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Cognition and Educational Achievement in the Toronto Adolescent and Youth Cohort Study: Rationale, Methods, and Early Data

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ABSTRACT

BACKGROUND: Both cognition and educational achievement in youths are linked to psychosis risk. One major aim of the Toronto Adolescent and Youth (TAY) Cohort Study is to characterize how cognitive and educational achievement trajectories inform the course of psychosis spectrum symptoms (PSSs), functioning, and suicidality. Here, we describe the protocol for the cognitive and educational data and early baseline data.

METHODS: The cognitive assessment design is consistent with youth population cohort studies, including the NIH Toolbox, Rey Auditory Verbal Learning Test, Wechsler Matrix Reasoning Task, and Little Man Task. Participants complete an educational achievement questionnaire, and report cards are requested. Completion rates, descriptive data, and differences across PSS status are reported for the first participants ($N = 417$) ages 11 to 24 years, who were recruited between May 4, 2021, and February 2, 2023.

RESULTS: Nearly 84% of the sample completed cognitive testing, and 88.2% completed the educational questionnaire, whereas report cards were collected for only 40.3%. Modifications to workflows were implemented to improve data collection. Participants who met criteria for PSSs demonstrated lower performance than those who did not on numerous key cognitive indices ($p < .05$) and also had more academic/educational problems.

CONCLUSIONS: Following youths longitudinally enabled trajectory mapping and prediction based on cognitive and educational performance in relation to PSSs in treatment-seeking youths. Youths with PSSs had lower cognitive performance and worse educational outcomes than youths without PSSs. Results show the feasibility of collecting data on cognitive and educational outcomes in a cohort of youths seeking treatment related to mental illness and substance use.

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Psychotic disorders are among the world's leading causes of disability, accounting for the highest impairment among youths and emerging adults (1). Psychosis spectrum symptoms (PSSs) are also prominent during this developmental period, with up to 20% of the general population between 8 and 21 years reporting PSSs in the Philadelphia Neurodevelopmental Cohort (PNC) (2). Notably, youths who met criteria for a psychiatric disorder had a higher prevalence of PSSs than youths who did not, suggesting that these disorders may in and of themselves serve as risk factors for psychotic symptoms (2).

There is compelling evidence showing that impairments in cognition are related to psychopathology in general and psychosis in particular. Multiple prospective studies have shown that low IQ is related to the development and course of several psychiatric disorders, including schizophrenia (3,4). IQ was also recently shown in the Healthy Brain Network (HBN) youth cohort to modulate coupling between diverse dimensions of psychopathology (5).

Performance in specific cognitive domains, including attention, working memory, learning and memory, processing speed, reasoning, and problem solving, is impaired in individuals with schizophrenia compared with healthy control participants (6,7). Meta-analyses have implicated processing speed deficits as the cognitive domain with the most significant impairment in people with schizophrenia and related functional outcomes (6,8,9). It is also associated with conversion to schizophrenia in those at high risk (10). Extensive literature has also implicated executive function as a cognitive domain tied to functional recovery across major psychiatric disorders (11). Deficits in these domains are also present in

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youths who do not have a psychotic disorder, but do have PSSs, in the PNC study (12). Youths with PSSs in the PNC study were also observed to have delays in cognitive development trajectories, and this delay was related to symptom severity. The impact of psychotic-like experiences on cognitive performance was also recently observed in the Adolescent Brain Cognitive Development (ABCD) Study general population youth cohort (13).

In populations of treatment-seeking youths, social cognition, which comprises perception, processing, and interpretation of social information, is related to psychosis symptoms (14). Metacognition, which may enable those with cognitive deficits to overcome cognitive difficulties in their daily life, is impaired in at-risk samples and is predictive of functional outcomes. Both metacognition (15) and social cognition (16) may mediate the relationship between neurocognition and outcomes in youths at risk for psychosis. To date, studies such as the PNC and the ABCD Study have focused on community or catchment-based samples of youths, rather than treatment-seeking samples, and thus the bidirectional impact of PSSs with cognition in a large sample of youths seeking treatment for mental illness has not been studied robustly.

