Electrophysiological Consequences of Binge Drinking in Adolescents and Young Adults: A systematic Review

Antunes, N.[1], Rodrigues, R.[1], Crego, A.[1], Carbia, C.[2], Sousa, S.[1], Sampaio, A.[1], & López-Caneda, E.[1]

[1]Psychological Neuroscience Lab, Research Center in Psychology (CIPsi), School of Psychology, University of Minho, Campus Gualtar, 4710-057 Braga, Portugal

[2]APC Microbiome Ireland, Biosciences Building, University College Cork, College Rd, T12 YT20, Cork, Ireland

More information: natalia.dalmeidas@gmail.com

BACKGROUND

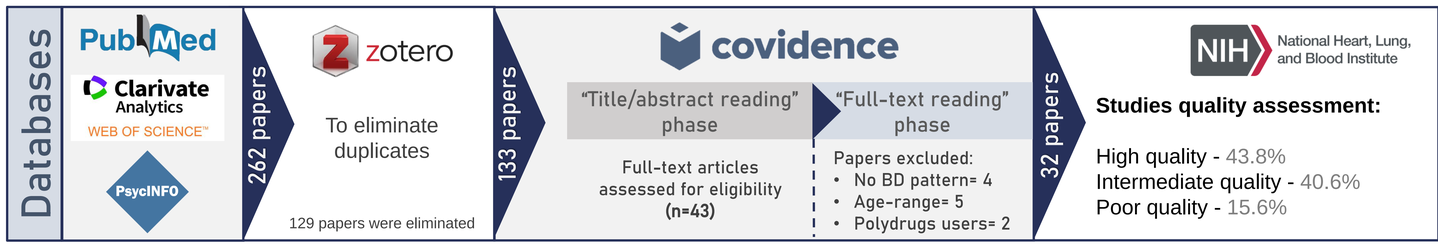
Binge Drinking (BD), a specific form of alcohol misuse, has received special attention in the last decade, mainly due to its high prevalence among youngsters. This pattern is characterized by alternations between excessive alcohol drinking episodes (i.e., the intake of four (or more) drinks in two hours for women and five (or more) drinks in the same period for men, until the blood alcohol concentration (BAC) reaches 0.08 g/dl or) and periods of low consumption or abstinence. BD has been associated with impaired cognitive performance, neurofunctional abnormalities and alterations in gray and white matter[1,2]. The electroencephalography (EEG) has been a method commonly used to assess the neurofunctional consequences of BD, whether by event-related potentials (ERPs), event-related oscillations (EROs) or during resting-state EEG.

AIMS

- To systematically review the potential EEG abnormalities associated with the BD pattern in adolescents and young adults (12-30 years)
- To discuss the general strengths and limitations of the studies
- To recommend areas of interest for future research

METHOD

Prisma Guidelines



RESULTS

Figure 1. Number of studies conducted worldwilde.
Note. Orange: USA and Australia; Red: Europe (Spain with 10 studies and Belgium with 7 studies); Green: South Korea.

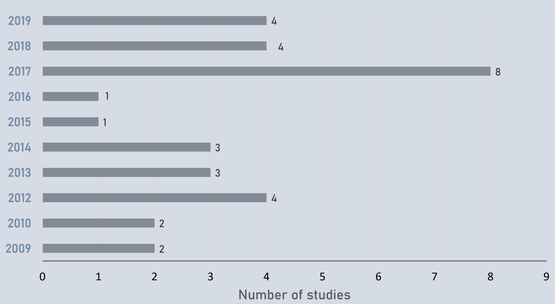


Figure 2. Number of studies conducted per year.

