
# ALZHEIMER'S DIESEAS DATA ANALYSIS REPORT

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# Alzheimer's Disease

To initiate our project, we first needed a comprehensive understanding of Alzheimer's Disease. Here, we outline our approach and thought process in addressing this subject. In this section, we explain our thought process and methodology for approaching the project.

Alzheimer's Disease is characterized by **three main aspects:**

1. **Neurodegenerative Nature:**

   Alzheimer's Disease is a specific **neurodegenerative** condition **marked by the accumulation of amyloid plaques and Tau tangles** in the brain. Over time, this accumulation causes **irreversible damage** to neurons. The symptoms **vary** depending on the affected brain region, leading to distinct syndromes:

   a. **Memory Syndrome:** Typically associated with the classic form of Alzheimer's.
   b. **Language Syndrome:** Known as the logopedic variant of Alzheimer's.
   c. **Visual Syndrome:** Often referred to as the wisteria or visual variant.
   d. **Frontal Syndrome:** Linked to the frontal variant of the disease.

2. **Core Symptoms:**

   Regardless of the specific syndrome, most forms of Alzheimer's Disease can be characterized by **a triad of core symptoms and sings:**

   **a. Progressive memory loss**
   **b. Cognitive decline**
   **c. Behavioral abnormalities**

3. **Types of Alzheimer's Disease:**

Alzheimer's Disease is divided into **two primary types:**

a. **Type 1 (Early-Onset):**
   i. **Age of Onset:** Symptoms typically appear **between ages 30 and 35.**
   ii. **Inheritance**: This type is genetic, following an **autosomal dominant inheritance** pattern. If a parent has Type 1, the child is likely to inherit it.
   iii. **Localization**: Certain subtypes are **geographically localized**, with examples found in regions like Mexico, Spain, and parts of Italy.
   iv. **Prevalence**: Type 1 accounts for **only 1-5%** of all Alzheimer's cases. Ongoing research aims to reduce the impact on patients' lives.

b. **Type 2 (Late-Onset):**
   i. **Age of Onset:** Symptoms begin to manifest **after the age of 60-65.**
   ii. **Causes**: The exact causes are **largely unknown**, though several factors are **theorized:**
      1. **Genetic (e.g., ApoEε4 allele)**
      2. **Metabolic and environmental influences**
      3. **Neurotransmitter imbalances**
      4. **Brain vascular issues**
   iii. **Distribution**: Type 2 is **sporadic and occurs globally**.
   iv. **Prevalence**: Type 2 represents **95-99%** of all Alzheimer's cases.

## Healthcare Approach

Diagnosing and managing Alzheimer's Disease involves coordination **across multiple healthcare** levels:

1. **Primary Healthcare: (Primary Care Clinics - Geriatric Clinics)**

   focus is on **initial detection and referral based**. These facilities **identify early signs** (doctor's observation) **and symptoms** (either the patient or one of family member complains) of Alzheimer's and direct patients to specialists for more comprehensive evaluations.

2. **Secondary Healthcare (Neurology Clinics - Memory Care Centers - Hospitals (Neurology Departments))** :

   focuses on **specialist diagnosis and in-depth evaluation**. Facilities in this category are equipped to **confirm an Alzheimer's diagnosis (detection of amyloid plaques and Tau tangles)** through advanced testing and imaging, providing detailed information on the disease's progression.

3. **Tertiary Healthcare (Alzheimer's and Dementia-Specific Care Units - Long-Term Care Facilities (Nursing Homes) - Assisted Living facilities - Home Health Care Services)**

   focuses on **long-term management and care**. These facilities provide ongoing care for Alzheimer's patients, particularly in advanced stages, ensuring safety, comfort, and quality of life.

