MASTERS PROJECT DESCRIPTION

This project seeks to fill crucial gaps in understanding how developmental factors during adolescence contribute to schizophrenia. By leveraging the comprehensive ABCD dataset, we aim to uncover actionable insights to inform early intervention strategies and improve outcomes for at-risk individuals. Our findings will advance scientific knowledge of schizophrenia and provide practical solutions to mitigate its impact through targeted, cost-effective approaches.

Schizophrenia is a complex disorder with developmental roots that often become apparent during adolescence. Significant changes occur in a number of areas during adolescence, such as puberty, social and environmental variables, and the structure and function of the brain. Understanding its progression involves examining multiple dimensions, including psychosocial stressors, hormonal fluctuations, and brain development. Existing literature indicates that:

1. Psychosocial stressors: Social adversity and stress are significant predictors of psychosis risk. During adolescence, stress can disrupt brain development, potentially contributing to the onset of schizophrenia.

2. Hormonal influences: Hormonal changes during puberty, such as fluctuations in gonadal hormones (testosterone, estrogen) and stress hormones (cortisol), play a critical role in neurodevelopment. These hormonal shifts are associated with changes in gray matter (GM) and white matter (WM), which may influence psychosis risk.

The Adolescent Brain Cognitive Development (ABCD) study is an extensive longitudinal research project aimed at investigating brain development and child health. The dataset includes a rich array of neuroimaging, cognitive, and psychosocial data from a diverse group of adolescents. Key elements of the dataset encompass Neuroimaging Data, Cognitive Assessments, Psychosocial Surveys, and Hormonal Measures.

Our objective is to utilize the ABCD dataset to explore how increasing complexity in assessment methods affects the development of schizophrenia. We will focus on understanding various contributing factors and their interactions, while also assessing the cost-effectiveness of integrating each level of complexity into our evaluations.

With the longitudinal nature of this dataset, we intend to predict T3 questionnaire scores using data from T1 and T2. Our approach will involve training a model on T1 and T2 measurements to forecast outcomes at T3.

▪**Plan should contain:**

title of the thesis

description of research project (research question, aims, hypotheses)

We want to use the ABCD dataset to analyse the effect of gradually increasing complexity in assessing the development of schizophrenia.

background literature / theories

methods (design, data collection, planned analyses)

First we will look at questionnaire KSADS (Kiddie Schedule for Affective Disorders and Schizophrenia) this has shown good reliability in assessing the presence of the disorder and consists of a parent and child interview.

**Another known facet of schizophrenia development is Social Stressors and Cortical Development in Adolescents at Risk for Psychosis**

* **Psychosocial Stressors Variables:**
  + sai\_y\_ss\_stress: Social adversity and stress (youth-reported)
  + resil\_ssr\_social: Social resilience scale (self-reported)
  + resil\_ssr\_family: Family resilience scale (parent-reported)
  + prs\_adverse\_childhood: Cumulative adversity and childhood trauma (parent-reported)
* **Brain Imaging Variables:**
  + smri\_thick\_cort.dkt.parc: Cortical thickness (specific regions such as the prefrontal cortex)
  + dmri\_rsi\_FA: Fractional anisotropy (white matter integrity in prefrontal regions)
  + dmri\_rsi\_MD: Mean diffusivity (another white matter integrity measure)
* **Psychosis Risk Variables:**
  + cbcl\_scr\_dsm5\_psych: Psychosis risk (based on the CBCL DSM-5 scale)
  + peeraff\_ssa\_y: Peer affiliation and social anxiety (self-reported)

**Another known facet of schizophrenia development Role of Gonadal and Stress Hormones in Brain Development and Psychosis Risk in Adolescence**

* **Focus:** Investigate how fluctuations in both gonadal hormones (testosterone, estrogen) and stress hormones (cortisol) during puberty influence gray matter (GM) reduction and white matter (WM) increases, and how these structural changes might contribute to psychosis risk.
* **Hypothesis:** In adolescents with higher levels of testosterone, estradiol, or cortisol, there will be accelerated GM volume decrease and WM integrity increases, potentially increasing susceptibility to psychosis.
* **ABCD Data Utility:**
  + Hormonal measures, brain imaging (GM and WM volumes), and cognitive assessments.

planning and organization of the work (i.e. who does what and when)

ethical considerations and applications

economics / resources needed

timetable with deliverables / milestones (i.e. data collection, finishing data analyses, writing of article)