A practically important field related to cognition is educational achievement. Educational achievement is negatively related to severe mental health disorders, including psychotic disorders (17). Lower performance on formal tests at school, lower grades, grade retention, and school dropout are related to later development of schizophrenia and bipolar disorder (17–19). Furthermore, deviation in expected educational achievement based on familial cognitive aptitude is a strong predictor of the later development of schizophrenia (20). While educational achievement may deteriorate due to the onset of psychotic symptoms, poor educational attainment is typically evident before illness onset, suggesting that poor achievement may reflect underlying aberrations in neurodevelopment. School size, attendance, accommodations, exclusions, and difficulties interacting with teachers and peers may also be important factors related to subsequent outcomes (21). Such data are of particular public health importance for youths who require mental health treatment, with whom there has been less research in relation to such outcomes than in the general population.

The Current Investigation

Herein we describe the protocol for the Toronto Adolescent and Youth (TAY) Cohort Study cognition and educational achievement aims, including associated rationale, youth and family engagement, and integration with clinical processes. We also provide the completion data, descriptive statistics, and associations with key demographic and clinical variables in participants recruited to date. Our study protocol includes the following aims (see the Supplement for detailed aims and hypotheses): 1) to identify cognitive and educational trajectories and relationships with social determinants in a large transdiagnostic sample of youth seeking mental health treatment and 2) to identify the role of cognitive and educational trajectories in predicting PSSs, functioning, and suicidality.

Another aim is to explore the mediating roles of cognitive and educational trajectories with respect to the impacts of familial, social, behavioral, and diagnostic antecedents on outcomes.

Additional aims include analyzing cognitive and educational trajectories in relation to clinical phenomenology and health service utilization data [as outlined in (22)], and imaging and biosample data [as outlined in (23)] will also be explored.

These aims will meaningfully advance our understanding of the trajectories of cognition, psychosis, and functioning, which to date have been primarily examined in population-based cohorts. How these variables are associated in a large clinical youth cohort is unknown. Furthermore, the inclusion of report card data has yet to be evaluated in a clinical cohort. It is anticipated that the nuanced Mental and Physical Health (22) and imaging and biosample protocol (23) will provide opportunities for additional exploratory aims. Data-driven analyses that examine the complex relationships among variables in this multimodal dataset will provide an opportunity for novel hypotheses and innovative approaches, particularly within subgroups of participants identified using such data-driven analyses, who may demonstrate unique cognitive and educational trajectories.

METHODS AND MATERIALS

Participants

The TAY Cohort Study uses a prospective observational design, with enrolled participants participating in multilevel assessments over 11 time points within a 5-year period (see Figure 1) (22,23). Eligible participants are 11 to 24 years old and seeking and/or accessing youth mental health services at the Centre for Addiction and Mental Health (CAMH) in Toronto, Ontario, Canada. Youths with psychotic disorders are not actively recruited because a key goal of the study is to identify factors associated with psychosis risk. Exclusion criteria include not providing informed consent or assent, being nonverbal, and not speaking English. For individuals who lack the capacity to consent for any reason, the inability of the parent/legal guardian to provide informed consent for the youth is also an exclusion criterion. Participants are not excluded on the basis of any other clinical features (such as psychosis, substance use, or medical conditions) or cognitive features.

All procedures were approved by the CAMH Research Ethics Board and comply with the World Medical Association Declaration of Helsinki (24). Youth participants are invited to involve a caregiver in their participation.

Measures

Rationale. The cognitive measures chosen incorporate the major domains that have been associated with serious mental illness in previous research. Wherever possible, we aligned cognitive domains and/or assessment instruments with existing cohort studies, most notably the ABCD Study, to facilitate comparative analyses with youths in the general population (25). Similar to what was done in these foundational studies, cognitive measures are repeatedly administered and were therefore chosen based on several key principles to be sensitive to 1) salient developmental changes from adolescence to emerging adulthood and 2) cognitive processes implicated in major mental illnesses and risk factors for the same. To manage participant burden, we administer core cognitive