# Differential Diagnoses for Alzheimer's Disease

As Alzheimer's Disease (AD) is **an irreversible condition**, Differentiating Alzheimer's Disease (AD) from other neurodegenerative conditions is a crucial aspect of clinical practice, especially since **the symptoms** of different types of dementia **often overlap**. Proper diagnosis is essential for effective management for AD or a definitive cure for the other differentials, and it becomes even more **obvious in the postmortem analysis (autopsy)**, where neuropathological features are definitive. Two conditions that are often considered in the differential diagnosis of **Alzheimer's Disease are Chronic Traumatic Encephalopathy (CTE) and Vascular Dementia (VaD).**

1. **Chronic Traumatic Encephalopathy (CTE)**
   - ❖ CTE is a progressive neurodegenerative disorder associated with **repeated head injuries,** particularly in athletes or individuals who have experienced multiple concussions or mild traumatic brain injuries. Given the **symptomatic overlap with Alzheimer's Disease**, distinguishing CTE from AD can be challenging, particularly in the early stages.
   - ❖ While Alzheimer's Disease typically manifests with cognitive decline and memory impairment, CTE often presents with changes in mood, behavior, and motor function before cognitive impairment becomes evident. Patients may experience depression, aggression, or impulse control issues early on. All of which overlap clinically.
   - ❖ **Amyloid beta (Aβ) plaques are a hallmark of AD but are usually absent in CTE (secondary and tertiary Healthcare Facilities).** This absence of amyloid deposition in CTE is a significant pathological distinction between the two conditions.

2. **Vascular Dementia (VaD)**
   - ❖ Vascular Dementia is the second most common cause of dementia after Alzheimer's Disease. It is caused by **impaired blood flow to the brain, often due to strokes or other vascular pathology**. Like Alzheimer's, Vascular Dementia leads to cognitive decline, but the underlying mechanisms and clinical presentation can differ.
   - ❖ While memory loss is typically the first symptom of Alzheimer's, the cognitive symptoms of Vascular Dementia can vary depending on the brain region affected by reduced blood flow. Executive function deficits, slowed thinking, and impaired judgment often precede memory issues in VaD.
   - ❖ Alzheimer's Disease is usually **progressive and continuous, while Vascular Dementia may progress in a stepwise fashion**, with sudden deteriorations after strokes or other cerebrovascular events. Mixed presentations are common when AD coexists with VaD.
   - ❖ **Absence of Hallmark AD Pathology**: The **absence of amyloid plaques and neurofibrillary tangles (Tau protein accumulation) is crucial for differentiating Vascular Dementia from Alzheimer's Disease during autopsy**.

Both Chronic Traumatic Encephalopathy (CTE) and Vascular Dementia (VaD) are irreversible and share symptoms with Alzheimer's Disease, making **clinical differentiation challenging**. Accurate diagnosis often **requires evaluation by secondary or tertiary healthcare providers**. The presence of amyloid plaques and neurofibrillary tangles (Tau protein accumulation) is essential for distinguishing Alzheimer's Disease from CTE and VaD."

# Study Design

## case-control study:

1. focused specifically on **AD Type 2**, therefore. the study **excludes patients under the age of 60**
2. Our dataset excludes **secondary care tests and investigations** (e.g., imaging, biomarker studies), which means you'll focus on elements like MMSE scores, medical history, and clinical symptoms—**critical in the primary care setting for early identification of dementia types.**
3. we will aim to explore **how various patient information** (such as lifestyle factors, medical history, and clinical measurements) **may predict or differentiate AD from its differential diagnoses**, including **Chronic Traumatic Encephalopathy (CTE)** and **Vascular Dementia (VaD)**.

**Interlinking Data Elements to Alzheimer's Disease (AD) and Differential Diagnoses:**

1. **Patient Information**

    - **Patient ID**: This unique identifier (4751–6900) will help track individual patients in the study, preventing overlap and aiding in clear case-control grouping.
    - **Age**: Since the dataset **excludes patients under 60**, the age range of 60–90 years is critical. Older age is a known risk factor for Alzheimer's, Vascular Dementia (VaD), and Chronic Traumatic Encephalopathy (CTE).
    - **Gender**: Alzheimer's prevalence can be higher in women, while CTE is more common in males, especially due to higher risk of head injury Plus we may find an interlink to induce a hormonal therapy if the prevalence in one gender is obviously more than the other.
    - **Ethnicity**: Cognitive decline and dementia can have varying prevalence across ethnic groups, due to factors like genetics, access to healthcare, and socioeconomic conditions.
    - **Education Level**: Cognitive reserve is thought to delay symptoms of AD. Higher education is associated with lower dementia risk, which is important for differentiating between types of dementia (e.g., AD vs. VaD).