Here is the data-tree <https://data-dict.abcdstudy.org/>

It does not look like there are any measures that are specific enough to predict/classify diagnoses such as schizophrenia/bipolar disorder, but if you decide on something psychosis-related, these seem to be the relevant variables:

KSADS (Kiddie Schedule for Affective Disorders and Schizophrenia) variables located here;

**Core -> Mental health -> Broad psychopathology -> Youth -> KSADS**

 and a paper giving some background on the KSADS <https://www.sciencedirect.com/science/article/pii/S0890856709603944>

and another assessment tool/questionnaire, the Prodromal Psychosis scale here;

**Core -> Mental health -> Psychosis -> Youth -> Prodromal Psychosis scale**

<https://jamanetwork.com/journals/jamapsychiatry/fullarticle/2681644>

This seems like a relevant paper <https://www.sciencedirect.com/science/article/pii/S0006322320317388>

and I will also throw in these two as they give a great overview of the disorders;

<https://www.nature.com/articles/nrdp201567>

<https://www.nature.com/articles/nrdp20188>

Ina

Paper on longitudinal deep learning: <https://direct.mit.edu/imag/article/doi/10.1162/imag_a_00215/122599/Individualised-prediction-of-longitudinal-change>

Best regards,

Psychosis in ABCD: <https://wiki.abcdstudy.org/release-notes/non-imaging/mental-health.html#important-information-about-the-youth-delinquency-scale-policing-items>

The ABCD (Adolescent Brain Cognitive Development) dataset contains a wealth of data that can support research in a variety of fields. For each of your thesis ideas, the dataset offers numerous variables across biological, psychosocial, cognitive, and environmental domains. Here’s an outline of relevant variables available in the ABCD dataset for each research idea:

### 1. \*\*Impact of Cannabis Use on Adolescent Brain Development\*\*

\*\*Relevant Variables\*\*:

- \*\*Substance Use\*\*:

- `abcd\_ssphp01`: Cannabis use, age of first use, frequency of use, type of cannabis (THC/CBD).

- `abcd\_ssphp02`: Substance use history.

- `abcd\_ssphp03`: Frequency of cannabis use in the past year.

- \*\*Brain Imaging (MRI Data)\*\*:

- `abcd\_mri01`: Cortical thickness, gray matter volume, white matter integrity (DTI), and specific prefrontal cortex measurements.

- `abcd\_dti01`: Diffusion tensor imaging (DTI) data, myelination patterns.

- `abcd\_gqi01`: Brain connectivity data, focusing on thalamo-cortico-striatal networks.

- \*\*Cognitive Function\*\*:

- `abcd\_tbss01`: Cognitive performance tasks (e.g., working memory, executive function).

- \*\*Other Relevant Data\*\*:

- `abcd\_tlf01`: Mental health diagnoses, including psychosis risk indicators.

### 2. \*\*Role of Pubertal Hormones in Psychosis Risk\*\*

\*\*Relevant Variables\*\*:

- \*\*Hormone Data\*\*:

- `abcd\_ys01`: Pubertal Development Scale (PDS) to measure self-reported puberty stages (including changes in sex hormones like testosterone, estrogen).

- `abcd\_horm01`: Data on hormone levels, including salivary testosterone and estradiol.

- \*\*Brain Imaging\*\*:

- `abcd\_mri01`: Brain structure data (cortical thickness, gray matter volume, white matter) in regions associated with pubertal changes (e.g., prefrontal cortex).

- `abcd\_dti01`: White matter tract development during puberty.

- \*\*Psychosocial Factors\*\*:

- `abcd\_ys02`: Social and emotional factors, including psychosocial stress, school stress, peer relationships.

- \*\*Cognitive Function\*\*:

- `abcd\_tbss01`: Measures of higher-order cognitive functions such as working memory and cognitive control.

### 3. \*\*Interaction Between Social Stressors and Brain Development\*\*

\*\*Relevant Variables\*\*:

- \*\*Social Stressors\*\*:

- `abcd\_mentalhealth01`: Data on exposure to social stressors such as bullying, isolation, or academic pressures.

- `abcd\_screener`: Life events and stressor data.

- `abcd\_fes01`: Family environment and social support data.

- \*\*Psychosocial Measures\*\*:

- `abcd\_ses01`: Socioeconomic status, family conflict, school stress (e.g., academic pressure).

- `abcd\_ys02`: Adolescent social environment, including social relationships and perceived stress.

- \*\*Brain Imaging\*\*:

- `abcd\_mri01`: Brain structural imaging, focusing on regions such as the hippocampus and prefrontal cortex, which are sensitive to stress.

