24-hour movement guideline adherence and mental health: A cross-sectional study of emerging adults with chronic health conditions and disabilities

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Abstract

Background. Recent work has shown that individuals with chronic health conditions and disabilities (CCD) meet the 24-hr movement guidelines at lower rates than population norms; however, the evidence base remains limited across different stages of the lifespan and very few studies have examined associations with mental health outcomes.

Objective. This study examined 24-hour movement guideline adherence among emerging adults with CCD compared to those without and associations between guideline adherence and indicators of mental health.

Methods. This cross-sectional study used data from the 2020 cycle of the Canadian Campus Wellbeing Survey. A total of 17,874 emerging adults enrolled at 20 post-secondary institutions (Mean age=21.6±2.94 years; 65.2% female), including 3,336 who identified with a CCD, self-reported their movement behaviors (physical activity, sedentary behaviors, sleep) and completed measures of psychological distress and mental wellbeing. Logistic regressions models were computed to examine differences in guideline adherence. Propensity score weighted linear regression models were computed to examine associations between guideline adherence and indicators of mental health.

Results. Emerging adults with CCD had significantly lower odds of meeting the 24-hr movement guidelines compared to their peers, and disparities in guideline adherence were most pronounced among those with multimorbidity, developmental and physical disabilities. Guideline adherence was associated with significantly more favorable scores for psychological distress and mental wellbeing among those with and without CCD.

Conclusions. Findings suggest emerging adults with CCD engage in less healthy movement behavior patterns than their peers, yet they appear to experience similar mental health benefits when they do meet the 24-hr movement guidelines.

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Emerging adulthood is a particularly stressful life stage from 18 to 29 years of age,[1] perhaps even more so for those who attend post-secondary education. Despite gaining autonomy, this major transitional period represents one in which emerging adults commonly move away from home, thus losing the structure or guidance often provided by caregivers, take on new responsibilities, and experience increased financial stress. Therefore, it is no surprise that this period is marked by a sharp rise in psychological distress and declines in overall wellbeing.[2] Research suggests that 21-37% of post-secondary students report having been diagnosed with one or more mental health disorders in the previous year.[3] In fact, the onset of most mental health disorders occur by age 24,[4] meaning that emerging adults are already in a vulnerable position apart from the challenges of attending higher education. The mental health challenges experienced by some emerging adults may even manifest into suicidal ideation and planning.[5] Specifically, meta-analytic evidence suggests that one in six post-secondary students report having experienced some form of suicidal ideation, with almost 45% reporting having experienced suicidal ideation in the past year – a pattern significantly higher than observed for the general population.[6] Collectively, these results underscore the need to identify risk factors that may prevent or reduce the mental health burden that attending post-secondary education might place on emerging adults.

Despite the high prevalence of mental health disorders among post-secondary students,[3] mental health challenges may be exacerbated for those with chronic health conditions and disabilities (CCD). Recent studies have shown that emerging adults with CCD experience mental health disorders and suicidal ideation at significantly higher rates than the general population.[7,8]

Despite these challenges, risk factors that stand to improve the mental health and wellbeing of post-secondary students with CCD have received limited attention. As a result, substantial knowledge gaps need to be addressed so that evidence-informed interventions can help this population realize their full potential.

The field of behavioral medicine has received increased attention over the past two decades for its potential to understand modifiable risk factors that may contribute to poor mental health.[9] Specifically, movement behaviors – which consist of physical activity, sedentary behaviors, and sleep – are a cluster of health behaviors that have been shown to play a significant role in mental health, both independently, and, more recently, as a collective.[10,11] The emphasis on taking an integrative approach to understand the interactive impact of movement behaviors on health began in 2016 with the release of Canadian 24-hour Movement Guidelines for Children and Youth.[12] The first guidelines for adults were released more recently in 2020.[13] These guidelines represent threshold-based recommendations for how much physical activity, sedentary behavior (recreational screen time and sitting), and sleep adults should engage in over the course of a whole "healthy" day. The Canadian 24-Hour Movement Guidelines for Adults recommend adults should engage in 150 minutes of moderate-to-vigorous physical activity per week, eight hours or less of sedentary behavior each day with three hours or less of recreational screen time, and seven to nine hours of sleep each day. [13] Previous research has shown that adults with CCD meet the 24-hour movement guidelines at significantly lower rates than adults without CCD. [14–16] Specifically, adults with disabilities related to mobility, cognitive, or self-care domains had half the odds of meeting all three guidelines compared to those without disabilities. [16] Although studies have examined guideline adherence among the broader adult population with CCD, no studies to date have investigated emerging adults. Considered in light of the recent evidence that

