Cognitive Health in Ageing

A ranked view on the impact of lifestyle factors on cognitive functioning

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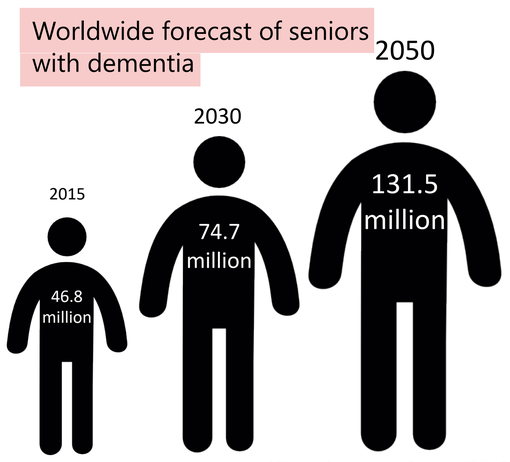
BACKGROUND

The number of older adults is increasing steadily through the developed world. It is predicted that in Canada, the number of seniors will reach between **9.9 and 10.9 million** people by the year 2030 (World Health Organization – Ageing Report (2015)).

Older individuals face many challenges associated with decreases in physical and mental skills. These include an increased risk of developing **dementia**, a disease that affects several domains of cognitive ability (Dixon & Lars-Goran Nilsson (2004)).

Despite consensus in the literature that long-term intra-individual changes include unpredictable variability in cognition over time (Hertzog et al., 2009), most results reported thus far are based on **linear methods** (Krakovska, Christie, Sixsmith, Ester, & Moreno, 2019).

These methods may not fully capture time-dependent cognitive changes and as such the **cognitive trajectories** may be misinterpreted or not fully understood.



PURPOSE

Understand the relationship between different lifestyle factors and cognitive health, using a non-linear approach.

HYPOTHESIS

Engagement in daily activities leads to increased scores in memory skills (i.e., word recall).

METHODS

Database

To test our hypothesis, the Health and Retirement Study database was used due to its high number of participants and richness of measured lifestyle factors.

To take advantage of the longitudinal features of the database, the years 2016 and 2012 were included.

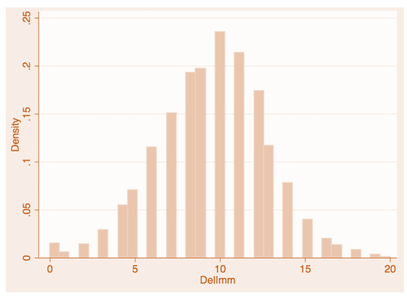
The total number of participants included in the study was 3,507.

Independent Variables

Overall, we included 30 independent variables in the analysis, related to income, health, psychosocial and lifestyle factors, and demographics.

Cognitive Variables

BOOK
CHILD
GOLD
HOTEL
KING
MARKET
PAPER
RIVER
SKIN
TREE



The categories of the cognition variable were divided into groups of 20%.

Why?

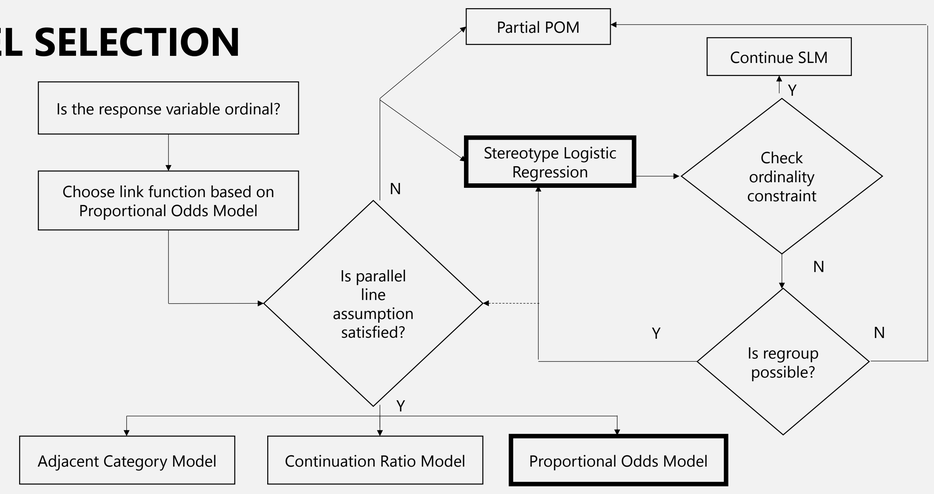
A. Removes the researcher's biases
B. Homogenizes the variability of the distribution