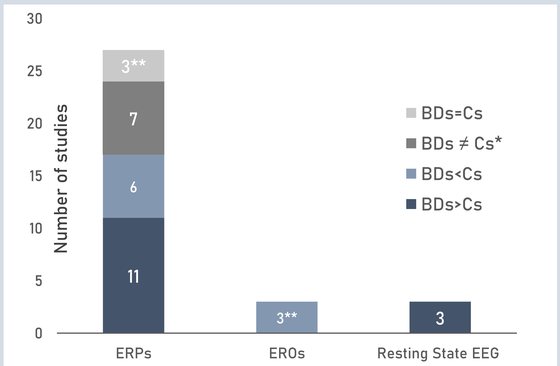


Figure 3. Number of studies, using the different methods of EEG analysis, that found increased (BDs>Cs), decreased (BDs<Cs), different (BDs ≠ Cs), and similar (BDs=Cs) brain activity in BDs when compared to Cs (control group or non/low drinkers).
Note. *Significant differences between conditions only in one group; **One study explored the neurofunctional consequences of BD trough ERPs and EROs

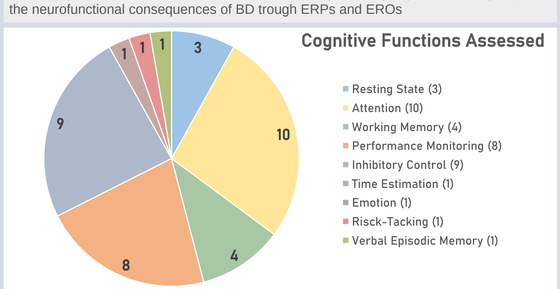


Figure 4. Number of studies assessing the each cognitive function

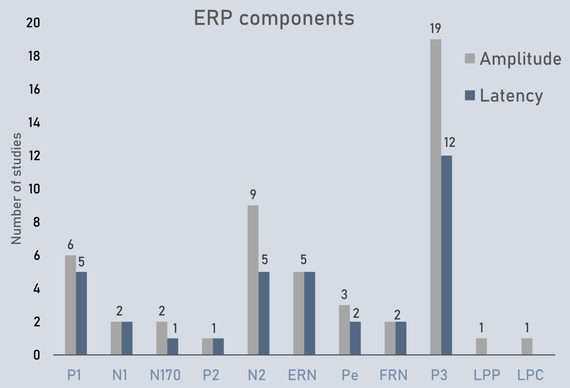


Figure 5. Number of studies exploring the amplitude and latency of each ERP component.

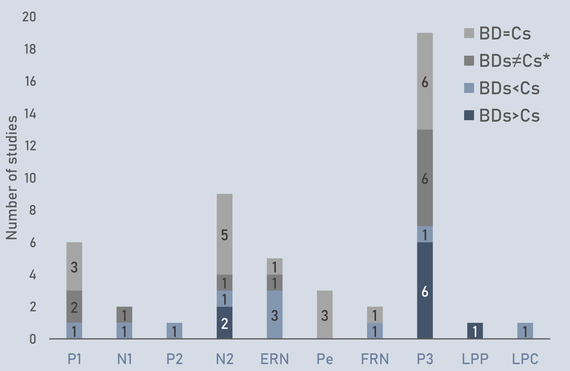


Figure 6. Number of studies, for each ERP component, that found increased (BDs>Cs), decreased (BDs<Cs), different (BDs ≠ Cs), and similar (BDs=Cs) amplitude in BDs when compared to Cs (control group or non/low drinkers).
Note. *Significant differences between conditions only in one group.

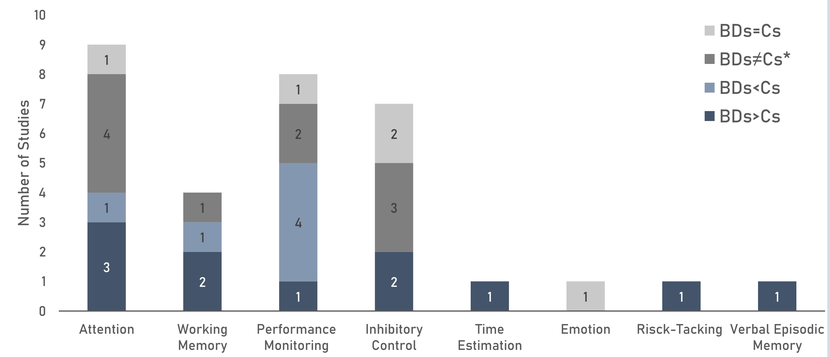


Figure 7. Number of ERP studies, for each cognitive function, that found increased (BDs>Cs), decreased (BDs<Cs), different (BDs ≠ Cs), and similar (BDs=Cs) electrophysiological activity (i.e., amplitude) in BDs when compared to Cs (control group or non/low drinkers). **Note.** *Significant differences between conditions only in one group.

