

# HR Attrition Analysis Report

## 1. Introduction

The primary goal of this analysis is to understand the drivers of employee attrition within the company. Attrition represents a major HR challenge due to its financial impact (recruiting costs, productivity loss) and knowledge drain.

This report evaluates:

- Which employee groups leave the company most frequently,
- Which explanatory factors correlate with resignation,
- Whether certain hypothesized risk factors significantly influence attrition.

The analysis focuses on Exploratory Data Analysis (EDA) and statistical hypothesis testing of the provided HR dataset.

The data set was cleaned in advance (`Data_Cleaning.ipynb`). All analyses can be found in `Data_Analysis.ipynb` and `Logistic_Regression.ipynb`.

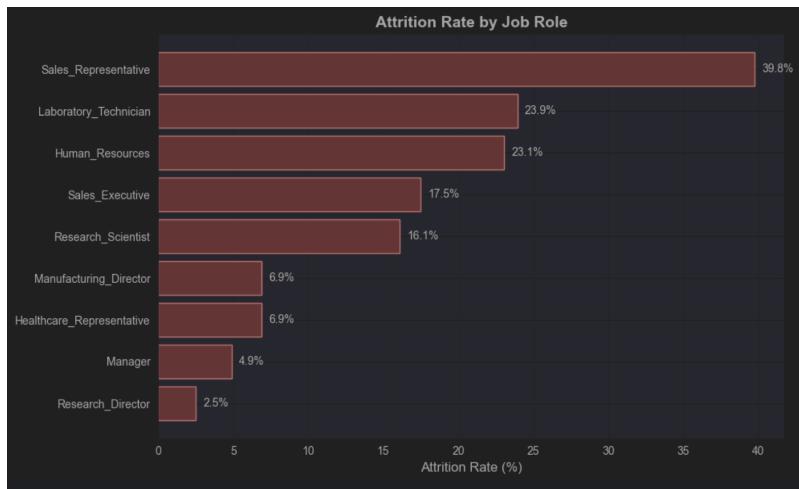
## Executive Summary (Key Findings)

1. Overtime is the strongest single factor for resignations.
  - Employees who work overtime are 51% more likely to leave the company.
2. Early attrition: Employees with  $\leq 2$  years of service have almost  $3\times$  higher resignation rates.
  - $\leq 2$  years: 34.9% attrition
  - 2 years: 12.9% attrition
3. Frequent business travel massively increases the risk of resignation.
  - Frequent travel: 24.9% attrition
  - Rarely: 14.9%
  - Non-travel: 0.08%
4. Income has a strong protective effect.
  - High-income employees resign 3 $\times$  less often than low-income employees.
5. Long-term employees (20–30 years) are at increased risk due to high overtime workloads.

## 2. Exploratory Data Analysis (EDA)

### 2.1 Attrition by Job Role

The attrition rate differs noticeably between job roles. Some positions show elevated resignation rates, indicating role-specific risk groups.

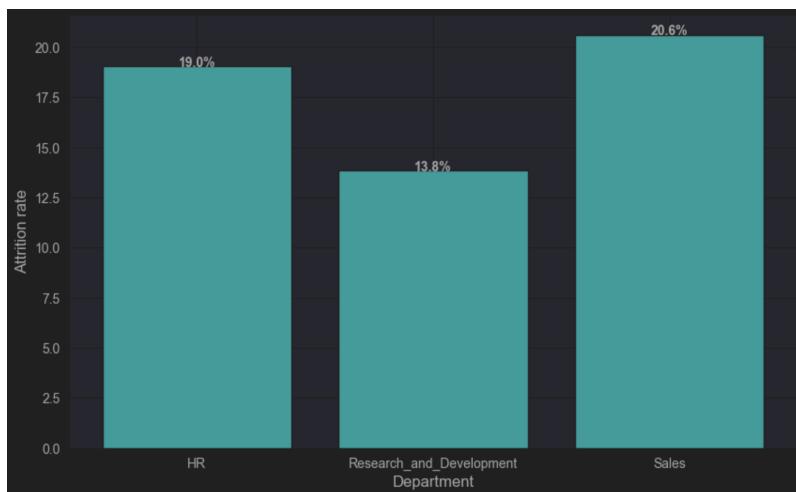


### 2.2 Attrition rate by Department

Analysis shows:

- Sales and Human Resources display slightly higher attrition rates than other departments.
- Research & Development has comparatively lower attrition.

However, no drastic differences exist between the departments, meaning department alone is not a strong predictor.

