiotensin II receptors, specifically AT1 receptor. ARB has good documentation and can be used as an alternative to ACE inhibitors as they have the same effect $[15,18]$.

### 1.6.3 ACE inhibitors

Angiotensin-converting enzyme inhibitors are antihypertension that lower high blood pressure by preventing ACE activates causing vasodilation to the blood vessels. Angiotensin-converting enzyme main activities is to transform angiotensin I to angiotensin II. Angiotensin II is a vasoconstriction. ACE inhibitors have evidence supporting there use for diabetics as a first-line treatment, however for patients with severe kidney disease the dosage should be reduced as well as a continuous observation of the patient $[15,19]$.

### 1.6.4 Diuretics

Thiazide is a drug class of diuretics that lower hypertension by inhibiting the reabsorption of NaCl from the distal tubule and increase diuresis. That happens by inhibiting thiazide receptor whose main function is to transport NaCl from the lumen into the distal tubule. Thiazide have also evidence supporting there use to prevent cardiovascular complications as well as heart failure for patient with high blood pressure. Thiazide are used as a first-line antihypertension and its considered effective to treat patient with isolated systolic hypertension. Isolated systolic hypertension is one of the most common types of hypertension and occurs when the systolic value is high ( $>140 \mathrm{mmhg}$ ) and the diastolic value is normal ( $90<\mathrm{mmhg}$ ). However, diuretics are contraindicated to patients with kidney diseases and gout [15, 20, 21].

### 1.6.5 Calcium Channel Blocker (CCB)

CCB are drug class used to treat hypertension and lower blood pressure by decreasing calcium movement through blood vessels muscle cells and blocking the calcium channels. CCB can be used as a monotherapy and have good clinical documentation to prevent patient from cardiovascular complications. However, CCBs are heterogeneous in their degree of vascular selectivity [15, 22].

### 1.7 Variation between primary care centers

There has been some variation between primary care centers in Stockholm when it comes to the blood pressure target. There are several reasons that could be the cause of the variations such as demography of population, socioeconomic factors, how primary care centers works, health workers adherence to guidelines( for example, target blood pressure is being rounded) and many more[2]. Differences in hypertension therapy in and between areas are nothing new, according to a recently published paper in the Drug and Therapeutics committee bulletin Evidence, but the reasons behind these differences remain unknown[2]. Data from the national primary care quality registry shows that the proportion of patients with a blood pressure of $140 / 90 \mathrm{mmHg}$ varies between primary care centers in the Stockholm region (PVQ). See Figure 2

However, the large difference between primary care centers in geography, ownership, size as well as age, comorbidity and socioeconomic characteristics of the population causes case-mix, which makes it difficult to do crude comparisons like the one in the Figure below. A range of factors such as demographics, socioeconomic, health worker compliance, working methods, as well as many more aspects may have an impact on the data, causing variation in the goal of

## Solnas hjärta toppar statistiken

Andel patienter med mottagningsblodtryck registrerat de senaste 18 mánaderna $<140 / 90 \mathrm{mmHg}$ vid vârdcentraler i Region Stockholm oktober 2020.
… Median EOviga Solnas Hjärta


Figure 2. Variation in the proportion of patients reaching blood pressure targets between different primary care centers in Stockholm region. Source: Evidens, the bulletin of the regional Drug \& Therapeutics Committee [2]. Data from PVQ
blood pressure measurement [2]. According to the findings of a 2010 study on high blood pressure control, despite those antihypertensive medications are effective, few patients were able to achieve a blood pressure target of $140 / 90 \mathrm{mmHg}$. The results were based on medical recorded data and registry of dispensed prescriptions. The study included 24 primary centers, which included 330,000 people but only 21,770 had high blood pressure. $27 \%$ of the 21,770 patients showed a blood pressure around $140 / 90 \mathrm{~mm}$ hg. One of the parameters addressed in this study was drug treatment in relation to age and gender [2, 23, 24].

