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Identifying Determinants of Survival Disparities in Multiple Myeloma Patients using Electronic Health Record Data

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Multiple Myeloma Overview

- Multiple Myeloma (MM) is a clonal plasma cell neoplasm characterized by the expansion of plasma cells in the bone marrow and specific biomarker derangement.
- MM is the 14th most common cancer in the U.S.
- In 2022, over 34,000 new cases and over 12,000 deaths from MM are projected in the U.S.
- Median age of diagnosis is 69 years old, and 5-year relative survival rate is 57.9% (78.5% for localized stage).

Study Objective

- Objective: Analyze sociodemographic, economic, and genetic characteristics of long-term and short-term survival in MM patients.
- Existing studies have shown higher incidence and mortality rates among Black patients compared to White patients.
- Building upon previous success in survival analysis (e.g., lung cancer), this study aims to analyze MM survival using electronic health record (EHR) data from a New York City hospital.

Dataset

- Generated from EHR at the Mount Sinai Health System in New York City that included a few cancer types
- Identified patients who were diagnosed with MM and extracted their genetic variant information
- Time period: Jan 2011 – Nov 2020
- Two subsets of patients:
  - Short Term Survival: Patients deceased within 5 years or less
  - Long Term Survival: Patients survived over 5 years after cancer dx

Study Design

- Logistic Regression:
  - Investigate the effect of demographic, economic, and cancer factors on patients' duration of survival after cancer diagnosis
  - The independent variables were age group, sex, race, income level and cancer stage
  - The dependent variable was defined as whether a patient survived a short time
    - Short Term Survival: 1
    - Long Term Survival: 0

Study Design

- Genetic Testing
  - Around 30% of patients had undergone genetic testing
  - Patients were grouped by race, and the distribution of genetic alterations was calculated for each racial group
- Software
  - Python 3.7.3

Results

- There were 2,111 patients in the analytic dataset
  - Short Term Survival (5 year or less): 472 patients (22%)
  - Long Term Survival (more than 5 years): 1639 patients (78%)

Logistic Regression Result

	OR	2.50%	97.50%	P-Value
Age_50 or younger	1			
Age_51 - 64	1.601	1.079	2.376	0.019*
Age_65 or older	2.705	1.827	4.006	0*
Gender: Female	1			
Gender: Male	1.199	0.968	1.484	0.097
Race: White	1			
Race: African American	1.392	1.049	1.848	0.022*
Race:_Others	0.729	0.563	0.943	0.016*

Logistic Regression Result

	OR	2.50%	97.50%	P-Value
Stage_I	1			
Stage_II	1.036	0.459	2.339	0.932
Stage_III	2.351	1.166	4.739	0.017*
Stage_unknown	3.441	2.087	5.672	0*
Income_level_medium	1			
Income_level_low	1.265	0.961	1.665	0.094
Income_level_high	1.077	0.817	1.42	0.601

Genetic Testing

- Aim at assessing the difference in genetic mutation distribution among Black and White patients
- 665 patients underwent genetic testing
  - 123 patients (18%) were African American or Black, 358 patients (54%) were White, and 184 patients (28%) were other races
- 220 unique genes and 909 variants were included in the dataset
- Identified the top 6 most frequent gene mutations

Distribution of Gene Mutations

	Black (n=123)		White (n=358)		P value
Gene	Patients (n)	percent	patients (n)	percent	
IGH	34	0.276	101	0.282	>0.05
TP53	24	0.195	67	0.187	>0.05
NRAS	21	0.171	51	0.142	>0.05
KRAS	19	0.154	65	0.182	>0.05
DNMT3A	18	0.146	48	0.134	>0.05
BRAF	11	0.089	27	0.075	>0.05

Distribution of Biomarker Finding

	Black		White	
Biomarker Findings	patients (n)	percent	patients (n)	percent
Tumor Mutation Burden				
Cannot Be Determined	28	34.1%	47	24.9%
Low (2 Muts/Mb or less)	38	46.3%	98	51.9%
not-low	16	19.5%	44	23.3%
Microsatellite Status				
Cannot Be Determined	25	36.2%	37	24.8%
MS-Stable	44	63.8%	112	75.2%

Discussion

- Older adults, African American patients, and those diagnosed at stage III had shorter survival times after their cancer diagnosis.
- Gene mutation differences between Black and White racial groups were not significant.
- While inconclusive, there was a higher proportion of stable microsatellite status observed in White patients compared to Black patients.

Limitations

- Study Limitations:
  - Limited sample size for minority groups undergoing genetic testing
  - Lack of evaluation of treatment options received by patients
- Future Directions:
  - Expand studies to include more racial and ethnic groups
  - Include a broader range of social determinants of health
  - Assess treatment options and their impact on survival outcomes
  - Increase sample size for minority groups to enable subgroup analyses

- Thank you!
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