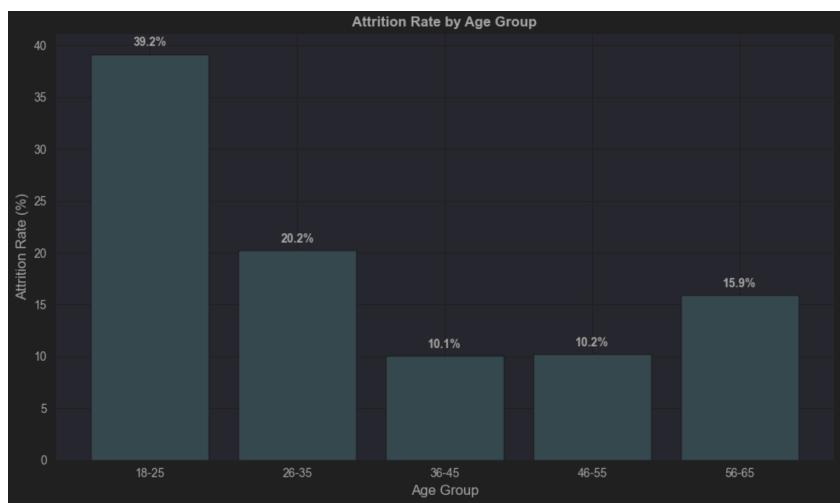


## 2.3 Attrition rate by Age

The age distribution analysis reveals:

- Employees between 18 and 25 years old show high attrition levels (Job switching).
- Employees between 18 and 25 years old show elevated attrition levels.
- Older employees (>56) show moderate attrition, often due to early retirement.

This identifies employees < 35 years as a potential risk group.



## 2.4 Attrition rate by Monthly Income

The monthly income in the dataset ranges as follows:

### Statistic Value

Min 1009

Q1 (low) 2911

Mean ~4919

Q3 8379

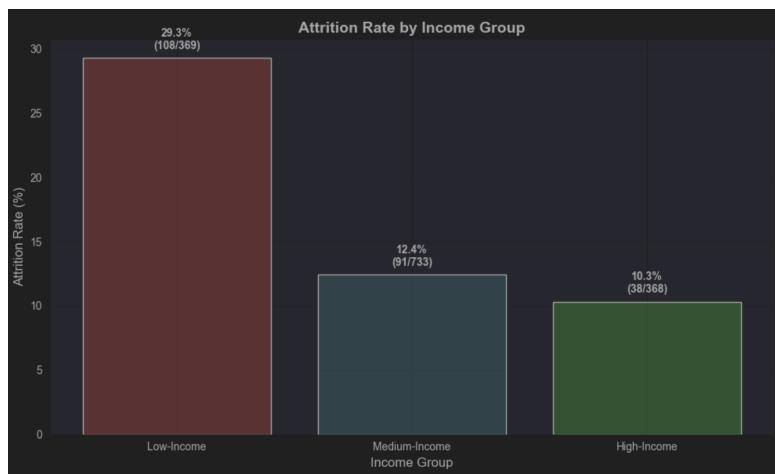
Max 19999

## Income Bands (Quantile-Based):

1. Low salary: 1000 – 2911
2. Medium salary: 2912 – 8379
3. High salary: 8380 – 20000

## Attrition Insights:

- High-salary employees have almost three times lower attrition than low-salary employees.
- The medium-salary group (50% of all employees) shows a moderate attrition rate (12.4%).
- Low-income employees represent a clear risk group with elevated resignation rates.



## 4. Hypotheses and Statistical Testing

### 4.1 Hypothesis H1: Overtime increases attrition

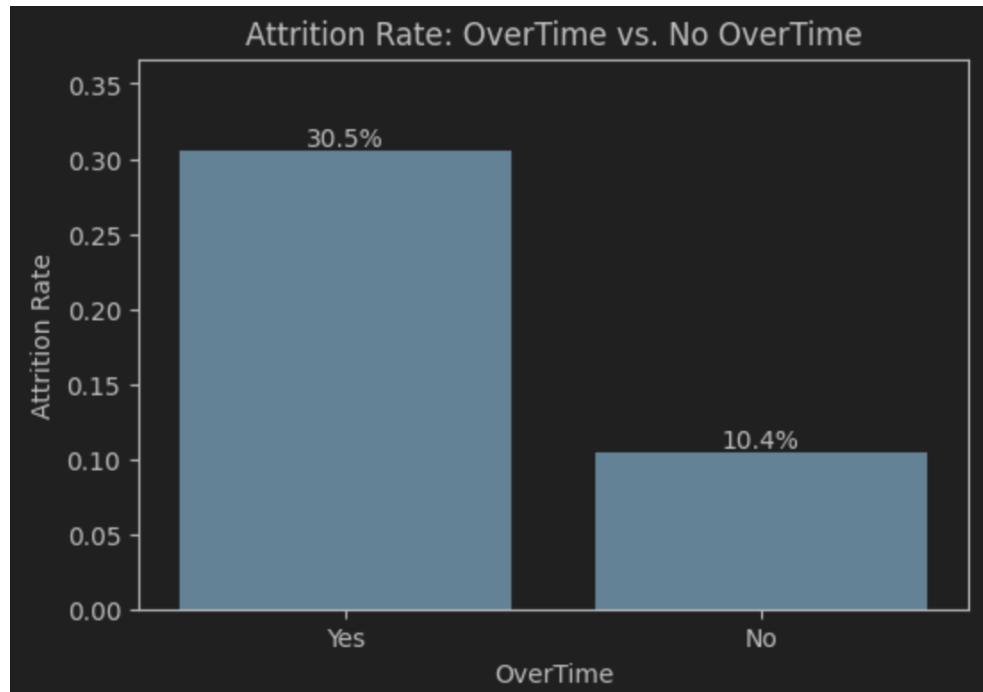
**H<sub>1</sub>:** Employees working overtime (OverTime = Yes) have higher attrition.  
**H<sub>0</sub>:** Attrition is independent of overtime.