Recommendations and guidelines among health workers are poorly complied to. Several studies have shown that there are many physicians do not follow the recommendations that come from the authorities, for example, regarding the dosage of drugs or target fulfillment for blood pressure[25]. In a previous study, it has been shown that there is a variation in the adherence in "Wise list" in Sweden. The "Wise list" contains information about drug recommendations and products that should be used as first-line alternative drugs or in combination with other drugs. The drugs that are recommended in the "Wise list" are selected based on their safety and efficacy[26]. Moreover, the Wise list contains recommendations for treatment of specific diagnoses. The content in the Wise list in Sweden is scientific evidence-based and written by experts. However, in some countries, guidelines are not evidence-based and may not be followed by healthcare professionals [26]. Studies have shown that the guidelines are not followed due to numerous "barriers" that are related to the level of management and organization of the health care centers, as well as the professional level[25]. Several studies in UK and US showed that many patients claim that they are not receiving adequate clinical care. Therefore, many experts emphasize that the reason behind suboptimal care should be investigated to see if it may be explained by poor compliance and misunderstanding of the guidelines or not[25, 27]. Another aspect that was showed in another study is that the number of guidelines has increased which is a challenging problem for many health care professionals to comply with[26, 28]. In 2004, a study in US was investigating how primary care centers adhere to the guidelines of hypertension through a survey, where 139 primary care centers were included. Furthermore, the study extracted information from the included primary care centers database to investigate how if the use of medications and the control for the BP is concordant with the guidelines. The results of the study showed that many physicians are not following guidelines and they underestimate them[29]. Other studies have found that the financial incentives can have a big impact when it
comes to develop effective strategies to increase the adherence on guidelines in primary care centers[26, 27]. Socioeconomic factors are one of the parameters that was chose to see how it is associated with diabetes care quality in primary care centers in US. The study investigated how socioeconomic factor such as poverty in certain areas can affect the quality. The result showed that patients who lived in deprived areas received less good diabetes care quality compared with other patients who lived in less deprived area[30]. The socioeconomic factors in Sweden can be quantified by Care Need Index (CNI). A study was made in three Swedish regions to study the correlation between CNI socioeconomic factors and consultations in primary care centers, where different outcomes were measured. The result of the study varied bur overall showed a positive correlation between CNI and healthcare consumption [31]. Several studies have used CNI as a health indicator to examine socioeconomic factors with other measurements and to see if there is a correlation between them, for example, coronary heart disease mortality[32], psychiatric admissions rate[33] and allocation of resources for primary care centers[34]. To the best of our knowledge, no prior study has assessed the correlation between CNI and proportion of patients reaching blood pressure targets.

## 2. Aim and objectives

The aim of this thesis is to study the variation between primary care centers in Stockholm County in proportion of patient reaching blood pressure targets and how this may be influenced by different factors such as practice size, ownership, time, socioeconomic factors for the listed population, and dispensed prescriptions for antihypertensive drugs.

### 2.1 Specific research questions

The specific research questions addressed in the study were:

- What is the variation between primary care centers in the proportion of patients reaching blood pressure targets?
- Is the variation stable over time, i.e. is it the same practices that perform well all years over a three year period?
- Is there any difference between public and private primary care practice in the proportion of patients reaching blood pressure targets?
- Is there any correlation between practice size, demography, CNI, treatment with antihypertensives and the proportion of patients reaching blood pressure targets, respectively?


## 3. Material and methods

### 3.1 Design

The design of this study was a cross-sectional register study with a descriptive quantitative perspective of blood pressure target achievement in primary care centers in region Stockholm. In this study the data was collected from three sources: National Primary Care Quality register (Nationell Primärvårds Kvalitet, PVQ), Care Need Index (CNI) from healthcare in Stockholm region and Stockholm County Council data warehouse VAL with all healthcare consultations, diagnoses and dispensed prescription medicines in the region.

### 3.2 Selection of the population

The study population included all patients over the age of 20 who were listed and diagnosed with hypertension in studied primary care facilities during June 2019-June 2021. The reason behind the age selection is that the high blood pressure is rare in children and adolescents. All primary care practices that had available data on the proportion of patient reaching blood pressure targets, CNI and dispensed prescriptions were included. In the records from the database VAL of practices in the region, there were in total 227 primary care centers identified, 226 of them had data on dispensed prescriptions for anti-hypertension drugs. 191 of 202 had data in PVQ on target fulfillment for blood pressure. Only 210 primary care centers had CNI-data from health and medical care administration since data on CNI was not available for primary care centers located in the municipality of Norrtälje in Stockholm County. In total, 179 practices remained for the analysis. The selection of practices is illustrated in Figure 3.

