

The Effect of Genetics on Developing Hypertension

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Summer Science Research Program, The Opportunity Network

Author Note

Aaron James is from Brooklyn, NY. He is an incoming freshman at Northwestern University studying Biomedical Engineering and minoring in International Relations. He participated in the Opportunity Network's Summer Science Research Program where he led and completed his research project on a topic of his choice. This proposal was created for two reasons: to determine to what degree genetics plays in one developing hypertension and to communicate the results to the public so they can be informed and work with their physicians on treatment plans to manage their condition. Correspondence concerning this proposal should be addressed to Aaron James, Contact: aaronmjames0906@gmail.com.

Abstract

Heart disease is the leading cause of death in the United States due to the millions of people who suffer from hypertension. Hypertension or “high blood pressure” affects over a billion people in the world and the most common form is essential hypertension. Essential hypertension doesn’t have a single cause because it is usually a combination of factors that cause its development. One of the least-known causes of hypertension is genetic mutation and its transmission through a family. Many people who have hypertension don’t know the cause of it. This leads to uncertainty in their lives of knowing what is causing their condition and prevents them from getting the right treatment from physicians.

This proposal aims to complete an in-depth investigation into the effect of genetics on developing hypertension. There have been numerous studies done before on genetics and hypertension which validates the need for further inquiry because it has been difficult to isolate a specific gene that is the causal factor of hypertension. Association studies and linkage analysis have shown a direct correlation between the inheritance of specific gene mutations and how they cause hypertension. Some genes have a connection to the condition, but with this study, progress can be made in finding the specific gene that causes hypertension.

With the results of this research, those suffering from hypertension will be informed about their genetic information and be able to work with their doctors on managing their conditions. Furthermore, researchers and other scientists can use the data recovered from this study to create methods to lower the number of people with hypertension. With the use of genome sequencing to gene editing, scientists can manipulate the expression of genes related to hypertension to stop the effect it has on the body, providing a better quality of life to millions of people.

Introduction

Around 1.28 billion people in the world have hypertension and more than half of people with hypertension live in low to middle-income areas. Hypertension otherwise known as “high blood pressure” is a condition where the pressure in your blood vessels is consistently too high. This pressure causes malfunctions in the heart causing it to overwork itself. As a result, hypertension is the cause of many diseases from coronary heart disease to renal disease. The most common type of hypertension is essential hypertension which has multiple causes and there isn't one defining factor that results in someone developing hypertension. Many people don't know what is causing their hypertension so researching the effect of genetics on hypertension can potentially help one realize if a genetic mutation is the causal factor of their hypertension. More attention needs to be put into studying the genetics of hypertension because of how many people have this disease and the solutions that could be created if more research is completed.

At the moment, studies have shown that the inheritance of hypertension is found in 20% of families in the world (Singh et al., 2016, p. 268). Genetic research has identified certain gene mutations that cause hypertension. It is important to note that no single gene mutation has been identified as a common gene that causes hypertension in all populations of humans. EH (essential hypertension) can be caused by gene mutations and environmental factors. Due to there being not just one cause of hypertension, the study of genetic variants is difficult but more and more genetic studies are being completed. Identifying specific mutations that cause hypertension has been difficult since the inheritance is so low. Researchers are attempting to identify what particular mutations cause hypertension although the combination of genetics and environmental factors have the greatest impact on hypertension development. Furthermore, researchers want to identify the effect the environment has on genes and how one's sensitivity to an environment can influence their genetic makeup. Genome sequencing and chromosome mapping have been used to try and identify candidate genes that cause hypertension.

There is ample information on how genetics affect hypertension. As stated before, it is difficult to

identify a single gene that is responsible for essential hypertension due to the condition having a myriad of causes. Furthermore, there isn't one definitive cause of essential hypertension which is why it's vital to do further inquiry into the genetic impact on hypertension. This study will investigate the effect of genetic mutations on developing hypertension.

Methods

The literature review will be conducted by researching existing articles on hypertension and the characteristics of the condition. Furthermore, research will be done on the intersection between genetics and hypertension, finding articles that delve deep into how genetics affect one developing hypertension. Existing research is appropriate and vital for this research proposal because it provides a foundation for what is already known about the impact of genetics and hypertension. From that, more can be built on that knowledge. Past research has already concluded the genetic effect on hypertension and then analysis can be made to draw conclusions. The criteria that will be used for selecting sources are that they discuss the clear correlation between genetics and hypertension. The sources are reputable and they cite information that has been peer-reviewed. Lastly, graphical details and statistics will be looked for because they give data that is peer-reviewed and tested using proper experimental techniques. One database I will utilize is Google Scholar and I will use keywords like "genetics", "hypertension" AND "genes".