has begun to establish the mental health benefits conferred by adherence to these guidelines for children and youth,[17,18] it is warranted to explore these associations among emerging adults, however, few studies have been conducted,[19,20] none of which focused on those with CCD.

Since emerging adults with CCD are at greater risk of mental health disorders than their non-disabled peers,[7,8] exploring the associations between movement behaviors and indicators of mental health stands to provide insight into the magnitude of the benefits (or lack thereof) that they may experience. At this point it is unknown what the relative benefits are for this population compared to emerging adults without CCD. Such findings will help to better inform future public health policies and campaigns tailored for and targeting individuals with CCD.

Therefore, the aims of this study are to: 1) examine adherence to the 24-hour movement guidelines among emerging adults with CCD attending post-secondary education compared to those without CCD; 2) determine the influence of different diagnoses as well as multimorbidity on guideline adherence; and 3) investigate associations between guideline adherence and indicators of mental health and wellbeing.

Methods

Data Source and Study Design

The present study was a pre-registered secondary analysis of data from the first deployment of the Canadian Campus Wellbeing Survey (CCWS). The CCWS was specifically developed as a surveillance system to help monitor the health and well-being of Canadian post-secondary students over time. The first cycle of the CCWS included 20 post-secondary institutions (PSI) consisting of 8 universities and 12 colleges or technical institutes. Each PSI selected their desired student sampling strategy based on the size and needs of their institution. Additional information about the CCWS study design, methods, survey measures and data access policy can be found at https://www.ccws-becc.ca/, with specific details of the survey tool's development also outlined elsewhere.[21] The CCWS was approved by the Behavioral Research Ethics Board at the [blinded for review], in addition to each participating PSI. Complete preregistration details for this study can be found at [blinded for review].

Participants

Across the 20 PSIs, 165,997 students were invited to participate in the online survey, with 24,760 student respondents (overall response rate = 14.9%). Students between the ages of 18 to 29 years (i.e., emerging adults) were included in the present study. Given that we would expect scores for indicators of mental health to be worse among individuals with mental health disorders, we excluded students who identified with a mental health condition to avoid confounding the associations between 24-hr movement guideline adherence with psychological distress and mental wellbeing. Accounting for our inclusion criteria of age, a total of 17,874 participants remained, 3,336 of whom reported a CCD (18.7%). Based on the response options of the CCWS, participants were considered to have identified with a CCD status if they

affirmatively responded to having any of the following disabilities or ongoing medical conditions that affect their everyday functioning: physical disability, blind/visually impaired, deaf/hard of hearing, neurological (learning disability, ASD, Traumatic Brain Injury, ADHD, etc.) disability, chronic health condition (Crohn's, HIV, etc.), or another condition not listed. A multimorbidity classification was assigned for participants who reported more than one CCD.

The sample consisted of primarily full-time (82.9%), female (65.2%) students living off-campus (89.5%) with parents who graduated from college/university (76.0%) (Table 1). Of the sample, 29.9% identified as White, 28.4% as East-Southeast Asian, 22.0% as South Asian, 2.1% as Black, 0.9% as Canadian Indigenous, 2.5% as Latino, 3.1% as Middle Eastern, 7.8% as Mixed, 3.2% as Other. Subtle differences were observed across emerging adults with and without CCD. Specifically, those with CCD were more likely to be female and White, domestic students, have parents with higher levels of education, yet experience greater financial stress.