Conclusion

Results **(31/32 studies; 96.9%)** indicated that young BDs exhibit **electrophysiological abnormalities**. However, they showed similar behavioral performance as non/low drinkers.

- **11 ERP studies (40.7%)** pointed to **augmented brain activity in BDs**, namely during tasks involving **attentional, WM and IC processes**, suggesting the recruitment of additional resources and highlighting the hypotheses of this pattern lead to **neurocompensatory mechanisms**.
- Similar to alcoholics, BDs show an **enhanced neural reactivity to alcoholic stimuli (4/27 ERP studies; 4.8%)** and exhibited **augmented brain activity at rest** (3/3 resting-state studies).

- **Females and males seem to be equally affected**; however, additional studies are required to verify this hypothesis.
- Future studies should be concerned with the need for third party replication of the studies here reviewed to clarify some inconclusive results.
- Longitudinal approaches are also required to understand the extent of the neural impairments caused by BD.

REFERENCES

[1]Lees, B., Mewton, L., Stapinski, L. A., Squeglia, L. M., Rae, C. D., & Teesson, M. (2019). Neurobiological and cognitive profile of young binge drinkers: a systematic review and meta-analysis. Neuropsychology review, 29, 357-385. https://doi.org/10.1007/s11065-019-09411-w

[2]Carbia, C., López-Caneda, E., Corral, M., & Cadaveira, F. (2018). A systematic review of neuropsychological studies involving young binge drinkers. Neuroscience & Biobehavioral Reviews, 90, 332-349. https://doi.org/10.1016/j.neubiorev.2018.04.013

ACKNOWLEDGEMENTS:
This study was conducted at the Psychology Research Centre (PSI/01662), School of Psychology, University of Minho, and supported by the Portuguese Foundation for Science and Technology and the Portuguese Ministry of Science, Technology and Higher Education (UID/PSI/01662/2019), through the national funds (PIDDAC). Moreover, this study was partially supported by the project POCI-01-0145-FEDER-028672, funded by the Portuguese Foundation for Science and Technology (FCT) and the European Regional Development Fund (FEDER).

Electrophysiological Consequences of Binge Drinking in Adolescents and Young Adults: A systematic Review

Antunes, N.[1], Rodrigues, R.[1], Crego, A.[1], Carbia, C.[2], Sousa, S.[1], Sampaio, A.[1], & López-Caneda, E.[1]

[1]Psychological Neuroscience Lab, Research Center in Psychology (CIPsi), School of Psychology, University of Minho, Campus Gualtar, 4710-057 Braga, Portugal

[2]APC Microbiome Ireland, Biosciences Building, University College Cork, College Rd, T12 YT20, Cork, Ireland