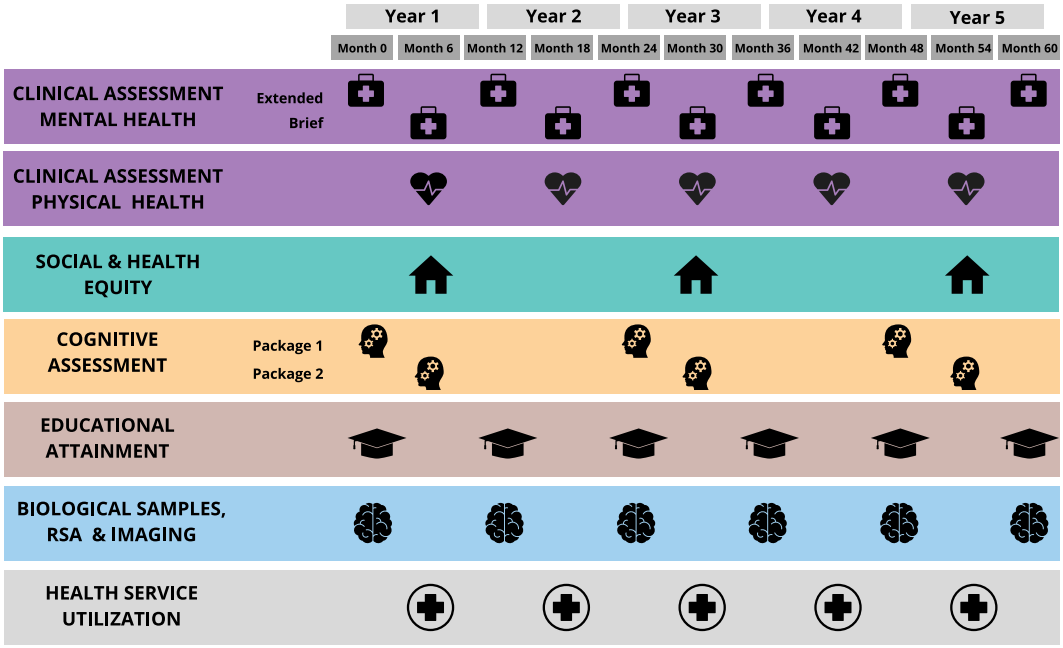

Figure 1. Overview of the Toronto Adolescent and Youth Cohort study assessment schedule. Clinical assessment of mental health, physical health, social and health equity, and health service utilization are described by Cleverley *et al.* (22). Cognitive and educational attainment assessments are described in this article, and biological samples and imaging have been described by Dickie *et al.* (23). RSA, respiratory sinus arrhythmia.

measures biannually during primary assessment points (years 1, 3, and 5), with additional cognitive measures during the 6-month assessment points that occur after these primary assessments. Measures were selected to be neuroscientifically informed and psychometrically sound and are sensitive to developmental effects with minimal floor and ceiling effects. Measures were also selected to limit sensitivity to practice effects, including only one task that involves rule-based learning or deception. Computerized administration involving minimal staff engagement and training was chosen to optimize consistent administration and minimize data entry errors. Limited duration and format were prioritized to optimize attention, engagement, and motivation.

Assessment of Cognition. At the initial assessment, visual acuity and handedness are assessed using the Snellen Chart (26) and Edinburgh Handedness Inventory (27). The NIH Toolbox cognition measures have been validated across this age range, are brief, and assess processing speed, working memory, language, and executive function (28). Behavioral measures assess cognitive deficits and biases related to inhibition as well as social cognition, whereas self-report measures assess decision making and metacognition. See Table 1 for an outline of all cognitive measures administered subsequent to these assessments and alignment with other major youth cohort studies (PNC, ABCD, and HBN) (2,29,30).

Assessment of Educational Attainment. The Educational Attainment Questionnaire is used to assess participants' level of education, grades, accommodations, support, and education-related items (31–42). The Educational Attainment Questionnaire is composed of items from the School Mental Health Survey, which is part of the Ontario Child Health Study, a longstanding prospective study of physical and mental health of children and youths ages 4 to 17 years in Ontario (43). Similar items were added for participants attending post-secondary education.

Participants attending school are asked to bring copies of their report cards, upload a copy of their report cards via secure transfer, or sign a third-party consent form for researchers to request these data directly from the participant's school. For participants attending high school, information about 6 learning skills and work habits, grades, Individualized Education Plan, and attendance are gathered from their report cards. Information on courses, credits, and standardized provincial assessment (e.g., Education Quality and Accountability Office assessments for grade 9 and Ontario Secondary School Literacy Test for grade 10) are gathered as applicable (44). Participants attending secondary education are asked for transcripts of their current education and their high school Ontario Student Transcript. Participants who have finished secondary education are asked to bring a copy of or upload their Ontario Student Transcript from college/university or sign a consent form to request the Ontario Student Transcript directly from the Ontario Colleges organization or their institution.