Measures

Measurement of Movement Behaviors

Students who met the moderate-to-vigorous physical activity (MVPA), sleep, recreational screen time, and sedentary time guidelines were categorized as meeting all of the 24-hour movement guidelines.

Physical Activity. MVPA was measured using the International Physical Activity Questionnaire (IPAQ).[22,23] Participants responded to four items that assessed the frequency (days) and duration (hours and/or minutes on an average day) of their moderate and vigorous physical activity performed in bouts of greater than 10-minutes over the past seven days. The scoring rules for IPAQ were applied to participants' data so that daily MVPA was capped to a

maximum value of 180 min. Students were classified as having met the guideline for MVPA if they achieved at least 150 min/week of MVPA.

Sedentary behavior. Recreational screen time was measured using a modified item from the International Sedentary Assessment Tool (ISAT).[24] Participants responded to one item that asked how many hours and/or minutes on average they spent watching TV or using a computer, tablet, or smartphone during their free time over the past seven days. Sitting time was measured using modified items from the ISAT**.**[24] Students responded to one item that asked how many hours and/or minutes they usually spent sitting during the full day over the last seven days. Participants who reported engaging in eight hours or less of sitting time per day and three hours or less of recreational screen time per day were classified as having met the sedentary behavior guideline.

Sleep. Participants responded to four items that assessed what time they typically went to sleep and woke up during weekdays and on the weekend over the past seven days. Times were reported to the nearest half-hour. Average daily sleep was calculated using the following formula: (5 x hours of sleep on weekdays + 2 x hours of sleep on weekends)/ 7. Students who, on average, reported getting seven to nine hours of sleep per night were classified as having met the guideline for sleep.

Mental Health

Psychological Distress. Psychological distress was assessed with the 10-item Kessler Psychological Distress Scale (K10).[25] The K10 consists of 10 items that assess symptoms of depression and anxiety to yield a global measure of distress that a person had experienced over the past 30 days. Example items included, “How often did you feel nervous?” and “How often did you feel depressed?” Participants responded to each item using a 5-point scale ranging from

1 (*None of the time*) to 5 (*All the time*). Responses were summed to obtain a score between 10 to 50, with higher scores reflecting higher levels of psychological distress.

Mental Wellbeing. Mental wellbeing was assessed with the Warwick-Edinburgh Mental Well-being Scale (WEMWBS).[24] The WEMWBS consists of 14 items that assess emotional, social, and psychological wellbeing over the past two weeks. Each item is positively phrased (e.g., I've been feeling optimistic about the future). Participants responded to each item using a 5-point scale ranging from 1 (*None of the time*) to 5 (*All the time*). Responses were summed to obtain a score between 14 to 70, with higher scores reflecting greater mental wellbeing.

Covariates

Covariates included age, ethnicity, gender, parental education, work hours, financial stress (models examining mental health only), place of residence, student enrollment status (i.e., full-time or part-time), domestic/international status, first-year student status, and disability group (models examining indicators of mental health among those with CCD only). These variables were referred to as the full covariate set.

Data Analysis

All analyses were performed in R (Version 4.1.1) and R Studio (Version 2022.02.3). First, we inspected the data for missingness using the *mice* package.[27] Data were considered missing at random and multiple imputation by chained equations using classification and regression trees was computed using the *mice* package to replace missing values. Multiple imputation is considered a best practice for addressing missing data.[28] A total of 20 multiply imputed datasets were created as per recommendations to set $m > 100$ times the highest fraction of missing information (16.3% for physical activity).[29] Descriptive statistics were computed for the full sample as well as for emerging adults with and without CCD. Demographic variables

were compared between emerging adults with and without CCD using general linear models for continuous variables and Rao-Scott adjusted chi-square tests for categorical variables.