More information: natalia.dalmeidas@gmail.com

BACKGROUND

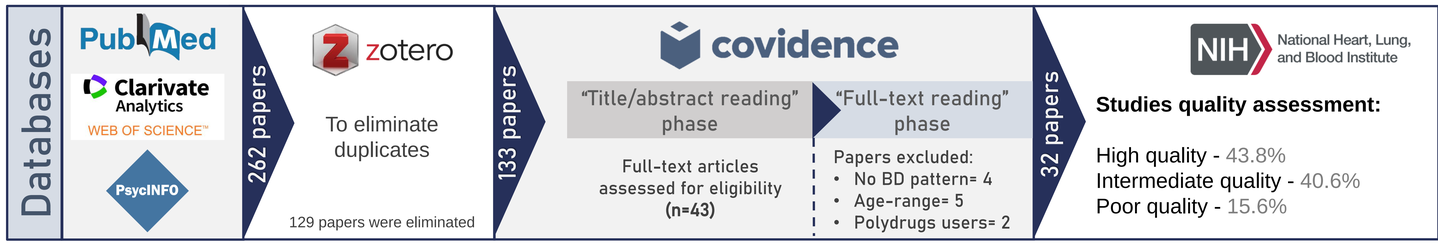
Binge Drinking (BD), a specific form of alcohol misuse, has received special attention in the last decade, mainly due to its high prevalence among youngsters. This pattern is characterized by alternations between excessive alcohol drinking episodes (i.e., the intake of four (or more) drinks in two hours for women and five (or more) drinks in the same period for men, until the blood alcohol concentration (BAC) reaches 0.08 g/dl or) and periods of low consumption or abstinence. BD has been associated with impaired cognitive performance, neurofunctional abnormalities and alterations in gray and white matter[1,2]. The electroencephalography (EEG) has been a method commonly used to assess the neurofunctional consequences of BD, whether by event-related potentials (ERPs), event-related oscillations (EROs) or during resting-state EEG.

AIMS

- To systematically review the potential EEG abnormalities associated with the BD pattern in adolescents and young adults (12-30 years)
- To discuss the general strengths and limitations of the studies
- To recommend areas of interest for future research

METHOD

Prisma Guidelines



RESULTS

Figure 1. Number of studies conducted worldwilde.
Note. Orange: USA and Australia; Red: Europe (Spain with 10 studies and Belgium with 7 studies); Green: South Korea.

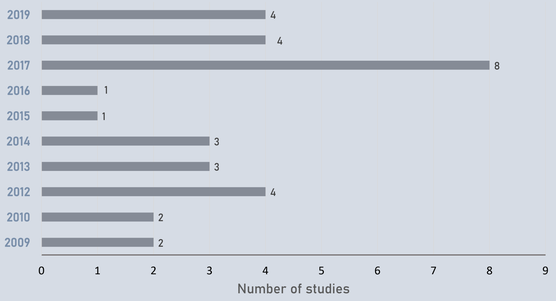


Figure 2. Number of studies conducted per year.

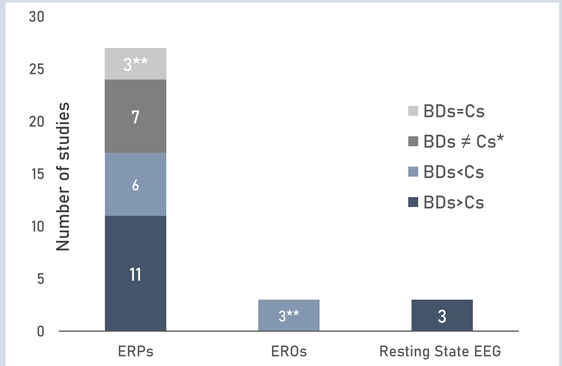


Figure 3. Number of studies, using the different methods of EEG analysis, that found increased (BDs>Cs), decreased (BDs<Cs), different (BDs ≠ Cs), and similar (BDs=Cs) brain activity in BDs when compared to Cs (control group or non/low drinkers).
Note. *Significant differences between conditions only in one group; **One study explored the neurofunctional consequences of BD trough ERPs and EROs

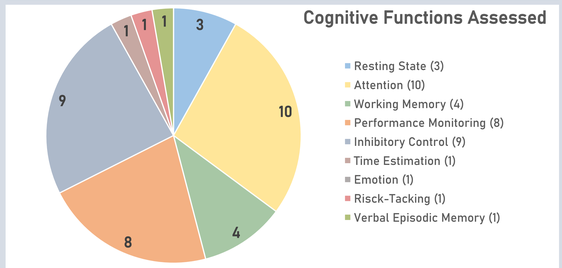


Figure 4. Number of studies assessing the each cognitive function

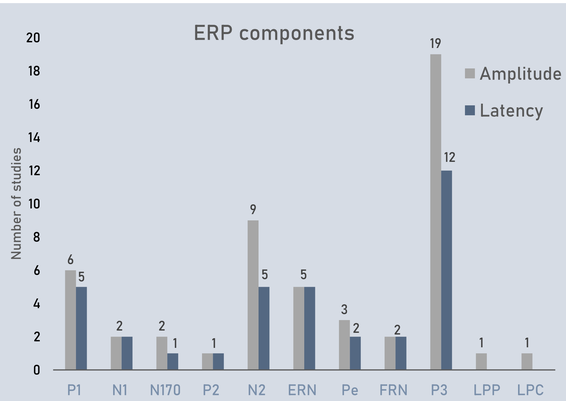


Figure 5. Number of studies exploring the amplitude and latency of each ERP component.

