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Effect of Beta-Blockers on Cognitive Function in Hypertensive Patients

Srikumar Chakravarthi[1*], Barani Karikalan[2], Ranjith Karthekeyan[3], Asrori SS[4], Shanmugasundaram S[5]

[1]Faculty of Medicine, Nursing and Health Sciences, SEGi University, Selangor, Malaysia

[2]Faculty of Medicine, MAHSA University, Selangor, Malaysia

[3]Department of Cardiac Anesthesia, Sri Ramachandra Medical College and Research Institute, Chennai, India

[4]International Office, Universitas Negeri Surabaya, Indonesia

[5]Department of Faciomaxillary Surgery, SRM University, Chennai, India

***Corresponding Author E-mail: srikumarc@segi.edu.my**

ABSTRACT

Hypertension is a major health problem around the world. It is commonly treated with long-term medications, such as beta-blockers. They are good in lowering blood pressure, but there are worries about how they can affect cognitive function, especially in older people. The goal of this study was to find out how beta-blockers affect cognitive performance in people with high blood pressure by comparing them to people who take other blood pressure drugs. This research used a cross-sectional, comparative design with 100 people with high blood pressure between the ages of 45 and 75. They were split evenly into two groups: those who used beta-blockers and those who did not. The Mini-Mental State Examination (MMSE) and the Montreal Cognitive Assessment (MoCA) were used to test cognitive abilities. The results showed that patients on beta-blockers had far lower cognitive scores and a higher rate of mild to moderate cognitive impairment than the control group. Statistical analysis showed that these differences were significant ($p < 0.05$). The study's conclusion is that beta-blocker therapy may make cognitive performance worse in people with high blood pressure. This shows how important it is to be careful when prescribing these drugs and to keep an eye on cognitive function in these individuals.

Key Words:

Hypertension, Beta-blockers, Cognitive function, MMSE, MoCA, Antihypertensive drugs, Cognitive impairment, Elderly patients

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1. INTRODUCTION

Hypertension is a common long-term condition that puts you at a higher risk for heart disease, stroke, and kidney failure. As the world's population gets older, it has gotten harder to treat high blood pressure[1]. This is because we need to think about not only the cardiovascular effects of antihypertensive medication but also the cerebral effects. Beta-blockers have been routinely used for decades because they are effective at lowering blood pressure and lowering the risk of heart problems[2]. But new data suggests that some beta-blockers, especially those that are lipophilic and can pass the blood-brain barrier, may affect how the central nervous system works, which could have negative impacts on thinking[3]. People with high blood pressure are

becoming more and more worried about cognitive impairment because it not only lowers their quality of life but also raises their risk of getting dementia. Even though beta-blockers are commonly used, the effects they have on thinking are not well understood in everyday medical settings. This calls for more concentrated research.

1.1.Background Information

Cognitive deterioration in people with high blood pressure is caused by a number of things, including alterations in blood vessels, oxidative stress, and poor blood flow to the brain[4]. It is very important for these individuals to get pharmacological treatment to avoid damage to their end organs[5], but the cognitive safety of different antihypertensive drugs differs. Some studies have linked beta-blockers to mood swings, weariness, and slower thinking, even if they are good at lowering morbidity and death. We don't know exactly how they work[6], but it's thought that they entail less blood supply to the brain and changes in how neurotransmitters are controlled[7]. In this clinical and pharmacological environment, this study looks at the long-term neurological safety of beta-blockers, which is of both scientific and therapeutic interest. This association is especially crucial for older people[8], who are already more likely to have cognitive deterioration and are the main people who get long-term beta-blocker therapy.

1.2.Statement of the Problem

Even though beta-blockers are commonly used to treat high blood pressure, there isn't much real-world evidence about how they might affect cognitive function in clinical settings. Most treatment guidelines put the health of the heart first[9], but they don't often think about the cognitive effects that may emerge from using the drug for a long time. This lack of understanding is a big clinical problem since cognitive impairment makes it hard for patients to be independent, stick to their treatment plan[10], and get the care they need. So, it's really important to find out if beta-blocker therapy raises the risk of cognitive deterioration in people with high blood pressure, especially when there may be safer drug options available.

1.3.Objectives of the Study

- To assess and compare the cognitive function of hypertensive patients on beta-blockers with those on other antihypertensive medications using standardized cognitive assessment tools (MMSE and MoCA).
- To determine the prevalence and levels (normal, mild, and moderate) of cognitive impairment in both beta-blocker and non-beta-blocker hypertensive patient groups.
- To statistically evaluate whether the differences in cognitive scores between the two groups are significant using appropriate tests (independent t-test and chi-square test).
- To identify any potential association between beta-blocker, use and cognitive impairment, thereby contributing evidence to inform more personalized and cognitively safe hypertension treatment strategies.

