Assessing Liver Transplant Waitlist Removals: Analyzing Fairness Through the Lens of Demographic Parity

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1 Introduction

Health disparities continue to pose significant challenges within healthcare delivery and outcomes. These disparities are exacerbated in scenarios involving the most critical and high-stakes decisions, such as those related to organ transplants. The focus of this study is specifically on the process of liver transplant waiting list removals. This process is fraught with complexities and high stakes, given that decisions made here can directly affect patients' chances of survival, making the need for fairness and equity paramount.

Understanding the myriad of factors that contribute to these removals is crucial for identifying potential biases and systemic issues that may unfairly influence the decision-making classification process. In this context ensuring fairness involves guaranteeing that all patients, irrespective of their background, are given an equitable chance of a transplant based on medical need rather than impermissible demographic factors.

Specifically, the study focuses on the removal of a patient for being 'too sick'. In theory, the decision is made by clinical assessment when an individual becomes either too frail or sick to cope with surgery or aftercare where liver disease severity and age are often considered [1]. However, this process is highly subjective leaving significant opportunity for individual bias to influence decision-making. There is no strictly defined criteria for delisting; instead the decision relies on the discretion and judgment of the clinical transplant staff.

In order to assess this disparity, it is essential to evaluate the removal rates from the liver transplant waitlist, for being'too sick' through the framework of demographic parity. Demographic parity refers to achieving equal outcomes across different demographic groups. By examining removal rates from the liver transplant waitlist, we can identify disparities that indicate underlying inequities in the process. Addressing these disparities helps to uncover systemic issues

that may contribute to unequal access and outcomes in healthcare delivery. Understanding these differences is crucial for developing targeted interventions to promote fairness and improve healthcare equity.

2 Participants

All data was obtained from the the United Network for Organ Sharing (UNOS)/ Organ Procurement and Transplant Network (OPTN) registry. It consists liver transplant waitlist data between 2001 - 2024. Individuals under 18 and those with MELD exception points were excluded from the study due to the varying likelihood of receiving a transplant or delisting. Those with a large number of missing or unknown entries were also excluded to ensure the accuracy and reliability of the analysis. After applying these exclusion criteria, a sample of $165,712$ were left in the final dataset including only those individuals with complete and consistent data records, allowing for a more precise evaluation of the disparities present in transplant waiting list removals.