To investigate Objective 1, the *survey package*[30] was used for computing separate multilevel logistic regression models to determine if adherence to each of the 24-hr movement guidelines and concurrent adherence to all guidelines differed between emerging adults with and without CCD. For Objective 2, participants with CCD were separated based on their self-identified health status and the presence of multimorbidity, resulting in seven distinct groups, and separate multilevel logistic regression analyses were computed to evaluate differences in adherence to each of the 24-hr movement guidelines as well as concurrent adherence to all guidelines for each of these groups compared to emerging adults without a CCD. For Objectives 1 and 2, results from each of the multiply imputed datasets were pooled as per Rubin's Rules.[31] Each model was adjusted for the full covariate set.

For Objective 3 we computed average treatment effects on the treated (ATT) to better understand the influence of 24-hr movement guideline adherence on indicators of mental health. Simply stated, ATTs represented how much mental health improved (or worsened) among the typical participant who adhered to a certain guideline relative to if they had not adhered to that guideline (i.e., counterfactual argument).[32] To do so, covariate data were first preprocessed using the *MatchThem* package[33] to calculate covariate balanced propensity score weights. Assigning propensity score weights to each participant allowed us to balance the observed covariates across different values of the treatment variable (i.e., whether or not participants met respective movement guidelines). Lack of covariate balance is common in observational studies, and covariate balanced propensity score weighting can be used to unconfound comparisons through covariate balance optimization.[34,35] The *survey* package[30] was then used to compute separate

multilevel linear regression analyses to explore associations between 24-hour movement guideline adherence and psychological distress as well as mental wellbeing for emerging adults with and without CCD. The full covariate set, in addition to disability status (models examining emerging adults with CCD only) and adherence to the other 24-hr movement guidelines not being modeled (models examining independent guideline adherence only), were included in the propensity score weighted linear regression models to allow for doubly robust estimation.[36] Disability status was included in the preprocessing procedures and CCD-specific regression models as a covariate to help reduce the heterogeneity amongst CCDs when investigating associations with indicators of mental health. ATTs were presented as beta coefficients with standard errors. Statistical significance was set at $\alpha < 0.05$ for all analyses.

Results

24-Hour Movement Guideline Adherence

Objective 1

Emerging adults with CCD were 18% less likely to meet all three movement guidelines concurrently than peers without CCD (Table 2). Specifically, those with a CCD had significantly lower odds of meeting the sleep (12% lower), physical activity (6%), and sedentary behavior (13% lower) guidelines.

Objective 2

Decomposing the CCD group into subgroups based on condition/disability type to further examine differences in 24-hr movement guidelines revealed additional important insights. The odds of meeting the sleep (22% lower) and sedentary behavior (28%) guidelines, in addition to all three guidelines concurrently (37% lower) were significantly lower for those in the multimorbidity group compared to those without CCD (Table 2). Those with developmental disabilities had 19%, 18% and 27% lower odds of meeting the sleep and sedentary behavior guidelines as well as all three guidelines, respectively. Individuals who identified with a physical disability had 31% lower odds of meeting the physical activity guideline and 22% lower odds of meeting the sleep guideline. Individuals with hearing impairments had significantly lower odds (45%) of meeting all three guidelines simultaneously when compared to individuals without CCD. Finally, those with visual impairments had 28% lower odds of meeting the sedentary behavior guideline. All other relationships did not reach our criterion for statistical significance.

Objective 3: 24-hour Movement Guideline Adherence and Mental Health

Meeting all three guidelines concurrently was associated with the greatest reductions in psychological distress for emerging adults with CCD (Beta = -1.59 ± 0.31 SE) and those without

(Beta = -1.93 ± 0.12 SE). The most favorable scores for mental wellbeing were also observed with meeting all three guidelines concurrently for both emerging adults with CCD (Beta = 2.61 ± 0.32 SE) and those without (Beta = 2.56 ± 0.19 SE).

Among emerging adults with CCD, independent adherence to the physical activity (Beta = -0.93 ± 0.25 SE), sleep (Beta = -1.43 ± 0.17 SE), and sedentary behavior (Beta = -1.24 ± 0.28 SE) guidelines were associated with significantly lower psychological distress. Similar patterns of results were observed for mental wellbeing in emerging adults with CCD in that adherence to the physical activity (Beta = 1.96 ± 0.28 SE), sleep (Beta = 1.24 ± 0.21 SE), and sedentary behavior (Beta = 1.87 ± 0.22 SE) guidelines were associated with significantly more favorable scores.