Moreover, among the presented primary care centers were 117 were private and the rest were public. The average proportion of patient reaching blood pressure targets for private and municipal primary centers 2019, 2020 and 2021 was calculated.


Figure 3. Flowchart for the selection of the primary Care Centers in Stockholm County.

### 3.3 Collection of data

Data were collected from three different sources and analysed to determine the praxis variation over goal fulfillment for blood pressure and how can different factors affect this variation. The sources were: National Primary Care Quality register, Care Need Index from healthcare in Stockholm region and Stockholm County Council data warehouse VAL. Accordingly, an excel file was used to collect all data from the three registers in one large administrative file. The excel file contained 187 primary care centers, with ten variables to be analysed with goal fulfillment for blood pressure between 2019 and 2021.

### 3.3.1 Primary Care Quality register (PVQ)

The national primary care quality is a register in Sweden that collects and analyzes quality data in primary care, with the goal of assisting quality improvement and follow-up efforts through analysis. PVQ has a specific quality indicator that documents evidence-based documentation[35]. For hypertension there are several quality indicators, such as, existence of hypertension, proportion patients with no BT value, proportion patients with $B T$ value $\geq 160 / 100$, $\leq 140 / 90,<140 / 90$ and proportion patients who have BT value between 141-159 / 91-99 [36]. The collected data is individual patient data, where new documentary and evidence are updated annually, and each primary center can then follow its own statistics. Hypertension is one of the common diseases where the primary care centers can follow up their quality in database PVQ. Thus, this is a non-nationwide database and not available for the general public[35].

### 3.3.2 Stockholm County Council data warehouse VAL

Val is a system consisted to collect, follow up and analyse data from Stockholm County Council (SLLs). The system obtains many different healthcare statistics and can have the opportunity to provide patients statics such as dispensed prescriptions. Further it is one of the few systems in Sweden where individual's healthcare data can be followed up for primary care during selected time periods. In this study VAL database was used as source to identify the number of listed patients at each practice, the number of elderly at the practice, the number of patients with a diagnosis of hypertension and the proportion of patients diagnosed with hypertension (ICD-code

I10) dispensed antihypertensive drugs, as well as patients who were dispensed antihypertension medicines but used it for other indications (Tabell 3).

Tabell 3. Antihypertensive drug classes with their ATC codes.

| Drug Class | ATC-code |
| :--- | :--- |
| Diuretics | C03 |
| Beta Blockers | C07 |
| Calcium channel blocker | C08 |
| ACE inhibitors \& ARB <br> with and without <br> combinations with <br> diuretics | C09 |

### 3.3.3 Care Need Index (CNI)

Care need index is a classification system that can be used to analyze healthcare based on a number of different socioeconomics factors such as the proportion of elderly people with age 65 and over, foreign born, unemployed, low educated people and other factors[37]. With low educated people means those who have no further education after primary school. SCB is the Sweden state agency that collect CNI data information for different regions and provide the altimetry solution. In this study CNI was used to identify the correlation between blood pressure fulfillment and socioeconomic factors[37]. Studies have found that the use of correlation between CNI and other different measurement is useful due to the positive results, therefore CNI was used in this study to examine the correlation between target blood pressure target and socioeconomic factors[30, 31].

### 3.4 Statistical methods

Descriptive statistics such as means and range were used to present the proportion of patients reaching blood pressure targets for the different primary care centers. Furthermore, a correlation
paper method was used in this study to assess the association between different variables. The correlation coefficient R 2 reflects how strong the correlation is. Correlation analyses were made using the different socioeconomics factors included in the CNI, the total CNI index and proportion dispensed prescriptions for antihypertensive drugs as independent variable and the proportion of patients reaching blood pressure target as the dependent variable.

Data extracted from PVQ included if patients in the primary cares achieved blood pressure fulfillment. Thus, data from PVQ were used as the dependent variable to assess correlation with the other data including socioeconomic factors from CNI and number of listed patients with hypertension and proportion of patients with hypertension dispensed antihypertensives, respectively, from VAL. The correlation coefficient R2 was used to analyze the data correlations, so if the value of the coefficient is close to one it indicates that there is a strong link between the chosen factors.