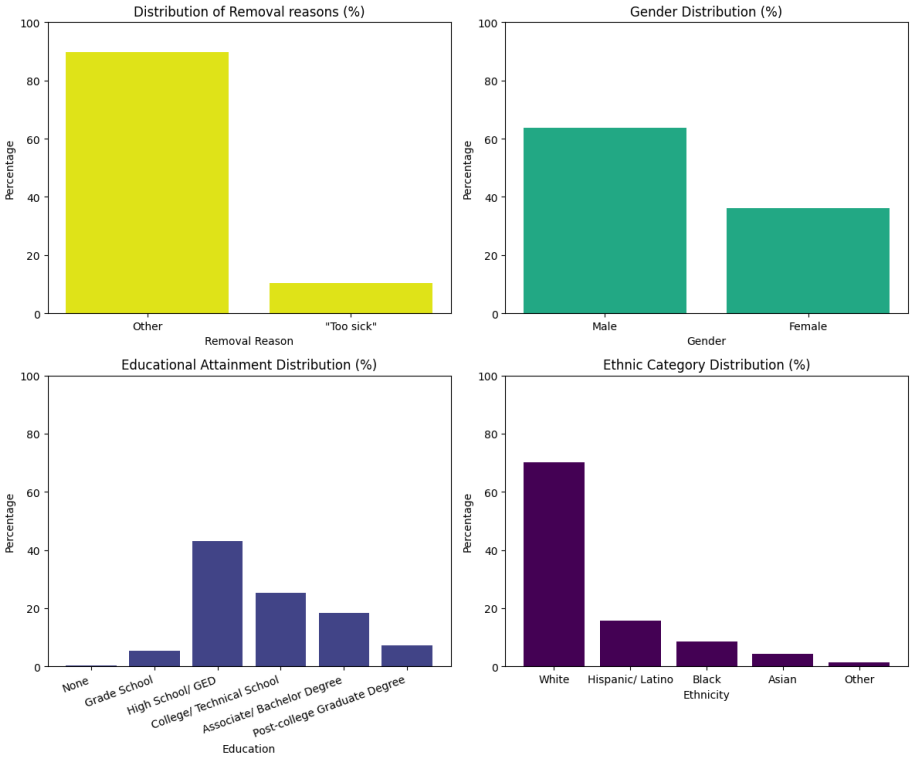

Figure 1: Demographics

3 Results

3.1 Gender

3.2 Ethnicity

3.3 Intersectionality

3.4 Education

With education and health being intrinsically linked, as adults with higher educational attainment live healthier and longer lives in comparison to their less educated peers [2], it is important to investigate where these disparities arise. Recognising and understanding these inconsistencies is essential for addressing inequities in healthcare delivery.

To explore the impact of educational attainment on the likelihood of liver transplant waiting list removals, we calculated and compared the removal rates across various education levels. The removal rate for each education category is determined by the proportion of individuals within that educational category who are removed from the transplant list due to being 'too sick'. To provide a relative measure of risk, we computed the removal ratio for each education level. This ratio compares the removal rate for each group to the rate of those with a High School diploma or GED which serves as a reference group due to containing the largest number of individuals. This ratio highlights disparities by showing how the likelihood of removal changes with varying levels of educational attainment.

The table below highlights the rates of waitlist removals for being too sick based on education level, along with the removal ratio. These metrics call attention to the impact of educational attainment on healthcare access and the need for targeted interventions to bridge these gaps.

Table 1: Education Distribution of Removals from the Liver Transplant Waitlist

Education Level	Removal Rate	Removal Ratio
None	0.164	1.513
Grade school	0.140	1.296
High school or GED	0.108	1.000
College/ technical school	0.098	0.907
Associate/ Bachelors degree	0.087	0.807
Post-college graduate degree	0.086	0.795

The results reveal substantial disparities in the rates of removal for being classified as 'too sick' across varying education levels. Individuals with the no formal education have a removal rate of 16.4%, significantly exceeding the baseline rate (High school level) of 10.8%. The comparison ratio for this group is 1.513, indicating individuals in this category are 51.3% more likely to be delisted compared to their counterparts with High School diplomas.

In contrast, individuals with higher levels of education, such as those with Associate or Bachelors degrees and Post-graduate degrees, demonstrate lower delisting rates of 8.7% and 8.6%, respectively. Specifically, the comparison ratio for those with a Post-college graduate degree is 0.795, indicating a 20.5% lower likelihood of being removed from the transplant list relative to the baseline group. These results suggest that individuals with lower education levels are disproportionately more likely to experience unfavorable outcomes, thereby highlighting a significant educational disparity within the delisting process.