Among emerging adults without CCD, independent adherence to the physical activity (Beta = -0.86 ± 0.10 SE), sleep (Beta = -1.60 ± 0.10 SE), and sedentary behavior (Beta = -1.24 ± 0.12 SE) guidelines were associated with significantly lower psychological distress. Similar patterns of results were observed for mental wellbeing in that adherence to the physical activity (Beta = 1.82 ± 0.13 SE), sleep (Beta = 1.45 ± 0.13 SE), and sedentary behavior (Beta = 1.62 ± 0.12 SE) guidelines were associated with more favorable scores.

Discussion

The results from the present study showed that when grouped together, emerging adults with various CCD met the guidelines for sleep, physical activity, and sedentary behavior as well as all three guidelines concurrently at lower rates than their peers. This study also contributes to the literature demonstrating links between 24-hr movement guideline adherence and mental health outcomes. Specifically, individual and concurrent guideline adherence were all associated with significantly lower scores for psychological distress and significantly higher scores for mental wellbeing among emerging adults regardless of identified health status. Overall, these findings address key gaps in our current knowledge regarding associations between 24-hr movement guideline adherence and indicators of mental health among emerging adults with CCD, which is essential for developing future evidence-informed, condition-specific guidelines.

The present study was the first to examine adherence to 24-hr movement guidelines for emerging adults with CCD attending post-secondary education. Findings generally support previous research on movement behaviors among children and youth with CCD,[37–40] in that this population also reports significantly lower adherence to the 24-hr movement guidelines than population norms. It is evident that among the 20 post-secondary campuses sampled across Canada, emerging adults with CCD generally engage in less healthy behavioral patterns, potentially making this group more susceptible to poor health outcomes, and thus highlighting the need for targeted and tailored health promotion campaigns aimed at this population.

One noteworthy finding when investigating 24-hr movement guideline adherence among each respective CCD was the impact of those living with multimorbidity. Specifically, those with multimorbidity were 22% and 28% less likely to meet the sleep and sedentary behavior guidelines, respectively, and had 37% lower odds of meeting all three concurrent guidelines.

Although the CCWS did not include items to assess the severity of CCD, which has been linked to guideline adherence among children and youth with neurodevelopmental disorders,[38] it is reasonable to postulate that the medical complexities experienced by emerging adults with multiple conditions play a role in their poorer guideline adherence. These findings suggest that additional resources should be allocated to emerging adults with multimorbidity who are attending post-secondary education considering they may stand to benefit the most from intervention.

Albeit to a lesser degree in most instances, reduced likelihoods of 24-hr guideline adherence were also as consistently observed among emerging adults who reported a lone developmental or physical disability diagnosis, and these relationships should not be overlooked. For instance, those who identified with a developmental disability had significantly lower odds of adherence to all three guidelines concurrently than those without CCD, which was driven by their lower odds of adherence to the sedentary behavior and sleep guidelines. This is important to note because individuals with developmental disabilities represented the largest subgroup among those who identified with a single CCD. From a campus health promotion standpoint, individuals with developmental disabilities may be a cost-effective group to target given how many post-secondary students could be reached with a one-size fits all campaign.

Subgroup sample sizes for physical disabilities, visual impairments and hearing impairments were much smaller than those with developmental disabilities; thus, estimates lack precision due to limited statistical power. As a result, we may have failed to detect some important effects for no other reason than potential type two errors. However, estimates suggest these groups have lower odds of meeting at least one of the guidelines, including those with hearing impairments having 45% lower odds of concurrently meeting all three guidelines,

respectively. Conversely, it appears that those living with chronic health conditions or "other" conditions may engage in healthier movement behavior patterns. While we lacked specific details regarding what these chronic condition diagnoses were, it is possible that these conditions do not involve impairments that may render individuals unable to perform (or avoid) certain activities that contribute to 24-hr movement behavior adherence. For example, Chron's disease likely poses a smaller barrier to physical activity engagement than living with a physical disability. Future research should consider collecting additional information on condition severity regarding the degree to which it affects activities of daily living and qualitative data about barriers to meeting each of the three guidelines. Such information could improve our current understanding of why individuals with certain CCD are more (or less) likely to adhere to specific guidelines than others.