- `abcd\_dti01`: White matter integrity, which can be affected by chronic stress or isolation.

- \*\*Cortisol and Stress Response\*\*:

- `abcd\_horm01`: Salivary cortisol levels as a measure of stress reactivity.

### 4. \*\*Prophylactic Intervention and Biological Mechanisms\*\*

\*\*Relevant Variables\*\*:

- \*\*Intervention Data\*\*:

- `abcd\_ys03`: Intervention history (e.g., mental health support, school interventions).

- `abcd\_health01`: Healthcare and preventive service usage, including therapeutic interventions.

- \*\*Brain Imaging\*\*:

- `abcd\_mri01`: White and gray matter development before and after interventions.

- `abcd\_dti01`: Data on brain connectivity changes post-intervention.

- \*\*Psychosocial Factors\*\*:

- `abcd\_pds01`: Psychosocial support and family intervention measures, including school environment changes.

- \*\*Outcome Variables\*\*:

- `abcd\_tbss01`: Cognitive performance and symptom improvement post-intervention.

### 5. \*\*Impact of Cortisol and Stress Response on Dopaminergic Systems\*\*

\*\*Relevant Variables\*\*:

- \*\*Cortisol and Stress\*\*:

- `abcd\_horm01`: Salivary cortisol levels, measures of the hypothalamic-pituitary-adrenal (HPA) axis response.

- `abcd\_mentalhealth01`: Mental health data related to stress, including perceived stress scales.

- \*\*Brain Imaging\*\*:

- `abcd\_mri01`: Imaging data on the hippocampus, prefrontal cortex, and other areas linked to stress and cortisol response.

- `abcd\_dti01`: White matter integrity, which may be affected by chronic stress.

- \*\*Dopamine Function\*\*:

- `abcd\_mri01`: Functional connectivity in regions associated with dopamine regulation, such as thalamo-cortico-striatal circuits.

- \*\*Psychosocial Factors\*\*:

- `abcd\_fes01`: Family and environmental stressors, which can modulate stress reactivity.

### 6. \*\*Sex Differences in Psychosis Risk and Brain Development\*\*

\*\*Relevant Variables\*\*:

- \*\*Sex and Puberty Data\*\*:

- `abcd\_ys01`: Pubertal Development Scale to track sex-specific hormonal changes.

- `abcd\_ys03`: Sex-specific factors influencing development, such as puberty timing and sex hormones.

- \*\*Brain Imaging\*\*:

- `abcd\_mri01`: Data on sex differences in cortical thickness, gray matter volume, and brain development trajectories.

- `abcd\_dti01`: White matter integrity differences between male and female adolescents.

- \*\*Cognitive Performance\*\*:

- `abcd\_tbss01`: Measures of cognitive function, looking at sex differences in psychosis risk factors.

- \*\*Psychosocial Data\*\*:

- `abcd\_fes01`: Family environment, peer relationships, and psychosocial stress measures, analyzing sex differences in social stressors.

### 7. \*\*Longitudinal Changes in Brain Structure Linked to THC/CBD Use\*\*

\*\*Relevant Variables\*\*:

- \*\*Substance Use\*\*:

- `abcd\_ssphp01`: Detailed cannabis use, including THC vs. CBD use, age of initiation, frequency, and patterns of use.

- \*\*Brain Imaging\*\*:

- `abcd\_mri01`: Longitudinal data on cortical thickness, gray matter volume, and white matter integrity over time.

- `abcd\_dti01`: White matter changes over time, with a focus on cannabis users.

- \*\*Psychosocial Data\*\*:

- `abcd\_ssphp02`: Psychosocial background of cannabis users, including family environment and stress.

- \*\*Cognitive Outcomes\*\*:

- `abcd\_tbss01`: Longitudinal cognitive performance, focusing on working memory and executive function, which can be affected by long-term cannabis use.

### General Tools for Analysis:

- \*\*Demographics\*\* (`abcd\_demo01`): Sex, age, race, socioeconomic status.

- \*\*Neurocognitive Tests\*\*: Full battery of cognitive performance tasks (working memory, executive function, processing speed, etc.).

- \*\*Psychiatric Assessments\*\*: Parent and youth psychiatric assessments, including psychosis risk factors, general mental health symptoms (`abcd\_mh01`).

### Conclusion:

Each of your research ideas can be explored using specific sections of the ABCD dataset, particularly through brain imaging data, hormone levels, substance use variables, psychosocial factors, and cognitive assessments. The longitudinal nature of the data will be especially helpful for tracking developmental changes over time.