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Who We Are

Brazilian Ministry of Health
- Oswaldo Cruz Foundation
- Polytechnic Health School Joaquim Venâncio
- Work Laboratory and Health Care Professional Education
- Brazilian Health Technicians Observatory

GOAL: Produce and share knowledge about the technical health workers, towards health workforce development in Brazil.
The Research Project

Construction of occupational categories that represents the general Brazilian Health sector; identification of the technical workforce – analysing the qualifications, trends and characteristics of these workers.

However...

What can we infer about technician workers in the Brazilian Health Sector?
The first (and macro) approach to study these workers was done considering the AMS (Medical-Sanitary Assistance)

- Survey produced by IBGE (Brazilian Institute of Geography and Statistics).
- Investigates all the health institutions existing in the country which provide individual or collective health assistance services.
The Research Project

The AMS exploratory analyses brings some interesting information:

- Health sector jobs requiring high school are concentrated in Brazil southeast region,
- Health sector jobs requiring elementary school are concentrated in Brazil northeast region.

A natural extension is studying the health workers, instead of establishments.
**Data Base**

**PNAD**: National Household Sample Survey

- Produced by IBGE (Brazilian Institute of Geography and Statistics).

- Represents a valuable instrument to the evaluation of the socio-economic and demographic reality in the country.

- Captures general attributes (self-declared) of the Brazilian population like
  - Occupation
  - Schooling
  - Labor details
  - …
The Health Sector

- Brazilian Health Occupations
  - Administrative
  - Medical / Hospital Equipment
  - Support
  - Specific Health Services
  - Other
Some Brazilian Health Workforce Idiosyncrasies

Gender Distribution (%)

- Administrative Occupations: 23.0% Male, 77.0% Female
- Medical/Hospital Equipment Occupations: 58.9% Male, 41.1% Female
- Support Occupations: 43.1% Male, 56.9% Female
- Especific Health Occupations: 25.1% Male, 74.9% Female
- Other Occupations: 38.6% Male, 61.4% Female

Job Sector Distribution (%)

- Administrative Occupations: 74.9% Private, 25.1% Public
- Medical/Hospital Equipment Occupations: 73.3% Private, 26.7% Public
- Support Occupations: 59.4% Private, 40.6% Public
- Especific Health Occupations: 44.6% Private, 55.4% Public
- Other Occupations: 70.9% Private, 29.1% Public
Some Brazilian Health Workforce Idiosyncrasies

Worked Hours per Week (%)

- Administrative Occupations
- Medical/Hospital Equipment Occupations
- Support Occupations
- Especific Health Occupations
- Other Occupations

<table>
<thead>
<tr>
<th>Hours</th>
<th>Administrative</th>
<th>Medical/Hospital</th>
<th>Support</th>
<th>Especific Health</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 14 hours</td>
<td>0.5</td>
<td>1.1</td>
<td>1.1</td>
<td>2.8</td>
<td>2.1</td>
</tr>
<tr>
<td>15 to 39 hours</td>
<td>22.0</td>
<td>21.9</td>
<td>29.5</td>
<td>34.8</td>
<td>17.9</td>
</tr>
<tr>
<td>40 to 44 hours</td>
<td>20.4</td>
<td>20.4</td>
<td>46.7</td>
<td>46.7</td>
<td>43.8</td>
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<tr>
<td>45 to 48 hours</td>
<td>11.7</td>
<td>16.1</td>
<td>20.4</td>
<td>21.2</td>
<td>10.5</td>
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<tr>
<td>More than 49 hours</td>
<td>10.4</td>
<td>14.5</td>
<td>13.4</td>
<td>13.0</td>
<td>13.0</td>
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</table>
The Problem

- The variable "occupation" was constructed based in the Brazilian Occupations Classification (CBO), a Brazilian adaptation to the International Standard Classification of Occupations (ISCO).

- Some PNAD occupations in health:
  - Nursing professionals
  - Nursing technicians
  - Chemists
  - Chemical Technicians
  - Biologists and related (?)
The Objective of this Study

Identify the technical health workers

1. Grouping occupations by similarities
2. Selecting pairs of occupations where the technicians and professionals are not fuzzy.
3. Modelling (statistically) the characteristics that delimit the workers as technicians and professionals.
– We constructed occupation clusters for the “Specific Health Occupations” group, and selected the pairs:

- Chemist and related technicians
- Pharmaceutic and related technicians
- Nursing and related technicians
- Physiotherapy and related technicians
- Odontologist and related technicians
### Pairs’ Descriptive Statistics

<table>
<thead>
<tr>
<th></th>
<th>Professionals</th>
<th>Technicians</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>179</td>
<td>181</td>
</tr>
<tr>
<td>Female</td>
<td>445</td>
<td>1023</td>
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<tr>
<td><strong>Schooling</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary School</td>
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<td>42</td>
</tr>
<tr>
<td>High School</td>
<td>20</td>
<td>832</td>
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<tr>
<td>Graduate</td>
<td>509</td>
<td>140</td>
</tr>
<tr>
<td>Master or Doctor</td>
<td>28</td>
<td>1</td>
</tr>
<tr>
<td><strong>Job Sector</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>175</td>
<td>540</td>
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<tr>
<td>Public</td>
<td>169</td>
<td>582</td>
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<tr>
<td><strong>Worked Hours Per Week</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 14 hours</td>
<td>21</td>
<td>20</td>
</tr>
<tr>
<td>15 to 39 hours</td>
<td>181</td>
<td>390</td>
</tr>
<tr>
<td>40 to 44 hours</td>
<td>224</td>
<td>421</td>
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<tr>
<td>45 to 48 hours</td>
<td>60</td>
<td>163</td>
</tr>
<tr>
<td>49 hours or more</td>
<td>137</td>
<td>210</td>
</tr>
</tbody>
</table>