### 3.5 Ethical considerations

The ethical principles were taken for consideration in this study. The information from the database which was obtained throughout the study is not available for public use, however it did not require any permission from the authorities to forbid the use and publication due to it does not process personal data with all analyses being done at an aggregate level. This is according to the Swedish law (2003:460) which explains "ethical review of research involving humans". Names of the primary care centers was remained anonym expect the top ten primary centers in the Stockholm county that fulfilled blood pressure measurements were shared in this study.

## 4. Result

A total of 179 out of all 227 primary care centers in the region were included in the study. These centers varied in size from 655 to 31523 listed patients during 2020. The primary care centers were divided into public and privet centers, which 117 were private and the rest were public.

### 4.1 Variation between primary care centers

The blood pressure target fulfillment varied significantly between the primary care centers in Stockholm. Figure 4 presents how the variation between primary cares looked like during 2021. The data presented illustrates percentage of patients who achieved their blood pressure target $(<140 / 90 \mathrm{mmHg})$ at various primary care locations. In first place comes one of the primary care centers with the highest rate in the region with $66 \%$ during 2021. One of the primary care centers who was studied had the highest record during 2019-2021. Figure 5 shows the percentage of patients who achieved their blood pressure target during 2019, 2020, and 2021 Although the range between practices was similar all years, individual centers could change the proportion of patients reaching target with up to more than $12 \%$-units between the three years, thus changing their place in the ranking Figure 5. Further, in Tabell 4 ten primary cares were chosen to present the top ten for fulfilling blood pressure measurement_during the studied period (2019-2021).


Figure 4. The percentage of patients reaching their blood pressure targets in different primary care centers during the year 2021. Source: Primary Care Quality register


Figure 5. The percentage of patients reaching blood pressure targets in different primary care centers during 2019, 2020 and 2021.

Table 4. Presenting top 10 primary care centers in Stockholm county with the highest proportion of patients reaching BP target.

| Primary care centers <br> $\mathbf{2 0 1 9}$ | $\mathbf{2 0 1 9}$ | Primary care centers 2020 | $\mathbf{2 0 2 0}$ | Primary care centers 2021 | $\mathbf{2 0 2 1}$ |
| :--- | :---: | :--- | :---: | :--- | :---: |
| VC Solnas Hjärta | $66 \%$ | VC Solnas Hjärta | $63 \%$ | VC Solnas Hjärta | $66 \%$ |
| Runby VC | $58 \%$ | Runby VC | $63 \%$ | Vibblaby HLM | $63 \%$ |
| Capio VC <br> Åkermyntan | $54 \%$ | Capio VC <br> Nockebyhöjden | $61 \%$ | Capio VC Nockebyhöjden | $60 \%$ |
| Capio Vårdcentral <br> Solna | $52 \%$ | Vibblaby HLM | $61 \%$ | Edsbergs vårdcentral | $59 \%$ |
| Husläkarna i <br> Margretelund | $56 \%$ | Husläkarna i <br> Margretelund | $61 \%$ | HLM Jakobsberg | $58 \%$ |
| Solna HLM i <br> Frösunda | $57 \%$ | Stureby vårdcentral | $60 \%$ | Fittja Vårdcentral | $56 \%$ |
| Capio vårdcentral <br> Bro | $54 \%$ | Lisebergs vårdcentral | $60 \%$ | Jordbro vårdcentral | $55 \%$ |
| Stureby vårdcentral | $56 \%$ | Capio Vårdcentral Solna | $59 \%$ | Fornhöjdens vårdcentrum | $55 \%$ |
| Capio VC Årsta | $60 \%$ | HLM Jakobsberg | $59 \%$ | Solna HLM i Frösunda | $55 \%$ |
| Bredängs vårdcentral | $52 \%$ | Attundahälsan | $59 \%$ | Järva VC | $55 \%$ |

### 4.2 Comparison between private and public primary care centers

The average proportion of patients reaching blood pressure targets was similar for private and public primary centers. But it decreased in the value during 2021 as Figure 6,7 below shows. Moreover, figure 6 and 7 present the variation between different primary care centers and their average value, where it shows that the private had higher variation, for instance during 2021 it varied with lowest variation rate $22 \%$ and highest rate $66 \%$. However, for the public primary care centers the variation rate was lower during 2021, where the lowest rate was $36 \%$ and the highest was $56 \%$. This can partly be explained by practice size with more private primary care centers being single-handed with a lower number of listed patients.