Youth and Family Engagement and Integration. Youth and family team members with lived expertise contributed to all aspects of this protocol. Specifically, youth and family members informed the original proposal for funding, the study protocol, and study standard operating procedures, scripts,

Table 1. Cognitive Measures, Processes, Descriptions, and Alignments

	Neurocognitive Domains		Cohort		
Cognitive Measure	Cognitive Process	Description	ABCD	HBN	PNC
Picture Vocabulary Task[a]	Language and verbal intellect	Youths are auditorily presented with a word and asked to choose which of 4 visually presented pictures match that word.	x	x	–
Oral Reading Recognition Task[a]	Language exposure and reading	Youths are asked to pronounce visually presented letters or words.	x	x	–
Pattern Comparison Processing Speed Test[a]	Visual processing	Youths are asked to determine whether 2 visually presented pictures are the same.	x	x	–
List Sorting Working Memory Test[a]	Working memory sequencing	Youths are presented with animals and foods of assorted sizes both visually and auditorily and are asked to list the items presented from smallest to largest.	x	x	–
Picture Sequence Memory Test[a]	Episodic memory	Youths are presented with pictures demonstrating events and asked to model those events with a series of actions using props.	x	x	–
Flanker Task[a]	Attention and inhibitory control	Youths are presented with a target stimulus and 2 surrounding flanker stimuli and are asked to indicate which direction the middle stimulus is facing; surrounding flanker stimuli may be facing in the same or the opposite direction.	x	x	–
Dimensional Change Card Sort Task[a]	Cognitive flexibility	Youths are presented with 2 stimuli at the bottom of the screen and asked to sort a third stimulus presented in the middle of the screen to match 1 of the 2 stimuli at the bottom by either color or shape.	x	x	–
Rey Auditory Verbal Learning Test (32)	Auditory learning and memory	Youths are asked to listen to and recall a list of unrelated words over 5 learning trials. They are then presented with and asked to recall as many words as they can from a second, distractor list of words, and recall of the initial list is then assessed.	x	–	–
Wechsler Intelligence Test for Children–V Matrix Reasoning (32)	Nonverbal reasoning, visual intelligence, spatial reasoning, perceptual organization, attention, and sequencing	Youths are presented with an incomplete array of visually presented stimuli and asked to select 1 of 4 alternatives to complete the array. For participants age 17 years or over, the WAIS-IV version is administered (33).	–	x	–
Little Man Task (35)	Visual-spatial processing	Youths are asked to indicate which hand a figure is using to hold a briefcase after being presented with the figure in 1 of 4 positions.	x	–	–
Emotional Stroop Task (35)	Prepotent response inhibition	Youths are asked to identify whether a word in the foreground describes a positive or negative feeling in the context of an emotional face in the background exhibiting a congruent or incongruent feeling.	x	–	–
Delayed Discounting Task (36–39)	Reward valuation	Youths are instructed to choose between hypothetical amounts of money, one of which would be received immediately and one of which would be received with a given delay.	x	–	–
Penn Emotion Differentiation Task (40)	Emotion identification	Youths are shown faces and must determine which emotions are expressed.	–	–	x
The Awareness of Social Inference Test–Short Version (41)	Social cognition	Youths are provided videos of naturalistic, everyday conversations in which 2 actors interact.	–	–	–
Metacognition Questionnaire 30 (42)	Metacognitive beliefs	The MCQ-30 generates subscales including cognitive confidence, positive beliefs about unwanted thoughts, negative beliefs about the uncontrollability of thoughts, negative beliefs about the need to control thoughts, and cognitive self-consciousness.	–	–	–

ABCD, Adolescent Brain Cognitive Development Study; HBN, Healthy Brain Network; MCQ-30, Metacognitions Questionnaire-30; PNC, Philadelphia Neurodevelopmental Cohort; WAIS-IV, Weschler Adult Intelligence Scale–IV.

[a]Designates measures administered as a part of the NIH Toolbox.

and materials. The measures chosen for inclusion were meaningfully shaped by feedback relevant to participant experience and assessment burden, as well as priorities for discovery. More specifically, an initial list of measures was developed by investigators, including a description of the construct, the measure, and the priority for discovery. Collaborative review and discussion with youth and family advisers were then conducted over several primary sessions to

incorporate lived experience priorities for discovery and key considerations (primarily assessment burden) and to prioritize and reduce the number of measures included. Measure administration and training procedures were also codeveloped with these team members during early data collection. Consistent with other TAY Cohort Study visits, visits are flexibly scheduled to accommodate youth and caregiver schedules, and participants are offered snacks, beverages, and meals during in-person visits, as well as transportation support and honoraria or credit for volunteer hours.