2. **Medical History**

    - **Family History of Alzheimer's**: A known genetic risk factor for AD. Presence or absence may differentiate AD from other forms of dementia like VaD or CTE.
    - **Cardiovascular Disease**: Strongly linked to VaD but also relevant in AD due to overlapping pathologies like atherosclerosis.
    - **Diabetes**: Increases the risk of both AD and VaD through mechanisms like insulin resistance and cerebrovascular damage.
    - **Depression**: Can precede or accompany AD, VaD, or CTE. It's often comorbid with dementia, making it essential for differential diagnosis.
    - **Head Injury**: Especially relevant for CTE. A history of head trauma may indicate an increased risk of CTE over AD.
    - **Hypertension**: A major risk factor for VaD due to its effect on brain vasculature. It may also exacerbate AD.

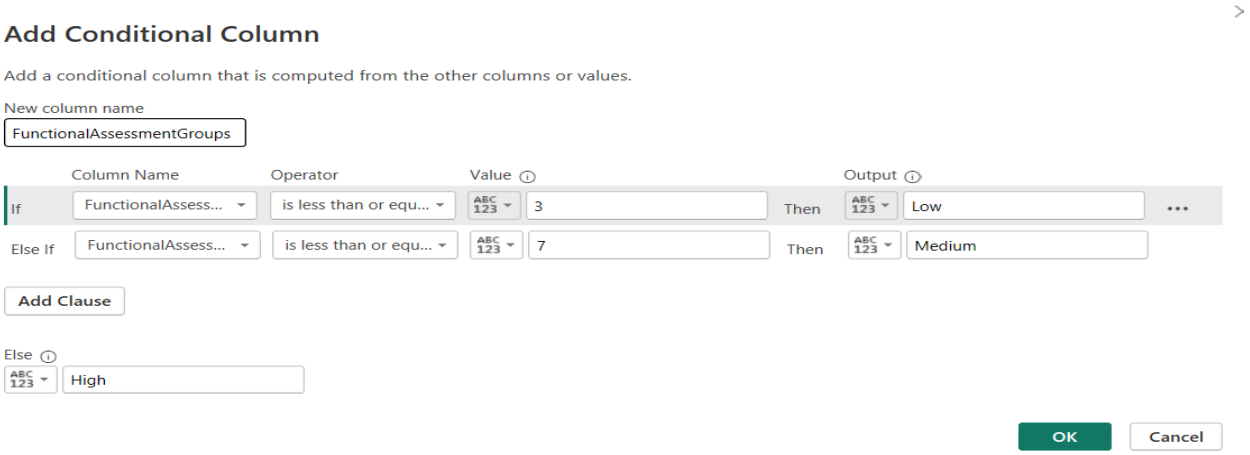
3. **Symptoms**

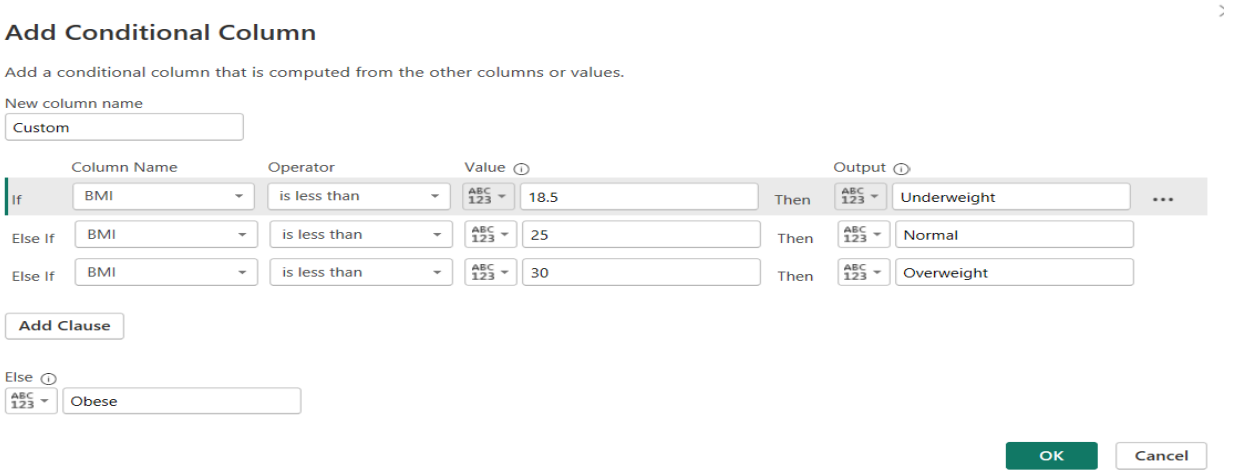
    - **Confusion, Disorientation, Forgetfulness**: These are hallmark symptoms of AD, and they overlap with VaD. In CTE, these may be accompanied by behavioral problems like aggression.
    - **Personality Changes**: Common in both AD and CTE. CTE may show more marked behavioral changes due to frontal lobe damage.
    - **Difficulty Completing Tasks**: An early symptom of cognitive decline seen in AD and VaD. CTE may present with more executive dysfunction.