Figure 6. Present the variation in BP target achievement in public primary care centers. Mean, quartiles and range.


Figure 7. Present the variation in BP target achievement in private primary care centers. Mean, quartiles and range.

### 4.3 Studied factors

Various socioeconomic factors and other factors were studied in relation to target blood pressure. The results obtained showed no correlation between target blood pressure for 2021 and certain variables such as proportion of low educated, unemployment, proportion foreign born, CNI and proportion of population aged 65 years and over in the Stockholm region, appendix 1.

The following results are presented in the following order: proportion of population aged 65 years and over, unemployment, proportion foreign born, proportion of low educated people, CNI, proportion of people diagnosed with hypertension and have received antihypertensive medication and proportion of people who have been dispensed blood pressure medication (Apendix 1).

## 5. Discussion

### 5.1 Summary

The main objective of this thesis was to analyze and study the variations in primary care centers in Stockholm county and how different factors such as socioeconomic factors can influence this diversity. Firstly, the result showed that blood pressure target fulfillment varies substantially between the primary care centers in Stockholm county. The total variation was similar during 2019, 2020, and 2021, but individual practices could change their ranking between years. The same primary care centers, VC Solnas Hjärta, were number one in proportion reaching targets all the three years. Secondly, there was no significant difference in proportion of patients reaching blood pressure targets between private and public primary centers. However, the private primary care centers had higher variation compared with the public. Thirdly, there was no correlation between the presented socioeconomic factors and target blood pressure fulfillment or between target blood pressure fulfillment and proportion patients who were dispensed antihypertensive drugs and had hypertension as well as patients dispensed antihypertensives but for another indications.

### 5.2 Outcome of blood pressure fulfillment

In the study the data presented the percentage of patients who achieved their blood pressure target ( $<140 / 90 \mathrm{mmHg}$ ) at various primary care centers during 2019-2021, and the result showed a significantly variation between the 179 primary care centers in Stockholm county. The ranking between primary care centers for target achievement changed between the three years and even though the top-performing centers was the same all three years, others on the top-ten list changed during the studied period (2019-2021). The reason behind this change during 2019-2021 may be due to COVID-19 pandemic. Many studies have reported that corona virus can increase the risk of developing severe infections for those with underlying health conditions and under the pandemic many preventive ways were performed to reduce the spread of COVID-19 transmission between the individuals. One of the preventative ways was social distancing, therefore many patients avoided visiting primary care centers under the pandemic causing to the change in the measurement between the year 2019-2020[38]. Moreover, covid-19 pandemic has
also caused those other diseases such as diabetes, obesity, heart disease, stroke and many more to become less important to pay attention to at the moment. These diseases have higher mortality and morbidity rate than the corona virus, therefore several studies consider and believe that if the right strategies were used and worldwide public health authorities had the same attention to observe the situation, these diseases could be combat [39]. However, it is important to acknowledge that one year of data may be short for a small practice leading to random variation. There may also be problems of incomplete reporting of data to the primary care quality register. Furthermore, there are large number of potential reasons behind the variation and only few of them are possible to measure using databases. In another study located in southern Sweden in Skåne region was made to analyze the reason behind the barrier for not following the guidelines for target blood pressure fulfillment among the doctors in primary cares, which the result also showed that it varies between the primary cares. Further, the study was designed as a survey for selected primary cares and the publicly employed doctors had to answer the survey. The similarity that has been seen between the study presented and the study in Skåne is that both found variation, thus both was used different design and the study in Skåne did not include all the primary care centers in the region, therefore the result may not have been completely correct as it was the employed doctors who answered the survey. Another aspect is that the study was made in 2009 and the variation may have changed since then [40].

### 5.3 Public and privet primary care center

The result from the study showed no differences in the average value between the public and the privet primary care centers. For the private primary centers, the value was decreased from $47 \%$ during $2019,48 \%$ in 2020 and $44 \%$ in 2021. However, this variation was also seen in the average value for the public primary care centers, where during 2019 and 2020 the value was $48 \%$ and then decreased to $45 \%$ in 2021. There seems to be no differences between the private and public values which can indicates that there are no major differences in the quality of care and both need to develop and improve it. Therefore, as a beginning it is maybe important to improve the quality by for example improving the communication with patients so they can understand the information. In a study it has been shown that one the most important quality improvements is patient communication[41]. It was shown that many patients misunderstand the information on
the prescription, which caused incorrectly dosage leading to not achieving the BP goal. Moreover, it is important that each primary care analyses the outcomes in their patients and evaluate them to see where the issue is and how to improve it [41]. On the other side, this comparison is only made in Stockholm County and for a better result other region could be analyzed as well. In another study was made in Sweden discussing the importance of the quality care and how to increase the quality projects by financial support [42]. The study result showed that for instance Stockholm region did improve their quality and increasing the projects due to the financial support from the region [42].