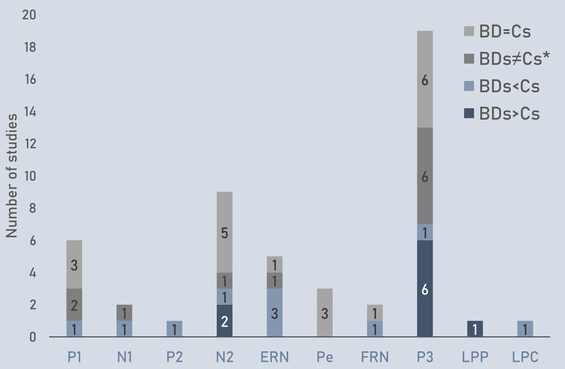


Figure 6. Number of studies, for each ERP component, that found increased (BDs>Cs), decreased (BDs<Cs), different (BDs ≠ Cs), and similar (BDs=Cs) amplitude in BDs when compared to Cs (control group or non/low drinkers).
Note. *Significant differences between conditions only in one group.

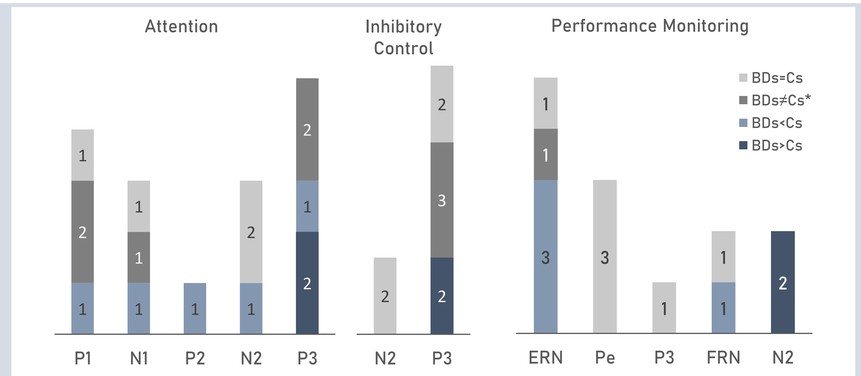


Figure 7. Number of studies exploring attention, inhibitory control and performance monitoring, for specific ERPs, that found increased (BDs>Cs), decreased (BDs<Cs), different (BDs ≠ Cs), and similar (BDs=Cs) amplitude in BDs when compared to Cs (control group or non/low drinkers). **Note.** *Significant differences between conditions only in one group.

Conclusion

Results **(31/32 studies; 96.9%)** indicated that young BDs exhibit **electrophysiological abnormalities**. However, they showed similar behavioral performance as non/low drinkers.

- **11 ERP studies (40.7%)** pointed to **augmented brain activity in BDs**, namely during tasks involving **attentional, WM and IC processes**, suggesting the recruitment of additional resources and highlighting the hypotheses of this pattern lead to **neurocompensatory mechanisms**.
- Similar to alcoholics, BDs show an **enhanced neural reactivity to alcoholic stimuli (4/27 ERP studies; 4.8%)** and exhibited **augmented brain activity at rest** (3/3 resting-state studies).
- **Females and males seem to be equally affected**; however, additional studies are required to verify this hypothesis.
- Future studies should be concerned with the need for third party replication of the studies here reviewed to clarify some inconclusive results.
- Longitudinal approaches are also required to understand the extent of the neural impairments caused by BD.