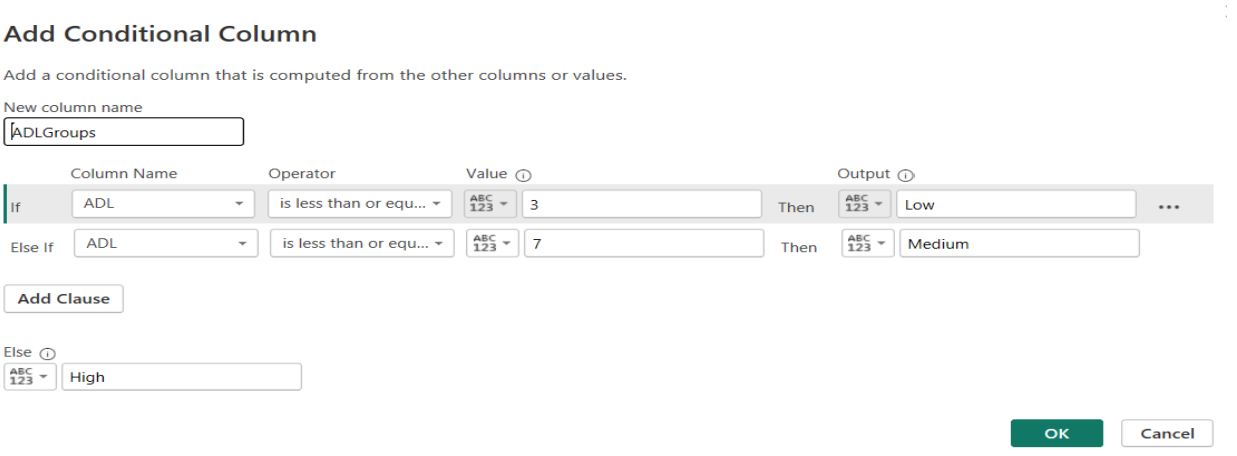
4. **Cognitive and Functional Assessments (Signs)**
    - **MMSE Score**: A lower score indicates cognitive impairment. Different patterns of cognitive decline (memory vs. executive function) help differentiate AD from VaD or CTE.
    - **Functional Assessment**: Assesses daily functioning. Greater impairment could suggest later stages of AD or more severe VaD.
    - **Memory Complaints**: Key in AD, where memory is affected early on. Less prominent in VaD or CTE.
    - **Behavioral Problems**: May be present in AD, VaD, or CTE, but are often more extreme in CTE (e.g., aggression).
    - **ADL (Activities of Daily Living)**: A measure of functional independence, often more impaired in later stages of AD or VaD.
5. **Lifestyle Factors (habits with medical interest):**
    - **BMI**: Both low and high BMI are associated with cognitive decline.
    - **Smoking**: Smoking can increase the risk of cardiovascular disease and therefore VaD, but its link to AD is still debated.
    - **Alcohol Consumption**: Heavy alcohol consumption can lead to brain damage and symptoms similar to AD or CTE, and to answer if there any correlation between hangover and brain injury.
    - **Physical Activity**: Physical inactivity is a modifiable risk factor for AD and VaD. Higher levels of activity are protective.
    - **Diet Quality**: Poor diet may increase the risk of cognitive decline, especially if high in saturated fats, which can lead to cardiovascular issues (VaD risk).
    - **Sleep Quality**: Poor sleep is increasingly recognized as a contributor to AD, as amyloid clearance is affected by sleep patterns.
6. **Clinical Measurements**
    - **Blood Pressure (Systolic/Diastolic)**: High blood pressure, especially in midlife, is linked to a higher risk of VaD and possibly AD.
    - **Cholesterol Levels**: Dyslipidemia (high cholesterol) is a risk factor for cardiovascular diseases, contributing to VaD. LDL and triglycerides can also be linked to cognitive decline in AD.
7. **Diagnosis Information**
    - **Diagnosis**: Determines the presence or absence of Alzheimer's. Differentiating between AD, VaD, and CTE is crucial, especially based on vascular risk factors (VaD) and trauma history (CTE).