### 5.4 Socioeconomic factors

This study showed no correlation between the studied socioeconomic factors and the target blood pressure fulfillment during 2021. As well as another study in Sweden showed that the employed doctors did not follow the guidelines recommendation regarding high blood pressure levels [43, 44]. The study included other factors such as age and considered it to be important when it comes to hypertension medication management, thus, nothing was studied in comparison with target blood pressure fulfillment. In another study the findings were similar when it comes to accepting a higher BP levers then what is recommended in the guidelines. In order to maintain the quality of the primary care centers and achieve the goal for the target blood pressure, the regional recommendations should be followed be the employed. However, this has been difficult due to some physicians do not adherence the guidelines. The main reason is the lack of documentation that shows adherence the recommendations will improve the outcomes in primary care centers [40, 45].

### 5.5 Method discussion

### 5.5.1 Study strengths

The first strength in this study is that it included a large region with 179 primary care centers both in urban and rural areas. It included all man and women who had been diagnosed with hypertension or used antihypertension medications for another indication. Therefore, the study considered credible for further research. Another strength is the database and registers that was
obtained in this study are collected from Swedish authorities care database and not extracted from self-reporting data, which makes the study more reliable. In addition, this study is the first study to present variation and target blood pressure fulfillment between primary care centers in Stockholm county during the period 2019-2021, as well as analysis socioeconomics factors in relation to BP goal.

### 5.5.2 Study limitations

The main limitation of the study is that use of aggregated data which do not allow for specific individual's data analyses on the association between different factors and the blood pressure target achievement. The data quality may also be a limitation. Data on blood pressures came from the Swedish national primary care quality register which $s$ based on voluntary reporting. There are primary care centers missing, some do not reveal their identity openly and there may be problems of incomplete coverage. Data on number of listed patients, diagnoses and drug treatment came from the regional data warehouse VAL. It has previously been used in studies of hypertension and other diagnoses and the estimated prevalence rates have shown to be consistent with other studies (ref) [46, 47]. Still, it is important to acknowledge that there may be problems of both over- and under reporting of diagnoses in databases. There was also a limited number of factors assessed, while it is known that there are several provider-and patient related factors that could be of relevance Moreover, the study considered only the region of Stockholm and therefore it cannot be generalized throughout the country.

### 5.6 Future research

In the future it can be considered to include other clinics than the primary care centers in Stockholm. There are also hospital-based specialists and other health clinics contributing the treatment of hypertension in Stockholm. Moreover, further research could also be made using survey or interviewing specific primary care centers, to analyse other explanations behind high or poor blood pressure control. Some examples of such factors may be patient compliance or the communication between physician and patient and if this has an effect of the target blood pressure fulfillment.

## 6. Conclusion

There is a substantial variation between primary care centers regarding goal fulfillment for blood pressure in Stockholm County. However, there was no correlation between practice size, ownership, socioeconomic characteristics of the practice population and the proportion of patients reaching blood pressure targets. Therefore, further analyzes are needed to assess the reason behind the variation and how it can be addressed.

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## 8. Appendix



Appendix 1.1 Correlation between blood pressure target 2021 and Proportion of Population aged 65 years and over in Stockholm.


Appendix 1.2 Correlation between blood pressure target 2021 and Proportion of unemployment.


Appendix 1.3 Correlation between blood pressure target 2021 and Proportion of foregin born.


Appendix 1.4 Correlation between blood pressure target 2021 and Proportion low educated people.


Appendix 1.5 Correlation between blood pressure target 2021 and CNI.


Appendix 1.6 Present the correlation between blood pressure target 2021 and proportion of people diagnosed with hypertension and have received antihypertensive medication.


Appendix 1.7 Present the correlation between blood pressure target 2021 and proportion of people who have taken blood pressure medication.