Clinical research integration was supported by youth and family team members as well as clinicians and clinical leadership in the services supporting recruitment. A key component of this integration was the codesign of clinician dashboards that summarize the results of the primary cognitive measures and youth dashboards that were codesigned to directly share highlights of the assessment results with participants, again with consent (see Figure S1).

Statistical Analyses

Sample Size Determination. Under the assumption of n = 1500, we used a Monte Carlo simulation study and concluded that we had abundant power (0.83) to correctly enumerate distinctive classes of cognitive and educational longitudinal trajectories using the Bayesian information criterion for testing hypothesis 1 assuming that there are 4 classes similar in size in the mixture. We had sufficient power (0.80) to detect a minimal effect size of 0.25 (Cohen's d) on continuous functioning outcomes when comparing one class with another. For categorical outcomes, we had sufficient power to detect a minimal odds ratio of 1.67 when comparing 2 classes of cognitive or education trajectories. The statistical power for hypothesis 2 depends on many assumptions. For example, focusing on the mediation effect of cognitive performance on the relationship between childhood adversity and a continuous functioning outcome, we had sufficient power (0.80) to detect a standardized mediation coefficient as small as 0.30. For the above power and sample size calculations, we conservatively assumed a 10% attrition rate at each wave of data collection. All tests were based on 2-sided tests and .05 level of significance.

Primary Data Analyses. Latent growth mixture modeling was used to identify distinct heterogeneity in growth trajectories on both cognitive measures and educational performance. We also used parallel processes (45) and cross-lagged (46) models to associate the growth characteristics of these domains. We tested the association between cluster membership of the cognitive/educational trajectories and PSSs as well as functional outcomes using generalized linear models, with other key clinical and social determinants controlled in the model. For mediation, we used the conventional product-of-coefficients method to test the mediational effect of cognitive/educational trajectories on the pathway from substance use, low socioeconomic status, and childhood adversity to PSSs and functioning. In terms of missing data strategy, multiple imputation and full information maximum likelihood methods were used. SAS and R software packages were used to conduct these analyses.

Early Data Analyses. For the baseline data of the first 417 participants included here, descriptive statistics were calculated cross-sectionally at baseline for all cognitive functioning and educational achievement measures. Comparisons between participants with and without PSSs were conducted using nonparametric Mann-Whitney U tests for continuous variables and χ^2 tests for categorical variables, as appropriate, to evaluate differences between groups in cognitive functioning and educational achievement. Youth participants were categorized as PSS or non-PSS using the Extreme Agreement Index on the PRIME Screen–Revised (≥1 item rated 6 "definitely agree" or ≥3 items rated 5 "somewhat agree") (2). Age and sex were included as covariates in all analyses; no correction for multiple comparisons was applied.

RESULTS

Cognitive Data

Of the 417 participants eligible and enrolled in the overall TAY Cohort Study between May 4, 2021, and February 2, 2023, 97.6% of participants consented to cognitive assessment. The mean interval between completion of the mental and physical health protocol (22) and the cognitive assessment was 32 days. The average duration of cognitive measure administration was 103 minutes (median 90 min) for the baseline assessment and 73 minutes (median 60 min) for the assessment at 6 months. Participants who did not complete the cognitive assessment (mean age = 19.7, SD = 3.23) were older than those who did (mean age = 18.1, SD = 3.23) based on the nonparametric Mann-Whitney test (U = 8775.5, p = .001). No other differences in demographic variables or in psychiatric diagnoses were observed (see Tables S1, S2). See the mental and physical health protocol (22) for full details of the additional clinical variables collected, including key current and retrospective features relevant to mental and physical health development and course.

As shown in Table S3, the means and standard deviations for the early data collected through February 2023 are as expected (age-corrected scores are presented where available). That is, means are mostly in the average range, although they are somewhat lower for the Toolbox Flanker Task, suggesting that this indicator of executive function may be lower in this clinical sample. Data are considered normal, with skewness and kurtosis values between ±2 and ±7, respectively (47,48). Most of the scores have small skewness values at or below +1 or −1. All kurtosis values are positive, suggesting somewhat more peaked distributions than normal. Values above 2 suggest that these scores generally demonstrate a higher density of scores around the mean.