2. METHODOLOGY

The goal of this study was to find out how beta-blockers affect the cognitive performance of people with high blood pressure. Given that the population is getting older and more people are experiencing cognitive impairment associated to high blood pressure, it is very important to understand the possible cognitive effects of routinely prescribed antihypertensive drugs, especially beta-blockers. We used a quantitative, observational methodology to look at and compare the cognitive function of people taking beta-blockers with those taking other antihypertensive drugs.

2.1.Description of Research Design

This study used a cross-sectional, comparative study design to look at the cognitive function of people with high blood pressure who were taking beta-blockers and people who were taking other antihypertensive drugs. The study used standardized tests to examine cognitive outcomes at one point in time.

2.2.Sample Details

There were 100 people with high blood pressure in the study, all of them were between the ages of 45 and 75 and came from the outpatient department of a tertiary care hospital. There were two groups of participants: 50 patients who had been on beta-blockers for at least six months and 50 patients who were taking other types of antihypertensive drugs. People who had already been diagnosed with neurodegenerative disorders, psychological problems, stroke, or drug misuse were not allowed to participate.

2.3.Instruments and Materials Used

The Mini-Mental State Examination (MMSE) and the Montreal Cognitive Assessment (MoCA) scales were used to test cognitive function. We used a digital sphygmomanometer to get blood pressure measurements. A structured questionnaire was used to gather demographic and clinical information, such as how long the person had high blood pressure and what medications they had used.

2.4.Procedure and Data Collection Methods

Data were gathered by face-to-face interviews and inspections of medical charts after getting ethical approval and informed consent from the participants. Trained healthcare specialists did cognitive tests in a quiet clinical setting. Each participant took the cognitive tests in one session that lasted around 30 minutes.

2.5.Data Analysis Techniques

This study used SPSS software to look at the data. We employed descriptive statistics to sum up the demographic and clinical traits. We used independent t-tests and chi-square tests to see how the cognitive scores of the two groups compared. A p-value of less than 0.05 was seen to be statistically important. We also performed multivariate regression analysis to account for factors that could have affected the results, like age, degree of education, and how long the person had high blood pressure.

3. RESULTS

This section shows what the study found about how beta-blockers affect the cognitive function of people with high blood pressure. Researchers looked at the data to see how well people with high blood pressure who were on beta-blockers and people who were taking other antihypertensive drugs did on cognitive tests. The MMSE and MoCA instruments were used to test cognitive scores. The presentation starts with descriptive results and then moves on to statistical analysis.

3.1.Demographic and Clinical Characteristics of Participants

There were 100 people with high blood pressure in the trial, including 50 people in each group. This Study documented and showed the demographic information, including age, sex, level of education, and length of time with high blood pressure, in Table 1.

Table 1: Demographic Profile of Participants

Variable	Beta-Blocker Group (n=50)	Non-Beta-Blocker Group (n=50)
Age Range (Years)	45–74	46–75
Number of Males	28	27
Number of Females	22	23
Primary Education	16	14
Secondary Education	21	20
Higher Education	13	16
Duration of Hypertension	6–15 years	5–14 years