Evidence from the present study also assists in identifying which movement behaviors are most beneficial for different aspects of mental health among emerging adults with CCD. For example, among emerging adults with CCD, meeting the sleep and sedentary behavior guidelines had the most robust effect on psychological distress, whereas physical activity, and sedentary behavior guideline adherence were associated with the strongest effects on mental wellbeing. Given that adherence to each of the guidelines and concurrent adherence to all three guidelines were consistently associated with favorable benefits for psychological distress and mental wellbeing among this population, it is imperative that campus-led health promotion campaigns consider an integrated 24-hr movement approach to alleviate the mental health burden they experience.

Examining associations between 24-hr movement guideline adherence and indicators of mental health among emerging adults with and without CCD provides important insight into the

strength of these relationships, particularly among an understudied population known to experience a high mental health burden. Although subtle differences exist, for the most part, the mental health benefits of 24-hr movement guideline adherence were relatively similar across these two populations. It should be noted, however, that sleep guideline adherence appears to have slightly more robust effects for mental health among emerging adults without CCD, whereas physical activity and sedentary behavior guideline adherence appear to be slightly more beneficial for mental wellbeing among those with CCD. Despite the subtle differences in effects between populations, these findings lend some credibility to existing movement behavior guidelines for individuals with CCD that were inferred from evidence from the general population in that the benefits for mental health may be similar – at least among emerging adults attending post-secondary education in Canada.

While this study has several strengths, there were also limitations. First, self-reported measures of movement behaviors such as physical activity are often over-estimated.[41] This limitation could be addressed in future studies using device-based measures, although given the size of the CCWS sample, self-reported measures were more feasible. Second, scores for psychological distress and wellbeing may have been influenced by a seasonal effect such as completion during stressful parts of the academic term (e.g., midterms, final exams), which might result in a poorer representation of participant's mental health and wellbeing. Third, all CCD diagnoses were self-reported and lacked specificity with regards to the severity by which their everyday functioning was impacted. Participants were only asked to report diagnoses that affected their everyday functioning, and we therefore lack insight into the potential role of impairment severity. The CCWS was developed with the broader post-secondary student population in mind; thus, only general information regarding student health conditions were

ascertained. Future studies are encouraged to include measures that assess the severity by which students' everyday functioning is impaired and to partner with campus health clinics to review medical records to confirm diagnoses. Such procedures would ultimately reduce bias in estimates. Finally, it should be acknowledged that the CCWS was not nationally representative sample of post-secondary students, and therefore our findings may not be generalizable to all emerging adults attending post-secondary education in Canada.

Conclusion

In conclusion, we found that emerging adults with CCD attending post-secondary education meet the guidelines for sleep, physical activity, and sedentary behavior as well as all three guidelines concurrently at lower rates than their peers. Our findings also suggest there are beneficial associations between 24-hr movement guideline adherence and indicators of mental health, which appear to be consistent among emerging adults with and without CCD. Collectively, these results will help to inform the dearth of evidence that has examined links between 24-hr movement guidelines and health among adults with CCD to date. As similar studies continue to be published, policymakers will no longer need to rely on evidence from studies of the general population when informing guideline development for individuals with CCD.

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Author Contributions:

DB and PM contributed to the conceptualisation of the study. DB, PM, and BT developed the analytical approach. DB was responsible for data curation and performed all analyses. DB interpreted the results. DB and CP drafted the initial manuscript. All authors critically reviewed and provided feedback on multiple iterations of the manuscript, and all authors approved the final version of the manuscript.