As shown in Table S4, most individual cognitive tests and composite scores were significantly associated. The correlations between the subtests that form the NIH Toolbox crystalized composite, as well as the fluid composite, can be characterized as strong effect sizes.

Several key cognitive indices differed across participants who scored above versus below established cutoffs for PSSs (see Table 2). More specifically, all 3 composite scores of the NIH Toolbox were lower in participants with PSSs. Indices of language and verbal intelligence, as well as working memory,

Table 2. Descriptive and Inferential Statistics for All Cognitive Tests and Composite Scores

Test	Process	PSS Status		p	Cohen's d
		No, n = 166	Yes, n = 172		
TPVT	Language and verbal intellect	106.4 (13.8)	101.0 (14.6)	<.01	0.38
TORRT	Language exposure and reading	110.1 (17.7)	107.3 (16.3)	.18	0.16
TPCPST	Visual processing	101.5 (22.2)	96.3 (25.7)	.05	0.33
TLSMT	Working memory sequencing	104.4 (13.8)	99.1 (14.6)	<.01	0.37
TPSMT	Episodic memory	104.2 (17.6)	101.4 (18.8)	.07	0.15
TFT	Inhibitory control	94.3 (15.8)	91.6 (17.1)	.11	0.16
TDCCS	Cognitive flexibility	102.3 (19.5)	97.9 (20.8)	.09	0.22
Crys	Crystalized intelligence	109.3 (15.2)	104.5 (15.4)	.01	0.31
Fluid	Fluid intelligence	101.7 (16.8)	95.6 (20.6)	.01	0.32
Total	Neurocognitive index	106.3 (15.2)	100.0 (17.7)	<.01	0.38
RAV Imm	Auditory memory	11.4 (2.8)	11.0 (3.1)	.27	0.14
RAV Del	Auditory memory	10.8 (3.2)	10.2 (3.4)	.06	0.18
MR	Nonverbal reasoning	10.1 (3.2)	9.9 (2.9)	.54	0.07
LMT-E	Visual-spatial reasoning	0.35 (0.16)	0.33 (0.17)	.24	0.12

Values are presented as mean (SD).

LMT-E, Little Man Test Efficiency score; MR, Matrix Reasoning scaled score; RAVLT, Rey Auditory Verbal Learning Test; RAV Del, RAVLT delayed recall total correct; RAV Imm, RAVLT immediate recall total correct; TDCCS, Toolbox Dimensional Change Card Sort Test; TFT, Toolbox Flanker Test; TLSWMT, Toolbox List Sorting Working Memory Test; TORRT, Toolbox Oral Reading Recognition Test; TPCPST, Toolbox Pattern Comparison Processing Speed Test; TPSMT, Toolbox Picture Sequence Memory Test; TPVT, Toolbox Picture Vocabulary Test.

were similarly lower in participants with PSSs. Notably, some measures of memory, visual spatial skills, and nonverbal reasoning did not differ across these individuals.

Educational Data

Table 3 shows educational outcomes of participants separated by PSS status. Report cards were collected from 40% of the participants (n = 168). For 64 participants (15.3%), the procedure for requesting their report card was still ongoing, suggesting that this frequency may increase, and 99 participants (23.7%) were not attending school. The report cards collected did not differ based on PSS status, suggesting that there were no significant biases in the gathering of report card data based on PSSs. Based on participants' educational status, 77 (20.6%) were enrolled in postsecondary education, 191 (51.1%) were enrolled in middle or high school, 98 (26.2%) were not in school, and data were not available for 8 participants (2.1%). There were no associations between PSS status and educational status when including participants for whom data are not available or when excluding these participants (χ^2_3 = 1.81, Cramer's V = 0.07, p = .41).

When comparing individuals meeting criteria for PSS status, no significant differences were found for academic achievement or additional academic support needed (see Table 3). For participants who were in an educational program, there was a significant association between PSS status and academic problems, with a higher proportion of participants with PSSs reporting academic problems than those without (24.8% vs. 11.9%). Furthermore, a significant association was found between PSS status and mental health problems interfering with academic performance. Specifically, a higher proportion of participants with PSSs reported mental health interference with academic performance than those without (82.7% vs. 55%).