![Age Distribution Graph](chart1.png)

![Income Distribution Graph](chart2.png)
In order to model/predict the relationship between workers' characteristics to their actual work position, we use the Bernoulli model,

The Bernoulli probability function is expressed as:

\[
P(Y = y) = \pi^y (1 - \pi)^{1-y}; \quad y = 0,1
\]

where \( \pi \) is the probability of success, \( y \) corresponds to success or failure.
The logit function was chosen by the AIC and BIC criteria.

The variables age, gender and worked hours per week were not statistically significant, and do not belong to the final model.

| Coefficients                     | Estimate | Std. Error | z value | Pr(|z|)  |
|----------------------------------|----------|------------|---------|---------|
| Intercept                        | 2.0349   | 0.5409     | 3.7620  | 0.0002  |
| Schooling: Elementary School     | -        | -          | -       | -       |
| Schooling: High School           | 1.8733   | 0.5894     | 3.1780  | 0.0015  |
| Schooling: Graduate              | -2.5597  | 0.5550     | -4.6120 | 0.0000  |
| Schooling: Master or Doctor      | -4.3159  | 1.1795     | -3.6590 | 0.0003  |
| Income                           | -0.0004  | 0.0001     | -3.2010 | 0.0014  |
| Job Sector: Private              | -        | -          | -       | -       |
| Job Sector: Public               | 0.6502   | 0.2054     | 3.1660  | 0.0015  |

In gray, the basal category
Goodness-of-Fit

Hosmer and Lemeshow Test

\[ G_{HL}^2 = \sum_{i=1}^{10} \frac{(O_i - E_i)^2}{E_i (1 - E_i / n_i)} \sim \chi^2_8 \]

Where:

- \( n_i \) is the number of observations in the \( i^{th} \) group
- \( O_i \) is the observed number of cases in the \( i^{th} \) group
- \( E_i \) is the expected number of cases in the \( i^{th} \) group

<table>
<thead>
<tr>
<th>Professionals</th>
<th>Technicians</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed</td>
<td>Expected</td>
<td></td>
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<tr>
<td><strong>1</strong></td>
<td>102</td>
<td>104.25</td>
</tr>
<tr>
<td><strong>2</strong></td>
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<td>71</td>
<td>74.71</td>
</tr>
<tr>
<td><strong>4</strong></td>
<td>17</td>
<td>21.46</td>
</tr>
<tr>
<td><strong>5</strong></td>
<td>3</td>
<td>3.07</td>
</tr>
<tr>
<td><strong>6</strong></td>
<td>3</td>
<td>3.04</td>
</tr>
<tr>
<td><strong>7</strong></td>
<td>2</td>
<td>2.82</td>
</tr>
<tr>
<td><strong>8</strong></td>
<td>5</td>
<td>2.12</td>
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<td><strong>9</strong></td>
<td>1</td>
<td>1.65</td>
</tr>
<tr>
<td><strong>10</strong></td>
<td>2</td>
<td>1.41</td>
</tr>
</tbody>
</table>

P-value: 31.78%
Residual Analysis

Studentized Residuals

Frequency

Deviance

-3 -2 -1 0 1 2 3

-3 -2 -1 0 1 2 3

Normal Q-Q Plot

Standard Normal Quantile

-3 -2 -1 0 1 2 3

-3 -2 -1 0 1 2 3
In order to evaluate the predictive power, we calculate the confusion matrix, and:

- **Total rate of "correct" classification**: 88.3%
- Percentage of professionals well classified: 93.1%
- Proportion of technicians well classified: 86.8%.
Reading the Model

Schooling
- Workers with high school as higher level have 6 times more chances to be technicians than those who have just elementary school
- University graduates have 13 times more chances to be a professional
- Master/doctoral graduates are 75 times more likely to be professionals than those with elementary school.

Job Sector
- Workers in public institutions have approximately 2 times more chances to occupy a technical position.
Results and Conclusions

- **Imbalances:**
  - 14% of health workers in technicians occupations are university graduates: bachelors or masters/doctorate;
  - 66% of the workers in technicians occupations work more than 40 hours per week.

- **Study Benefits:**
  - A right work insertion based on schooling has a larger impact in the public health sector.
  - The multiple work links diminishes the income impact (estimated coefficient: -0.0004);
  - The model allowed us to *identify* the large numbers of technicians with university degree, masters/doctorate
  - Estimating the Brazilian health technical workforce stock.
Further Work

- Extend the cluster analysis to the other four identified health occupations groups (managers, medical/hospital equipment, support and others),

- Sophisticate the model to cover all health occupations groups.

- Explore data availability from all years of the survey, towards understanding trends in the qualification and work insertion of this workforce.
Thanks!!!

Polytechnic Health School Joaquim Venâncio:
www.epsjv.fiocruz.br

International Network of Health Technicians Education:
www.rets.epsjv.fiocruz.br

Inequalities in Technical Brazilian Health Workforce

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