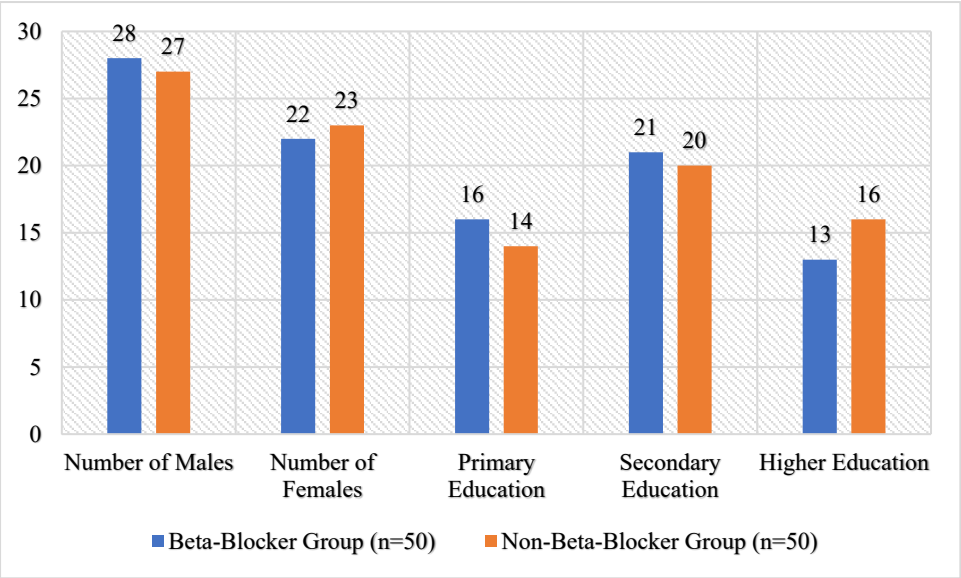

Figure 1: Graphical Representation of Demographic Profile of Participants

There were 50 people in each group, therefore Table 1 shows the demographic profile of the study participants. The ages of the people in the two groups were similar. The people in the beta-blocker group were between 45 and 74 years old, while the people in the non-beta-blocker group were between 46 and 75 years old. There were 28 men and 22 women in the beta-blocker

group and 27 men and 23 women in the non-beta-blocker group. This means that both groups had a reasonably even number of men and women. The educational backgrounds were likewise similar, except the non-beta-blocker group had a few more people with higher education (16 vs. 13). The beta-blocker group had hypertension for 6 to 15 years, and the non-beta-blocker group had it for 5 to 14 years. This shows that both groups had similar clinical profiles.

3.2.Cognitive Assessment Scores

Based on their scores on the MMSE and MoCA scales, Table 2 shows how many people were in each category. The scores were grouped into three groups: normal cognition, mild cognitive impairment, and substantial impairment.

Table 2: Cognitive Function Classification Based on MMSE and MoCA

Cognitive Level	Beta-Blocker Group (n=50)	Non-Beta-Blocker Group (n=50)
MMSE		
Normal (24–30)	30	41
Mild Impairment (18–23)	16	8
Moderate Impairment (<18)	4	1
MoCA		
Normal (26–30)	27	38
Mild Impairment (18–25)	19	10
Moderate Impairment (<18)	4	2

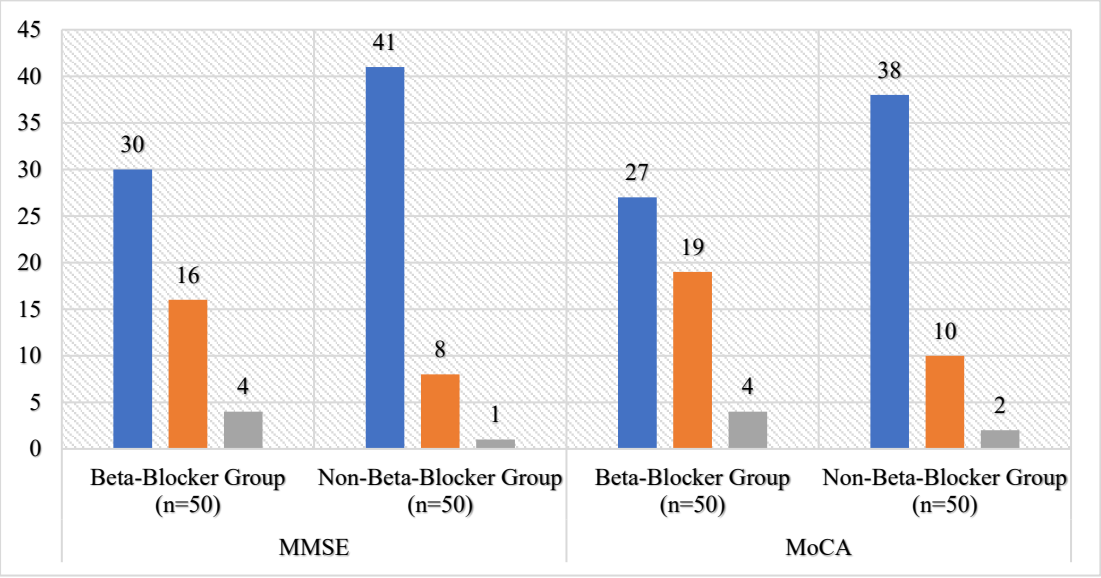

Figure 2: Graphical Representation of Cognitive Function Classification Based on MMSE and MoCA

There is a big difference in cognitive function between the beta-blocker group and the non-beta-blocker group, as seen in Table 2. In the MMSE test, 30 people in the beta-blocker group had normal cognitive scores, while 41 people in the non-beta-blocker group did. The beta-blocker group also had more people with mild and moderate impairments (16 and 4, respectively) than the non-beta-blocker group (8 and 1, respectively). On the MoCA scale, only 27 people on beta-blockers scored in the normal range, whereas 38 people in the comparison

group did. There were again more beta-blocker users (19 and 4) than non-beta-blocker users (10 and 2) who had mild to moderate cognitive deficits. This suggests that beta-blocker use may be linked to lower cognitive function.