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Data sharing:

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Table 1. *Descriptive statistics for sociodemographic variables, movement behaviors and indicators of mental health.*

Variable	Full Sample (N = 17,874)	General Population (n = 14,358)	Individuals with CCD (n = 3,336)	p value
Age				.03
Mean (SD)	21.6 (2.94)	21.6 (2.93)	21.8 (2.99)	
Gender				<.001
Female	11,650 (65.2%)	9,441 (64.9%)	2,209 (66.2%)	
Male	6,038 (33.8%)	5,024 (32.1%)	1,014 (30.4%)	
Other	186 (1.3%)	73 (0.5%)	113 (3.4%)	
Race/Ethnicity				<.001
White	6,609 (32.0%)	3,914 (26.9%)	1,438 (43.1%)	
Black	367 (2.1%)	294 (2.0%)	73 (2.2%)	
East/Southeast Asian	5,068 (28.4%)	4,390 (28.6%)	678 (20.3%)	
Canadian Indigenous	166 (0.9%)	129 (0.9%)	37 (1.1%)	
Latino	450 (2.5%)	365 (2.5%)	85 (2.5%)	
Middle Eastern	563 (3.1%)	462 (3.2%)	101 (3.0%)	
South Asian	3,939 (22.0%)	3,498 (24.1%)	441 (13.2%)	
Mixed	1,398 (7.8%)	1,030 (7.1%)	368 (11.0%)	
Other	571 (3.2%)	456 (3.1%)	115 (3.4%)	
CCD Diagnosis				
Developmental	940 (5.3%)	0 (0%)	940 (28.2%)	
Multimorbid	492 (2.8%)	0 (0%)	492 (14.7%)	
Physical	247 (1.4%)	0 (0%)	247 (7.4%)	
Chronic Health	348 (1.9%)	0 (0%)	348 (10.4%)	
Condition				
Visual Impairment	295 (1.7%)	0 (0%)	295 (8.8%)	
Hearing Impairment	93 (0.5%)	0 (0%)	93 (2.8%)	
Other	921 (5.2%)	0 (0%)	921 (27.6%)	
None	14,538 (81.3%)	14,538 (100%)	0 (0%)	
Parental Education				.26
High school or less	4,279 (23.9%)	3,523 (24.2%)	756 (22.7%)	
Completed post-secondary	9,553 (53.4%)	7,762 (53.4%)	1,791 (53.7%)	
Completed Graduate or Professional degree	4,04 (22.6%)	3,253 (22.4%)	789 (23.1%)	
International Student (yes)	5,135 (28.7%)	4,615 (31.7%)	520 (15.6%)	<.001
Student Status	14,813 (82.9%)	12,159 (83.6%)	2,654 (79.6%)	.003
New to Institution (yes)	4,854 (27.2%)	3,965 (27.3%)	889 (26.6%)	.48
Residence				.03
Off campus	16,000 (89.5%)	13,003 (89.4%)	2,997 (89.8%)	
On campus	1,772 (9.9%)	1,468 (10.1%)	304 (9.1%)	
Unstable	102 (0.6%)	67 (0.5%)	35 (1.0%)	
Weekly Work Hours				.28
Mean (SD)	10.0 (10.8)	10.1 (10.9)	9.51 (10.7)	

Variable	Full Sample (N = 17,874)	General Population (n = 14,358)	Individuals with CCD (n = 3,336)	p value
Financial Stress				<.001
None	2,036 (11.4%)	1,744 (12.0%)	292 (8.8%)	
Very little	3,651 (20.4%)	3,074 (21.1%)	577 (17.3%)	
Some	5,276 (29.5%)	4,321 (29.7%)	955 (28.6%)	
Quite a bit	3,575 (20.0%)	2,864 (19.7%)	711 (21.3%)	
A great deal	3,336 (18.7%)	2,535 (17.4%)	801 (24.0%)	
Psychological Distress				<.001
Mean (SD)	25.2 (8.03)	24.4 (7.76)	28.4 (8.34)	
Mental Wellbeing				<.001
Mean (SD)	45.8 (10.0)	46.6 (9.87)	42.6 (10.1)	
Physical Activity (hr/day)				
Mean (SD)	0.70 (0.63)	0.70 (0.63)	0.71 (0.63)	
Recreational Screen Time (hr/day)				
Mean (SD)	4.69 (2.71)	4.65 (2.69)	4.90 (2.78)	
Sitting Time (hr/day)				
Mean (SD)	7.86 (3.43)	7.82 (3.43)	8.06 (3.45)	
Sleep Duration (hr/day)				
Mean (SD)	7.93 (1.33)	7.91 (1.31)	7.99 (1.42)	