**Power Query:**

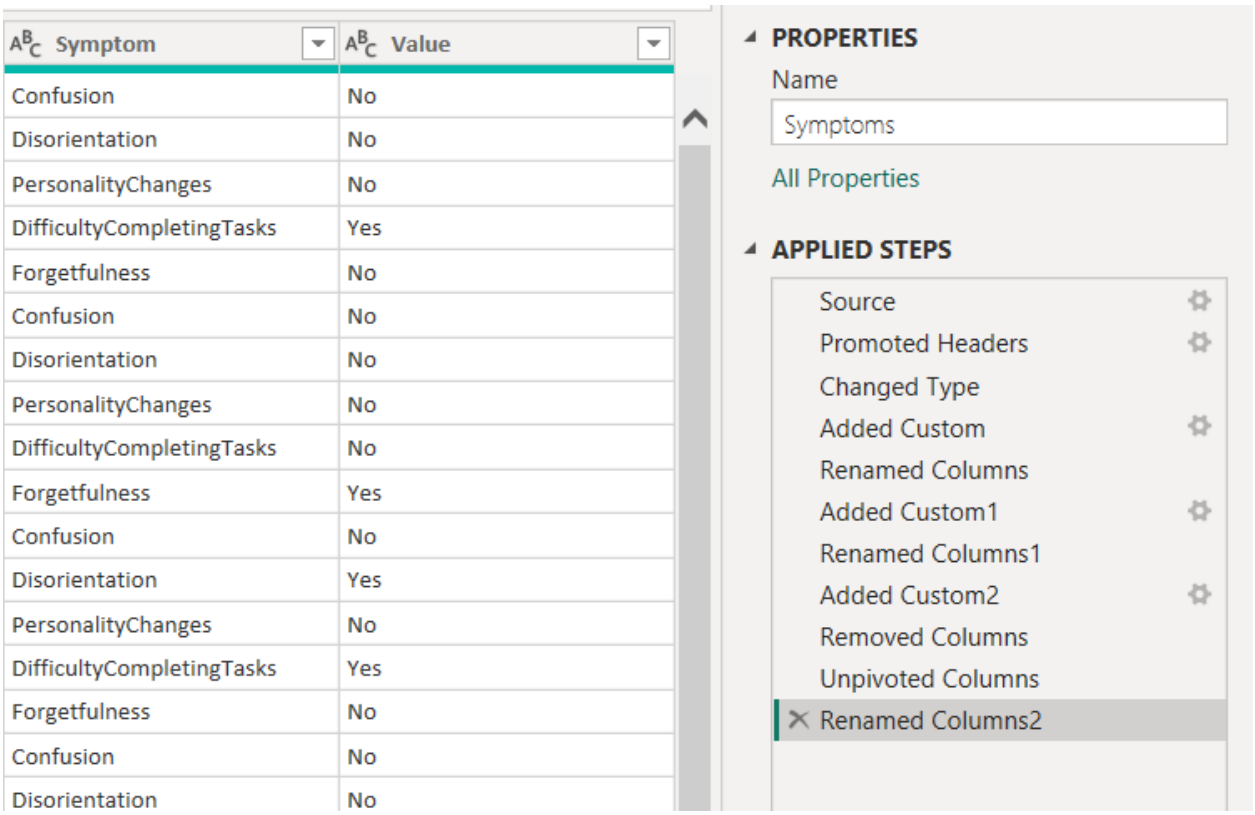
1. Grouped values through conditional columns:



2. Unpivoted Symptoms column to create a new table:



| Symptom | Value |
|---|---|
| Confusion | No |
| Disorientation | No |
| PersonalityChanges | No |
| DifficultyCompletingTasks | Yes |
| Forgetfulness | No |
| Confusion | No |
| Disorientation | No |
| PersonalityChanges | No |
| DifficultyCompletingTasks | No |
| Forgetfulness | Yes |
| Confusion | No |
| Disorientation | Yes |
| PersonalityChanges | No |
| DifficultyCompletingTasks | Yes |
| Forgetfulness | No |
| Confusion | No |
| Disorientation | No |