Notably, the initial participants were recruited and assessed between May 4, 2021, and February 2, 2023, which includes a period during which COVID-19 pandemic restrictions, such as temporary school closures and a switch to online education, occurred.

DISCUSSION

Herein we describe the procedures and highlights the feasibility of collecting cognitive and educational outcomes in a clinical cohort of youths seeking treatment related to mental illness in a tertiary care setting. Almost all youths who consented to participate in the study completed the cognitive battery. While those who did not complete cognitive assessments were older, participant demographic features and psychiatric diagnoses were representative of the overall sample. Descriptive statistics for cognitive tests were generally in the average range, with minor differences compared with general population samples (e.g., minor kurtosis compared to the ABCD Study baseline cognition). Intercorrelations were consistent with those found in previous investigations. These robust descriptives are suggestive of strong engagement and support the choice of tasks in this population. In contrast, only one-half of the participants currently in school were able to provide their report card or were in the process of doing so. These unique data are rarely collected in existing cohort studies; nevertheless, this completion rate is lower than anticipated, and active efforts are underway to address this issue.

In this early subset of participants at baseline, 49% of youths met a pre-established threshold for PSSs. Youths with PSSs demonstrated lower cognitive functioning and educational outcomes than those without PSSs on several key outcomes. Specifically, youths scored significantly lower in fluid,

Table 3. Descriptive Statistics for Educational Outcomes

Outcome	PSS Status		
	No, *n* (%)	Yes, *n* (%)	*p*
Report Card Completed			.69
Completed	85 (63.4%)	79 (58.1%)	
Not completed	25 (18.7%)	27 (19.9%)	
Not applicable	24 (17.9%)	30 (22.1%)	
Educational Status			.50
Yes—postsecondary education	44 (23.5%)	33 (18.4%)	
Yes—middle/high school	97 (51.9%)	94 (52.5%)	
No	46 (24.6%)	52 (29.1%)	
EAQ Academic Performance			.05
A, 80–100	72 (51.4%)	56 (44.8%)	
B, 70–79	45 (32.1%)	32 (25.6%)	
C, 60–69	14 (10%)	14 (11.2%)	
D or lower, <60	5 (3.6%)	14 (11.2%)	
Not applicable	4 (2.9%)	9 (7.2%)	
EAQ Academic Problem			.03
No	118 (88.1%)	91 (75.2%)	
Yes	16 (11.9%)	30 (24.8%)	
EAQ Additional Support			.28
No	56 (41.2%)	39 (31.7%)	
Yes	80 (58.8%)	84 (68.3%)	
Mental Interference			<.01
Neither agree nor disagree	20 (14.3%)	13 (10.2%)	
No	43 (30.7%)	9 (7.1%)	
Yes	77 (55%)	105 (82.7%)	

Significance testing was conducted with a χ^2 test for all variables with the exception of academic performance, for which the Wilcoxon rank sum test with continuity correction was used.

EAQ, Educational Attainment Questionnaire.

crystalized, and overall intelligence in the NIH Toolbox and reported more often that their mental health problems interfered with educational achievement. Despite small effect sizes, these findings are significant because this sample consists only of clinically referred youths and young adults, highlighting the fact that these deficits are found even in the context of other youths experiencing significant psychopathology. More specifically, early results show that participants with PSSs scored lower on all 3 composite scores of the NIH Toolbox and indices of language, verbal intelligence, and working memory. This is comparable to previous studies that have reported moderate impairments in these domains in youths with PSSs (12,49–51). Notably, numerous measures of memory, visual spatial skills, and nonverbal reasoning did not differ across these individuals, suggesting that the presence of PSSs may impact specific cognitive domains.

Early data suggest that there are no significant associations between PSS status and educational status, and there was no evidence for lowered availability or access to report cards. However, participants with PSSs reported having more academic problems and that their mental health symptoms interfered with academic performance to a greater degree than those without PSSs, with medium to large effect sizes. These results suggest that symptoms of PSSs may affect educational outcomes above and beyond the experience of psychopathology.