3.3.Statistical Analysis

This study used independent-samples t-tests and chi-square tests to see if the differences in cognitive outcomes between the two groups were statistically significant. The table below shows the results of the t-test for MMSE and MoCA scores between groups in the style of SPSS.

Table 3. Independent Samples Test for MMSE and MoCA Scores Between Groups

Test Variable	Levene's Test for Equality of Variances	t-test for Equality of Means	Sig. (2-tailed)	Mean Difference	df	t-value
MMSE Score	F = 1.242, p = 0.268	Equal variances assumed	0.014*	-1.68	98	-2.501
MoCA Score	F = 1.783, p = 0.185	Equal variances assumed	0.009*	-2.12	98	-2.679

The independent samples t-test in Table 3 shows the differences in MMSE and MoCA scores between hypertensive individuals taking beta-blockers and those taking other antihypertensives. Levene's test showed that the assumption of equal variances was met for both cognitive tests ($p > 0.05$). The t-test results showed that there was a statistically significant difference in cognitive function. Patients on beta-blockers had far lower MMSE scores ($t = -2.501$, $p = 0.014$) and MoCA scores ($t = -2.679$, $p = 0.009$) than patients who were not on beta-blockers. These results imply that using beta-blockers may make cognitive performance worse in those with high blood pressure.

Table 4: Chi-Square Test for Cognitive Impairment Levels

Test	Value	df	Asymp. Sig. (2-sided)
MMSE: Impairment Category	7.435	2	0.024*
MoCA: Impairment Category	6.732	2	0.035*

The Chi-square test findings shown in Table 4 show the link between the kind of antihypertensive medication and the level of cognitive impairment as determined by the MMSE and MoCA. The Chi-square value for the MMSE impairment categories was 7.435, which was statistically significant at the 0.024 level. The Chi-square value for the MoCA was 6.732, which was statistically significant at the 0.035 level. The results show that there is a statistically significant link between the type of antihypertensive therapy and the level of cognitive impairment because both p-values are less than 0.05. This means that people who took beta-blockers were more likely to have cognitive deterioration than people who took other blood pressure drugs.

4. DISCUSSION

The goal of this study was to find out how beta-blockers affect cognitive function in people with high blood pressure by comparing the cognitive performance of people using beta-blockers to those taking other antihypertensive drugs. As more and more research links heart health to cognitive loss, it's important to know how different types of drugs, such beta-blockers, affect patients' treatment, especially for older people with high blood pressure. The results showed that there were big disparities in cognitive scores between the two groups. This raises concerns about the cognitive safety profile of beta-blockers.

4.1.Interpretation of Results

The study's results showed that patients on beta-blockers were more likely to have mild to moderate cognitive impairment than people taking other antihypertensive drugs. On both the MMSE and MoCA scales, fewer people in the beta-blocker group scored in the normal range for cognitive function, whereas more people scored in the mild to moderate range for cognitive impairment.

The independent samples t-test showed that the beta-blocker group had statistically significant lower mean scores on both the MMSE ($p = 0.014$) and the MoCA ($p = 0.009$). This suggests that beta-blockers may have a negative effect on overall cognitive performance. Also, the Chi-square analysis showed that there was a strong link between using beta-blockers and the level of cognitive impairment on both scales ($p < 0.05$).

These results are in line with other studies that showed that some centrally acting beta-blockers could be able to pass the blood-brain barrier and change how neurotransmitters work, which could make cognitive performance worse. However, not all studies have found the same results. Differences may be due to the type of medicine, the dose, or patient-specific characteristics including age and other health problems.

4.2.Comparison with Existing Studies

Several recent studies in the field support and are consistent with the results of this study, which show a strong link between beta-blocker use and cognitive impairment. Dhami et al. (2023)[11] did a retrospective observational study that showed that some antihypertensives, especially centrally acting agents like beta-blockers, were more likely to cause cognitive decline in older people than other types of drugs like calcium channel blockers or ARBs. Cojocariu et al. (2021)[12] also pointed out that lipophilic beta-blockers could have neuropsychiatric effects like memory problems and cognitive slowness since they can cross the blood-brain barrier. This supports the biological validity of the current study's conclusions. Eddin et al. (2025)[13] did a systematic review and meta-analysis that showed that beta-blocker medication, especially for people who have been taking them for a long time, raises the risk of neuropsychiatric diseases, including cognitive impairment. Carnovale et al. (2023)[14] supported this by pointing out that antihypertensive medicines can have both positive and negative impacts on brain function. They found that beta-blockers are one of the groups that can have both therapeutic and possibly deleterious effects on neurocognitive function, depending on the patient. On the other hand, research on other antihypertensive drugs, like D'Silva et al. (2022)[15], has shown that angiotensin II receptor blockers (ARBs) may not only stop cognitive decline but also protect against dementia. This suggests that different antihypertensive classes may have different

effects. These combined results support the findings of this study and make a stronger case for tailored prescribing for those with high blood pressure, especially those who are at risk of cognitive deterioration. But the fact that the results of different studies are not always the same shows how important it is to think about things that could affect the results, like the patient's age, the drug's lipophilicity, and the length of treatment.

