We Turn UK Biobank Data Into Actionable Health Insights

Case Study: Hyperlipidemia Doubles MS Risk in Healthy Adults: Insights from UK Biobank

Executive Summary

This study investigates how common cardiometabolic conditions like hypertension and hyperlipidemia influence multiple sclerosis (MS) risk even among individuals maintaining a healthy lifestyle. Leveraging UK Biobank data, we conducted a case-control study comparing MS and non-MS individuals who were non-smokers, had BMI < 30 kg/m^2, and exercised regularly. The study reveals that hyperlipidemia significantly increases the odds for MS (OR ≈ 2.2), implying the importance of early cardiovascular risk monitoring even in otherwise healthy individuals. This cohort analysis highlights the value of large-scale biobank data in evaluating associations between lifestyle, metabolic comorbidities, and chronic diseases like MS.

Detailed Solution Overview

Background

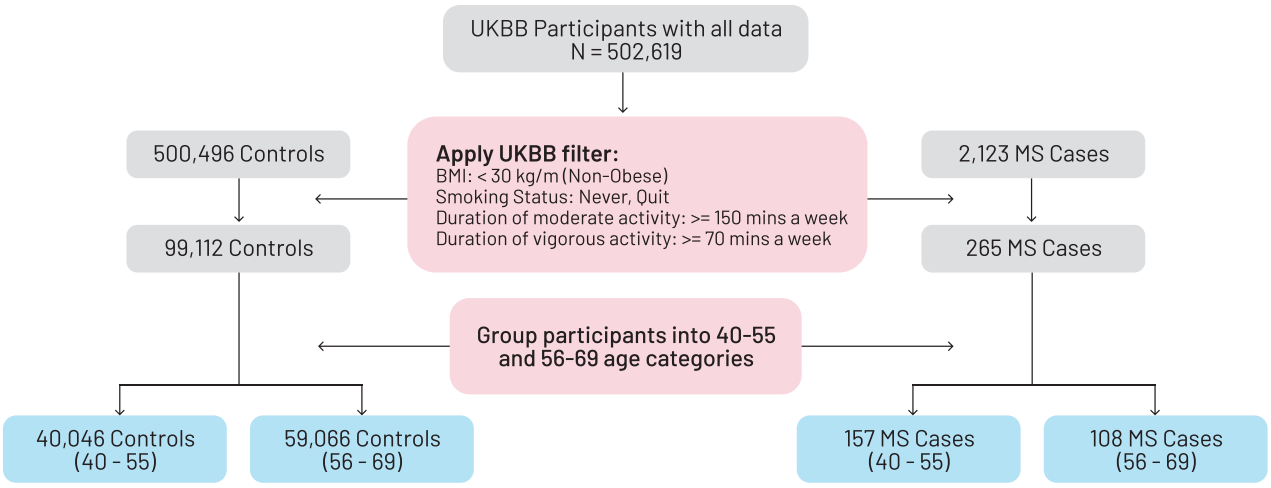
- MS is a chronic demyelinating disorder affecting ~2 million people globally.
- Comorbid conditions in MS are known to worsen outcomes, accelerating disability, reducing life quality, and increasing mortality.
- Previous research has poorly explored the significance of a healthy lifestyle for the disease. This study shifts the focus to individuals with and without MS who follow healthy lifestyle habits.

Objective

To determine whether cardiometabolic comorbidities - hypertension, hyperlipidemia, and alcohol use - are associated with MS in adults who otherwise follow healthy lifestyle practices.

Study Design

- Source: UK Biobank (UKBB), a population-based cohort of ~500,000 individuals
- Study Type: Case-control study using UK Biobank data
- Population: The participant selection and filter criteria applied are depicted below:



- Variables included: The variables that have been considered in the study are:

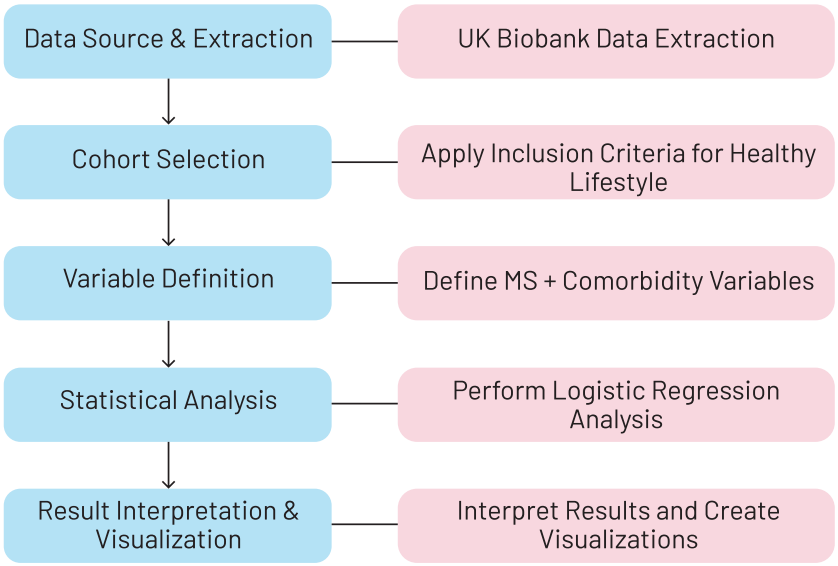
    1. Disease status (MS or non-MS)
    2. Diagnoses (ICD-10 coded)
    3. Hyperlipidemia (HL) identified via E78 codes
    4. Hypertension (HT) identified via I10 codes
    5. Demographics: Age, sex, ethnicity
    6. Lifestyle factors: Smoking, alcohol intake, physical activity