The longitudinal design of this study coupled with the clinically relevant needs of the youth population distinguishes this cohort. Following longitudinal trajectories of cognitive and educational measures will allow for further exploration of the impact of PSSs over time. Bidirectionally, it will also allow for a better understanding of how cognitive and educational trajectories may be early signs or predictors of worsening PSSs, poor functioning, or suicidality in this high-risk group. It will also allow for an understanding of the impact of age, gender identity, socioeconomic status, childhood adversity, and substance use in the context of divergent cognitive and educational trajectories. Efforts to ensure representativeness are ongoing. Youth engagement promises to advance these strategies, for example through the codesign of effective incentives such as the Clinician and Youth Cognitive Dashboards. These unique methods of feeding back clinically relevant data to clinicians, youths, and caregivers will further support retention (also used in the HBN) (29).

There are some limitations in the design of this protocol. In particular, norms are limited or lacking for several of the cognitive measures utilized, particularly across the full range of backgrounds reported. Furthermore, not all cognitive processes and tasks of initial interest were included due to our striking a balance between comprehensiveness and assessment burden across the entire research study. Finally, the wide range of educational institutions, and associated administrative processes, contributed to ongoing challenges in acquiring report cards from respondents, as well as variation in the nature of the information contained in these documents (particularly qualitative information). Efforts are underway to mitigate the impact of these challenges (e.g., linkages to the Ontario Student Record); youth, family, and knowledge users from the educational field are key to these efforts. Potential solutions to enhance data collection under review include changes in the timing of information collection (so as to be more aligned with report card or transcript release) and determining the feasibility of obtaining consent to request report cards directly from educational institutions or the Ontario Student Record itself (a centralized record of student educational progress in Ontario schools).

The mechanisms that underlie premorbid cognitive and educational impairments in psychotic disorders are commonly explained by neurodevelopmental models of schizophrenia (52,53). Important questions remain regarding to what extent cognitive deficits are specifically related to psychosis development or to a general risk factor for psychopathology (54). Poor educational achievement is often distressing for youths and often also directly results in a lower level of education, school exclusions, and school dropout, which has lifelong consequences. Cognition and educational achievement have been associated with suicidality as it relates to psychosis (55). Given the challenges that many youths seeking mental health treatment face, the presence (or absence) of PSSs and their impact over time on cognitive and educational performance could ultimately provide information needed for decisions regarding supports that youths with mental illness may need as they move through school. Future analyses will leverage the capacity of the full dataset, including dimensional analyses of psychotic symptom severity, course, and associated factors, to advance this understanding further. There are also

opportunities to better understand neurobiological trajectories and interaction with social determinants of health, which underpin the cognitive and educational trajectories that will be identified.

Conclusions

The CAMH TAY Cohort Study provides an unprecedented advantage of integrating neurocognitive measures with self-report and performance-based tasks that may enable the modeling of differential neurocognitive and educational trajectories in youths at risk for psychosis and living with significant psychopathology.

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Establishing a TAY Cohort Study repository that will serve as a platform for data sharing (across the study team and with qualified researchers external to the study team and for comparison with findings from harmonized datasets) is critical to the success of this initiative. In support of open science, the TAY Cohort Study will utilize the data governance model established by the CAMH BrainHealth Databank, detailing policies, procedures, and processes for gaining and providing secure access to deidentified TAY Cohort Study data. In keeping with Canadian Ethical Standards, only data from participants who explicitly consent to sharing data for future secondary re-use will be included in data releases. Three data releases are planned: a baseline cross-sectional release, a release following completion of the year 3 longitudinal time point, and a final 5-year longitudinal release. Each release will be timed with the publication of primary research papers from the TAY Cohort Study Team. Released data will include summary scores, item-level data, and associated metadata and code. Before each data release, a risk of re-identification analysis will be conducted that includes an assessment for the uniqueness among indirect identifiers of the participants. The Brain Health Databank Data Steward may alter the initial dataset to mitigate the risk of re-identification.

The Brain Health Databank serves as the data repository for CAMH and is currently nearing approval by the CAMH Research Ethics Board. External researchers will use the web-based cohort finder to facilitate the completion of the data access request form. All researchers accessing the Brain Health Databank must agree to the Data Use Agreement terms, which detail how data would be cited and acknowledged. The Data Use Agreement also forbids "re-identification"; researchers cannot attempt to reveal the identity of any individual using the data provided. The data access requests reviewed and approved by a Data Access Committee will be available for download via the Brain Health Databank. Data will be available for download via the Brain Health Databank portal. Researchers will need to renew data access annually.

Limited data for a smaller sample size were presented in poster form at the 2023 Annual Congress of the Schizophrenia International Research Society, May 11–15, 2023, Toronto, Ontario, Canada (56).

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