**Test:** Chi-Square Test of Independence

**Result:** p < 0.001 → *Highly significant*

## **Interpretation:**

Employees who work overtime are significantly more likely to resign.  
This aligns with the observed positive correlation between Attrition and OverTime (+0.25).



4.2 Hypothesis H2: Employees with <2 years of tenure leave more frequently

**H<sub>0</sub>:** Attrition is independent of tenure < 2 years.

**H<sub>1</sub>:** Employees with < 2 years tenure quit more frequently.

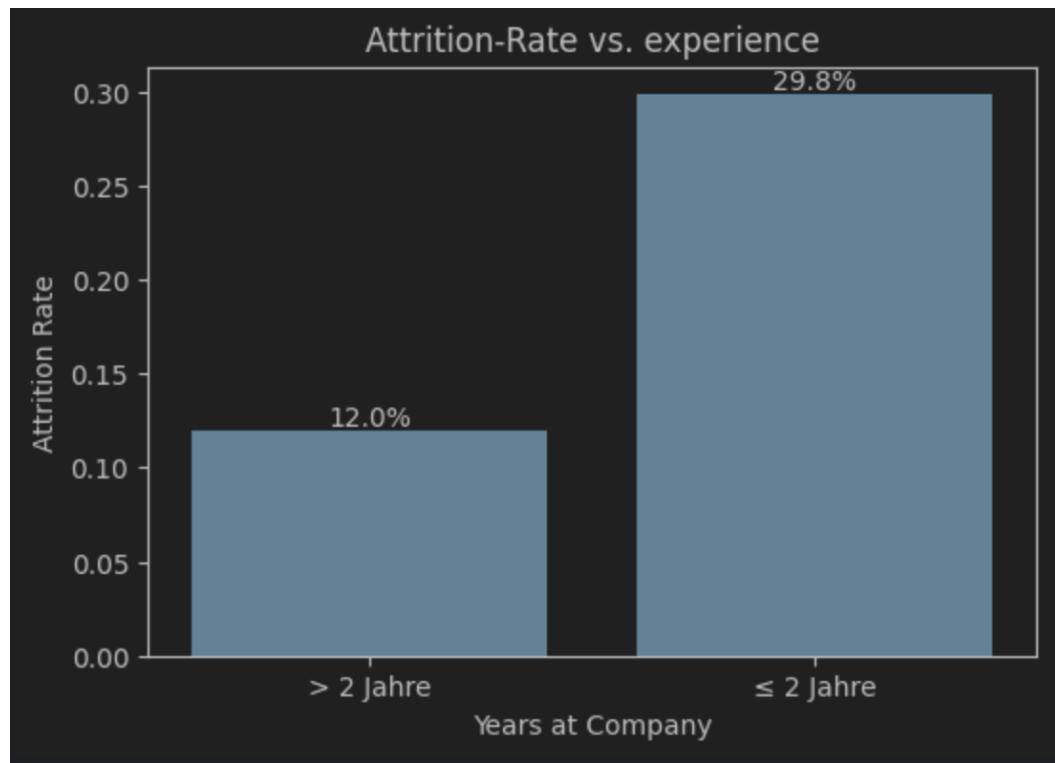
**Test:** Chi-Square Test of Independence

## **Result:**

- Extremely strong evidence against H<sub>0</sub>
- Attrition rates:
  - <2 years: 34.9%
  - ≥2 years: 12.9%
- Employees with <2 years tenure resign almost 3× more often

## **Interpretation:**

Early-stage employees are a major high-risk group.  
Onboarding and early engagement initiatives are critical.