REFERENCES

[1]Lees, B., Mewton, L., Stapinski, L. A., Squeglia, L. M., Rae, C. D., & Teesson, M. (2019). Neurobiological and cognitive profile of young binge drinkers: a systematic review and meta-analysis. Neuropsychology review, 29, 357–385. https://doi.org/10.1007/s11065-019-09411-w

[2]Carbia, C., López-Caneda, E., Corral, M., & Cadaveira, F. (2018). A systematic review of neuropsychological studies involving young binge drinkers. Neuroscience & Biobehavioral Reviews, 90, 332–349. https://doi.org/10.1016/j.neubiorev.2018.04.013

ACKNOWLEDGEMENTS:
This study was conducted at the Psychology Research Centre (PSI/01662), School of Psychology, University of Minho, and supported by the Portuguese Foundation for Science and Technology and the Portuguese Ministry of Science, Technology and Higher Education (UID/PSI/01662/2019), through the national funds (PIDDAC). Moreover, this study was partially supported by the project POCI-01-0145-FEDER-028672, funded by the Portuguese Foundation for Science and Technology (FCT) and the European Regional Development Fund (FEDER).

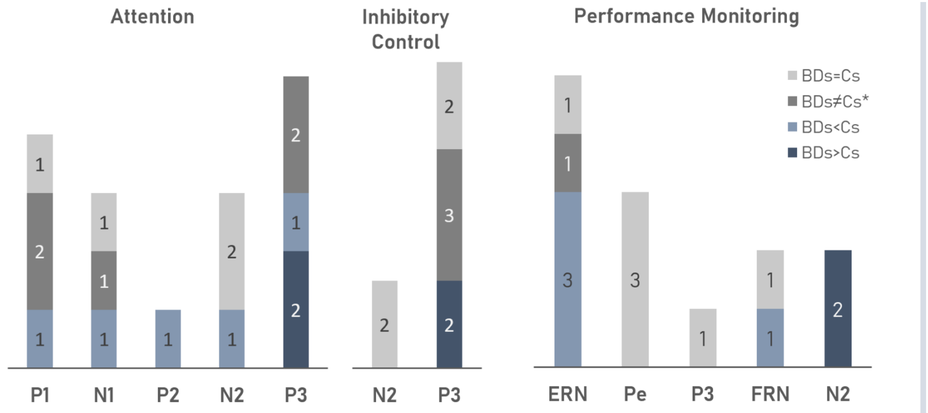


Figure 7. Number of studies exploring attention, inhibitory control and performance monitoring, for specific ERPs, that found increased (BDs>Cs), decreased (BDs<Cs), different (BDs ≠ Cs), and similar (BDs=Cs) amplitude in BDs when compared to Cs (control group or non/low drinkers). **Note.** *Significant differences between conditions only in one group.

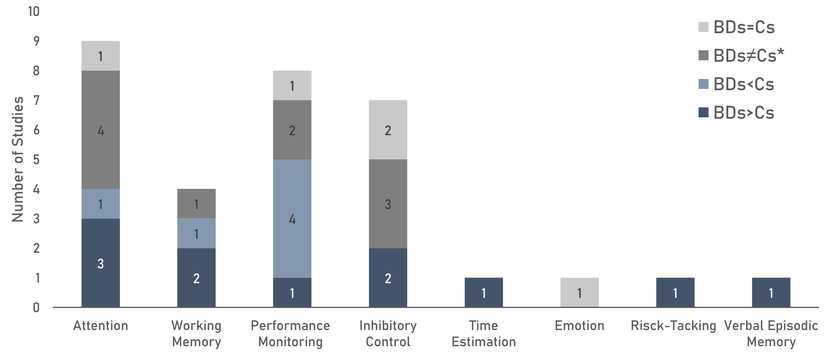


Figure 7. Number of ERP studies, for each cognitive function, that found increased (BDs>Cs), decreased (BDs<Cs), different (BDs ≠ Cs), and similar (BDs=Cs) electrophysiological activity (i.e., amplitude) in BDs when compared to Cs (control group or non/low drinkers). **Note.** *Significant differences between conditions only in one group.