CCD = chronic conditions and disabilities

Table 2. *24-hr movement guideline adherence for emerging adults with chronic health conditions and disabilities compared to those without.*

	Physical Activity		Sleep		Sedentary Behavior		Concurrent Guideline Adherence	
	Proportion % (SE)	aOR (95% CI)	Proportion % (SE)	aOR (95% CI)	Proportion % (SE)	aOR (95% CI)	Proportion % (SE)	aOR (95% CI)
Emerging adults without CCD	61.8 (61.0, 62.6)	1.0	61.0 (60.2, 61.8)	1.0	23.5 (22.8, 24.2)	1.0	10.6 (10.1, 11.1)	1.0
Emerging adults with CCD	63.6 (62.0, 65.3)	**0.94 (0.88, 0.99)**	58.5 (56.8, 60.2)	**0.88 (0.84, 0.92)**	21.1 (19.7, 22.5)	**0.87 (0.80, 0.96)**	9.4 (8.4, 10.4)	**0.82 (0.72, 0.93)**
Emerging adults with CCD by group								
Developmental	66.4 (63.3, 69.3)	0.95 (0.86, 1.06)	57.0 (53.8, 60.2)	**0.81 (0.72, 0.90)**	20.2 (17.8, 22.9)	**0.82 (0.71, 0.96)**	8.0 (6.4, 9.9)	**0.73 (0.62, 0.86)**
Physical	56.7 (50.4, 62.7)	**0.69 (0.53, 0.89)**	55.1 (48.8, 61.1)	**0.78 (0.66, 0.92)**	19.4 (15.0, 24.8)	0.97 (0.84, 1.11)	9.7 (6.3, 14.1)	0.81 (0.64, 1.03)
Hearing	53.8 (43.7, 63.5)	0.92 (0.75, 1.14)	52.7 (42.6, 62.5)	0.69 (0.46, 1.05)	22.6 (15.3, 32.1)	0.91 (0.61, 1.34)	8.6 (4.4, 16.1)	**0.55 (0.32, 0.94)**
Visual	63.4 (57.8, 68.7)	1.01 (0.85, 1.20)	59.0 (53.3, 64.4)	0.97 (0.83, 1.15)	18.3 (14.3, 23.1)	**0.72 (0.56, 0.94)**	8.1 (5.5, 11.8)	0.79 (0.55, 1.14)
Chronic health condition	68.1 (63.0, 72.8)	1.07 (0.96, 1.19)	60.9 (55.7, 65.9)	0.99 (0.87, 1.12)	22.7 (18.6, 27.4)	0.91 (0.76, 1.09)	10.9 (8.1, 14.6)	0.92 (0.73, 1.18)
Other	61.9 (58.7, 65.0)	0.99 (0.92, 1.07)	62.3 (59.1, 65.4)	0.99 (0.90, 1.09)	23.8 (21.1, 26.6)	1.00 (0.89, 1.13)	10.7 (8.9, 12.9)	1.01 (0.84, 1.22)
Multimorbid	64.0 (59.7, 68.1)	0.84 (0.64, 1.10)	55.1 (50.7, 59.4)	**0.78 (0.70, 0.87)**	18.7 (15.5, 22.4)	**0.72 (0.56, 0.92)**	9.1 (6.9, 12.0)	**0.63 (0.47, 0.84)**

aOR = adjusted Odds Ratio; CCD = chronic conditions and disabilities; bold text signifies significance at $p < .05$