## **4.3 Hypothesis H3: Frequent Business Travel increases attrition**

**H<sub>1</sub>:** Attrition rates differ between BusinessTravel categories.

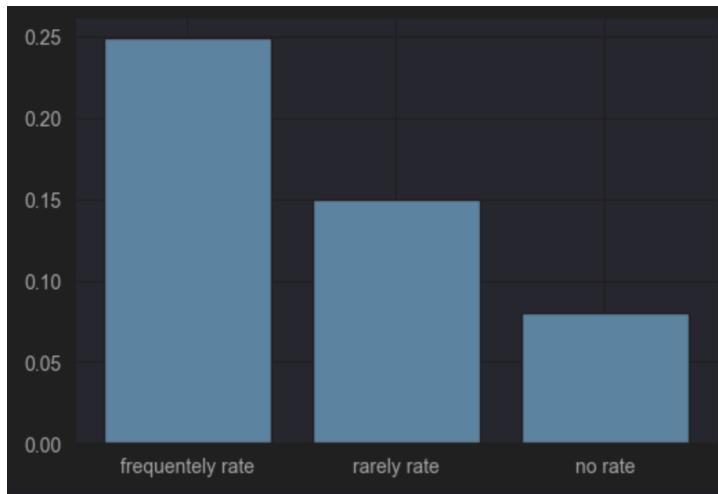
**H<sub>0</sub>:** BusinessTravel and Attrition are independent.

**Test:** Chi-Square Test of Independence

**Result:** Significant difference between groups.

## **Attrition Rates by Travel Frequency:**

- Frequently: 24.9%
- Rarely: 14.96%
- Non-traveling: 0.08%



### **Interpretation:**

Frequent travellers are far more likely to leave.  
This suggests travel-related strain may contribute to employee churn.

## **6. Multinomial logistic Regression**

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 [ 27 12]]
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Confusion Matrix:

	precision	recall	f1-score	support
0	0.90	0.97	0.94	255
1	0.63	0.31	0.41	39

### **Baseline Comparison:**

The logistic regression model for predicting employee attrition demonstrates significantly improved predictive power compared to simple baseline models and successfully identifies the most important factors influencing turnover.

## **Attrition:**

- |   |                                 |
|---|---------------------------------|
| 0 | 1233 (83.9%) – No Attrition (0) |
| 1 | 237 (16.1%) – Attrition (1)     |

## **Baseline-Models:**

- "predict 1 every time": 16.1% Accuracy
- "predict 0 every time": 83.9% Accuracy
- log\_reg: 88.4% Accuracy

## **Key Performance Indicators**

- Accuracy: 88.4% (+4.5 points above baseline)
- Recall: 97.3% - Nearly all actual attrition cases are detected
- Precision: 90.2% - 9 out of 10 warnings are genuine risk cases
- False Negatives: Only 7 out of 255 attrition cases missed

# **Key Factors Influencing Attrition**

## **Risk Factors (Increase Attrition Probability)**

1. Overtime (OverTime)
  - Effect Size: Medium influence
  - Odds Ratio: 1.51
  - Interpretation: Employees working overtime have 51% higher probability of attrition
  - Business Implication: Overtime culture as critical risk factor
2. Company Tenure (YearsAtCompany)
  - Effect Size: Medium influence
  - Odds Ratio: 1.37
  - Interpretation: Longer company tenure correlates with 37% higher attrition risk
  - Business Implication: Long-term employees require special attention

## **Protective Factors (Reduce Attrition Probability)**

1. Current Role Tenure (YearsInCurrentRole)
  - Effect Size: Medium-Low influence
  - Interpretation: Stability in current role reduces attrition tendency
2. Job Satisfaction (JobSatisfaction)
  - Effect Size: Medium-Low influence
  - Interpretation: Higher job satisfaction demonstrably lowers turnover risk

## 7. Conclusions

### Key Risk Groups Identified

- Employees working overtime
- Employees with <2 years tenure
- Employees with frequent business travel
- Employees with low salary levels
- Employees aged under 25

### Important Drivers of Attrition

1. OverTime
2. BusinessTravel
3. MonthlyIncome
4. YearsAtCompany
5. JobRole differences

### Findings in Drivers:

1. There are no clear differences between overtime in the individual income groups. They are distributed almost symmetrically. All income groups work approximately 28% overtime.
2. New employees (<24 months) have an almost constant overtime rate of around 30%. This is enough to trigger termination (early attrition effect), whereas the overtime rate for employees who have been with the company for longer is very high (although this may be due to outliers).



- a. (a) Attrition = Yes (red): Overtime almost always 100% → This indicates that: When long-term employees resign, it is almost exclusively due to high overtime loads.
- b. (b) Attrition = No (green): moderate overtime (40–70%) → Many stay even though the workload is increasing – but: this group is extremely small (few samples) which is why small individual cases appear to have a strong visual impact.

## 8. Strategic HR Implications

- Strengthening onboarding programs
- Reducing overtime workloads
- Travel load balancing
- Adjusting compensation for low-salary roles