Based on the information gathered from the literature, it can be assumed that genetics plays a small part in developing hypertension. The linkage analysis used related individuals with a history of hypertension as the experimental group. The association studies used unrelated individuals with genetic hypertension markers compared to those without as the control. Additionally, I will look at the breakdowns of the candidate genes including the location on the chromosome, parts of the body it affects, polymorphisms, and real-world applications each gene has. Completing thematic analyses will help me identify patterns and trends in the data. Comparing multiple research articles and looking at overlaps of data will allow me to conclude if genetics plays a large role in the development of hypertension.

Furthermore, I will look for specific results of which genes affect hypertension and draw meaningful conclusions that will lead to a more definitive answer if genetics does play a role in developing hypertension.

Discussion

The first study discussing the molecular genetics of essential hypertension attempted to highlight that there is a significant genetic influence on blood pressure and variations of it. It is important to note that the genetic trait being studied isn't a single gene but a combination of genes that react with the environment to be expressed differently. An experiment was conducted where the genome was studied in three groups. The first group was people who were related with a history of hypertension. The second group was people who had no relation to each other but had hypertension. The final group was a control group of people who didn't have hypertension and weren't related to each other. Based on linkage analysis and association studies of these groups, it was proven that genetics have around a 30 to 50% effect on developing hypertension (Singh et al., 2016, p. 269). Some genes were found to correlate with causing hypertension, but no single gene could be identified as the causal factor (Luft, 1998, p. 1875). The second study investigated the relationship between genes and the environment. Specifically, the research study tries to emphasize different aspects of the environment and how they combine with genetic mutations to develop hypertension. The researchers in the study worked with organizations such as the Human Genome Project to sequence and learn about which genes are connected to high blood pressure (KUNEŠ et al., 2009, p. 34). Furthermore, genetic models are used to show how diet and specific substances affect genes and their expression.

The results of these studies relate to each other by how they identify that there is a genetic influence on hypertension but simultaneously, environmental factors combined with that genetic effect cause hypertension in someone. Both studies discuss the difficulty of finding a specific gene that causes hypertension due to the scarcity of people who have a family history of hypertension. The first study

focuses more on the specific genes that have a connection to hypertension and how they affect the body. They use linkage analysis and association studies while the second study utilizes genetic models and gene sequencing. (Singh et al., 2016, p. 274). In the first study, in-depth descriptions of gene groups are given in terms of location and relation to the body. Conversely, the second study gave data on how specific environmental factors like eating habits affect one's genes which causes hypertension. Generally, both studies agree that it is difficult to determine what individual gene is the cause of hypertension because of diet and other environmental factors.

The findings of these studies helped contribute to the genetic research field because they proved a correlation between one's genes and the probability of developing hypertension. A solid foundation of genetic hypertension was built and from that further research can be completed by looking at specific genes and their probability of developing hypertension. Furthermore, the results of the studies proved that the potential proposal being made is valid. It is commonly accepted that genetics affect hypertension. Researchers from both articles hope that association studies will help better understand hypertension genetics so physicians will become better at diagnosing and finding the causes of someone's hypertension on a case-by-case basis. From there, progress can be made in creating more effective treatments from gene therapies or cell editing. Additionally, researchers desire more in-depth studies into what single trait affects developing hypertension rather than a combination of traits with environmental influence.

Conclusion

Hypertension is a disease that many people have heard about and experienced but they aren't informed of the causes of the condition. Genetics have a definitive impact in about 30% of hypertension cases but many aren't aware. The results from this research can progress information on how genes affect our bodies while providing information to physicians and patients so they can communicate with one another to work on more effective treatments. Right now, researchers know groups of genes that have a connection to the development of hypertension but there hasn't been a single gene identified as being the

causal factor of the disease. Furthermore, it's difficult to find these genes because hypertension has many causes, not just genetics. The environment has a monumental impact on one's health and that can combine with genetics to cause hypertension.

This research can help find the gene(s) that causes hypertension and from that researchers can work on how to manipulate those genes. Using gene and cell editing techniques, scientists can alter the genes that cause hypertension. Millions of lives could be permanently altered for the better. If physicians could prevent hypertension before it even develops using gene therapies, the domino effect that hypertension leads to is heart disease, renal failure, and kidney disease. A better quality of life can be given to all who suffer from this seemingly unknown condition.

References

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