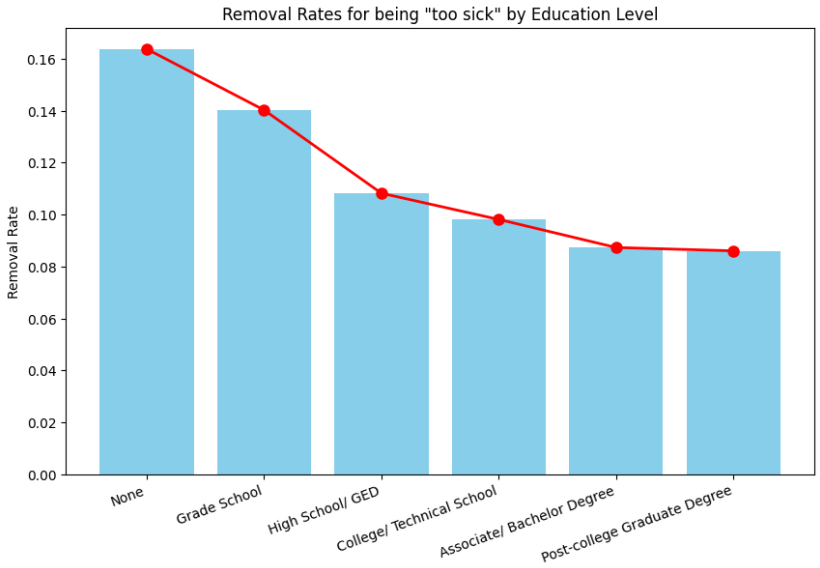

Figure 2: Comparison of rates of removal by Education level

Figure ... depicts removal rates from the transplant waiting list across different education levels. The bar plot shows a clear gradient, with individuals holding lower or no educational qualifications, facing higher removal rates (16.4%) compared to those with higher education levels, like 'Post-college Graduate Degree,' who have a lower rate of approximately 8.6%. The line connecting the bar tops highlight a decreasing trend in removal rates as education levels increase. This trend reveals significant educational disparities, suggesting that individuals with less education are disproportionately more likely to be removed from the transplant waiting list, indicating potential inequities in healthcare access and outcomes.

This disparity cannot be attributed to levels of sickness or age as seen by Figure ... and .... which show that there are no substantial differences in MELD scores or age across education levels.

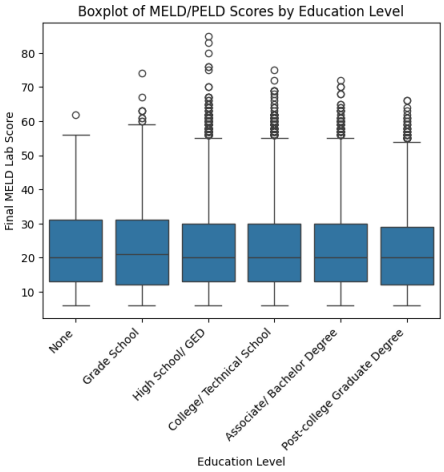

Figure 3: Comparison of MELD scores by Education level

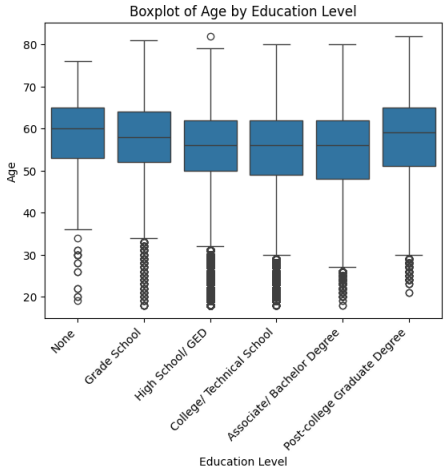

Figure 4: Comparison of Ages by Education level

To further support this observation, Pearson's correlation coefficients were calculated for the relationships between education level and MELD score, as well as for education level and age. The correlation coefficient for education level and MELD score was r $= -0.0143$, with a $p-$value $p < 0.0001$, and the correlation coefficient for education level and age was r $= -0.0050$ with a $p-$value of $p < 0.05$. These results indicate negligible correlations, suggesting suggesting that the observed disparity in removal rates is not due to variations in medical need or age among different education levels. Instead, the inequity likely reflects other factors, such as systemic inequities or implicit bias.

4 Discussion

5 References

References

[1] Yanik J. Bababekov et al. "Do Social Determinants Define "Too Sick" to Transplant in Patients With End-stage Liver Disease?" In: *Transplantation* 104.2 (Feb. 2020), p. 280. ISSN: 0041-1337. DOI: 10.1097/TP.0000000000002858. URL: https://journals.lww.com/transplantjournal/fulltext/2020/02000/do_social_determinants_define__too_sick__to.15.aspx (visited on 08/30/2024).

[2] Anna Zajacova and Elizabeth M. Lawrence. "The Relationship between Education and Health: Reducing Disparities through a Contextual Approach". In: *Annual review of public health* 39 (Apr. 1, 2018), pp. 273–289. ISSN: 0163-7525. DOI: 10.1146/annurev-publhealth-031816-044628. pmid: 29328865. URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5880718/ (visited on 08/30/2024).