4.3.Implications of Findings

The link between beta-blocker uses and cognitive deterioration is vital for doctors to know about. Healthcare professionals should be careful when giving beta-blockers to older people with high blood pressure or people who are at risk of losing cognitive function. Patients who are on beta-blockers for a long time may need to have their cognitive function checked often. If cognitive function is a concern, they may want to think about using a different antihypertensive drug.

This study also adds to the growing body of research that shows how important it is to use tailored therapy to treat high blood pressure. When choosing medications, you should think about not only how well they work for the heart but also how safe they are for the brain, especially in older people.

4.4.Limitations of the Study

Despite its valuable insights, the study had several limitations:

- This study couldn't figure out what caused what. We need longitudinal studies to see how cognitive changes happen over time.
- A larger and more diverse sample could help make the results more generalizable, even though the current size is fine for early comparisons.
- The study didn't control for differences in the kind, dose, and length of time beta-blockers were used.
- Regression analysis tried to take into account age, education, and how long someone had high blood pressure, but there are other characteristics that weren't examined that could also affect cognition, like depression, sleep quality, and lifestyle.

4.5.Suggestions for Future Research

To strengthen the evidence base and guide clinical decision-making, future research should focus on the following:

- Long-term research to see how beta-blockers affect thinking over time.
- Randomized controlled trials (RCTs) to find out what causes what and reduce bias.
- Looking at different types of beta-blockers (lipophilic vs. hydrophilic) to see how they affect the brain in different ways.
- Investigating how things work, like how beta-blockers affect blood flow to the brain, neuroinflammation, and the balance of neurotransmitters.
- Using neuroimaging and advanced neuropsychological methods to get a more accurate picture of cognitive function.

5. CONCLUSION

This study looked into how beta-blockers might affect the cognitive function of people with high blood pressure by comparing their cognitive performance to that of people using other antihypertensive drugs. The results showed that patients on beta-blockers had a higher rate of mild to moderate cognitive impairment, as evaluated by the MMSE and MoCA, than patients not taking beta-blockers. These data suggest that there may be a connection between using beta-blockers and having less cognitive function, especially when used to treat high blood pressure over a lengthy period of time. Because beta-blockers are so widely used, this concern needs to be taken into account when making therapeutic decisions, especially for older people who are more likely to have cognitive deterioration.

5.1.Summary of Key Findings

- A large number of individuals on beta-blockers showed mild to moderate cognitive impairment on both the MMSE and MoCA tests.
- Statistical analysis showed that the beta-blocker group had far worse cognitive scores than the non-beta-blocker group ($p < 0.05$).
- Chi-square tests showed that there was a statistically significant link between the usage of beta-blockers and levels of cognitive impairment.
- The groups were rather evenly matched in terms of demographic factors including age, gender, education, and how long they had been hypertensive. This made the cognitive differences more reliable.

5.2.Significance of the Study

This study shows that beta-blockers can help control high blood pressure, but they may also be bad for cognitive health, especially in older persons. It adds to the continuing discussion in clinical pharmacology about how to find a balance between cardiovascular benefits and neurological safety. The results are useful for doctors, especially in primary care and geriatric settings where tailoring treatment to each patient is important. Being aware of possible cognitive impacts encourages proactive monitoring and personalized blood pressure medications.

5.3.Recommendations

- Routine cognitive screening should be a part of the clinical care of those with high blood pressure, especially those who are using beta-blockers.
- Doctors should think about using other antihypertensive drugs for individuals who are at risk of or are showing signs of cognitive deterioration.
- More research is needed to find out how different types of beta-blockers (for example, lipophilic vs. hydrophilic) affect cognition.
- Long-term research are needed to find out what causes things and keep track of how people's cognitive abilities change over time.
- People should be more aware of the non-cardiac adverse effects of beta-blockers so that patients and caregivers may make better treatment decisions.

CONFLICT OF INTEREST:

The authors have no conflicts of interest regarding this investigation**.**

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