Categorization

Number Good - Delayed	Frequency	Percentage	Cumulative	
0	192	5.47	5.47	1
1	124	3.54	9.01	
2	244	6.96	15.97	2
3	563	16.05	32.02	3
4	729	20.79	52.81	4
5	798	22.75	75.56	
6	529	15.08	90.65	5
7	220	6.27	96.92	
8	77	2.20	99.12	
9	25	0.71	99.83	
10	6	0.17	100.00	
Total	**3,507**	**100.00**		

The cognitive health categories were created without splitting the original groups, with each category containing the closest approximation to the 20% section in the cumulative function

MODEL SELECTION



Dotted line indicates optional approach; Y-Yes; N-No

Kulothungan, et al. (2018)

Ordinal Logistic Regression

This model takes advantage of the ordinality of the dependent variable by comparing the probability of a response less than or equal to a given category (j = 1, 2, ..., k -1) to the probability of a response greater than this category

$$\boldsymbol{Y_i^*} = \beta_1 X_1 + \beta_2 X_2 + \ \ldots + \beta_k X_k + \varepsilon_i$$

These unobservable latent variables can be related to the observed variables Y_i $(i = 1, \ldots, 5)$ as follows,

$$\begin{array}{lll} Y_i = 1 & if & -\infty < Y_i^* < \tau_1 \\ \vdots & & \vdots \\ Y_i = 5 & if & \tau_4 < Y_i^* < \infty \end{array}$$

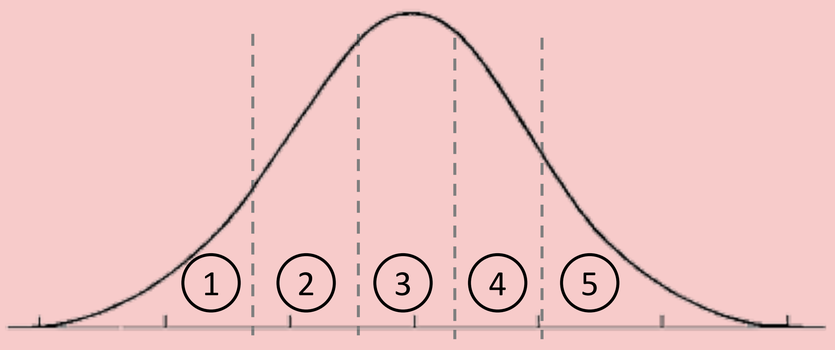
Harrell, F. E. (2015)

RESULTS

Out of the 30 initial independent variables, 11 showed significance in our results, and are included in the equation below.

Presented below is the latent variable representation for the ordered response model. This threshold mechanism divides the latent variable in 5 intervals by using 4 threshold parameters. According to this method, higher values of the latent variable lead to higher values of the ordered dependent variable.

$$\begin{aligned} \widehat{\boldsymbol{Y}}_{\boldsymbol{i}}^* = \ & -0.36 * HousingProblems + 0.35 * Read + 0.55 * WordGames + 0.63 * UseComputer \\ & + 0.61 * Sew/Knit + (-0.38) * Walk20min + 0.65 * MildAct + (-0.10) * Age \\ & + 0.19 * YearsEducation + (-0.52) * Smokes + 0.39 * Drinks \end{aligned}$$



$\boldsymbol{\tau_1 = -3.52 \quad \tau_2 = -2.48 \quad \tau_3 = -1.53 \quad \tau_4 = -0.76}$

The probability of an individual belonging to a specific category will be calculated using the difference between the threshold values ($\boldsymbol{\tau_i}$) and the latent variable result. This value will then be computed from the logistic cumulative distribution function.

DISCUSSION AND CONCLUSION

- Depending on the set of lifestyle factors a person is involved in, they will belong to a specific cognitive category
- "Use Computer" and "Mild Activities" were the most relevant factors on increasing cognitive outcomes
- "Read", "Word Games", "Use Computer" and "Sew/Knit" have a positive effect on the cognitive outcome
- "Walk 20min" showed a negative relation with the cognition variable
- The continuous variable "Age" impacts the negativity of the threshold values ($\boldsymbol{\tau_i}$)

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