Analysis

- Logistic regression is used to evaluate associations between MS and:

    1. Hypertension (HT)
    2. Hyperlipidemia (HL)
    3. Demographics: Age, sex
    4. Lifestyle factors: Smoking, alcohol intake

- Interaction term (HT*HL) tested for combined effects
- The following case study workflow diagram shows the analysis steps in brief



Key Findings

- **Hyperlipidemia** was associated with **2.2x increased odds of MS** ($p = 0.007$)
- Hypertension showed no significant association
- HT*HL interaction was not significant, indicating independent effects of comorbidities
- Compared to females, males have lower odds of presenting with MS (Odds Ratio ≈ 0.46)
- Compared to never smokers, previous smokers have higher odds of manifesting MS.

Findings Consistent with Previous Studies

Most of our findings are consistent with previous studies, as detailed below

- Hyperlipidemia is associated with an increased risk of MS, aligning with earlier reports linking adverse lipid profiles to MS susceptibility and progression (Tettey et al., 2014; Weinstock-Guttman et al., 2011).
- Male sex is associated with significantly lower odds of MS (Hanne F. Harbo et al., 2013).
- People who smoke have a higher chance of being diagnosed with MS than those who have never smoked. This supports previous findings that link smoking to an increased risk of MS (Peng Zhang et al., 2016).
- Previous studies treat hypertension and hyperlipidemia as separate independent variables, occasionally considering a cumulative comorbidity burden (Marrie RA et al., 2010; Zhang T et al., 2018). We examined the interaction between hypertension (HT) and hyperlipidemia (HL) using interaction terms (e.g., HT * HL) to evaluate their combined synergistic effects on MS progression or risk.
- In previous studies, it has been reported that hypertension has a significant association with MS (Marrie RA et al., 2010; Briggs FBS et al., 2021). However, we did not find this connection among participants who followed a healthier lifestyle.

Study Conclusion

Hyperlipidemia may significantly elevate MS risk even in individuals with otherwise healthy lifestyles. These findings highlight the need for early lipid monitoring and preventive cardiovascular care in MS screening strategies. Hypertension alone does not show an independent link with MS, and no synergistic effect with HL was observed.

Our Expertise: End-to-End UK Biobank Analytics

Why use the UK Biobank?

- Focus on healthy lifestyle subgroup: Enables targeted analysis of a growing yet under-studied population segment with favorable lifestyle behaviors.
- Comprehensive, high-quality data: Offers access to a large, deeply phenotyped cohort (n > 500,000), including multi-omics, imaging, clinical, and longitudinal follow-up data.
- Detailed health and lifestyle data: Provides rich information on habits, environment, and medical history, making it easier to account for comorbidities and other factors that may influence disease outcomes.
- Supports discovery of risk and prognostic factors: Facilitates identification of early predictors and long-term outcomes for a wide range of diseases.

What We Offer

- Cohort identification and classification from large population data
- Data Extraction: ICD-10, Primary Care, Self-Reported, including extraction of time-point specific data
- Data Integration and Quality Assessment: Integration of various data types such as omics (WES, WGS, proteomics, genotypic), imaging, prescription, and other relevant metadata
- Lifestyle Variable Filtering: Disease-specific and general lifestyle variables, like BMI, smoking, physical activity, frequency of headache, etc
- Comorbidity & Risk Profiling: Inferring answers to questions like the effect of Hyperlipidemia in participants with Multiple Sclerosis. The questions are customizable based on the requirements
- Regression, ML, and Predictive Modeling: Models for phenotypic classification of samples and subtypes, predict if the genetics data has significant analysis power, etc
- Omics Data Mapping: GWAS, pQTL, eQTL, find common and rare variants, functional prediction of the variants, identify top-ranking potential target genes/proteins and check if these targets are druggable, etc.
- Multi-data Analysis and Reporting: Combined analysis of omics data as well as other metadata, such as prescription, imaging and disease-specific relevant factors. Shareable, ready-to-use and customizable analysis pipeline according to the analysis objective

Our study highlights the effective use of UK Biobank data to uncover complex links between lifestyle factors and disease risk. This reflects our expertise in navigating large-scale population datasets to deliver nuanced epidemiological insights. We offer end-to-end support from data extraction to analysis tailored to specific research needs.

References

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> We were very impressed with the quality of work and timeliness; you're definitely our go-to for bioinformatics consulting
>
> - Director, Bioinformatics, Illumina

> We were immensely impressed by Strand's ability to rapidly recruit a substantially sized clinical cohort of cancer patients, and to design and run a complex liquid biopsy panel on samples drawn from the cohort, all in roughly a year's time.
>
> - Dr. Nishant Agarwal
> Chief of Otolaryngology-Head and Neck surgery and director of Head and Neck Surgical Oncology, University of Chicago.

> We have been using the StrandOmics pipeline to analyze and generate a report for our clinical cancer panels for over three years now. i would highly recommend using it to analyze data generated from clinical cancer NGS panels and the outputted clinical report provided after analysis.
>
> - Senior Scientist/ Medical laboratory director for NY State, Prim Bio Research Institiute

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