

RESEARCH ARTICLE

Patterns, predictors, and outcome of the trajectories of depressive symptoms from adolescence to adulthood

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Abstract

Background: The long-term trajectory of depressive symptoms has a heterogeneous pattern. Identifying factors associated with different trajectories and outcomes may have important theoretical and clinical implications. This study explored patterns of depressive symptom trajectory from adolescence to adulthood, and their relationship with subsequent psychiatric disorders.

Method: A sample of 816 participants (58.8% girls; $M = 16.58$ years old at baseline, $SD = 1.21$) from a large community sample were interviewed four times during adolescence and adulthood. Depressive symptoms were also assessed. Symptom trajectory identification was based on latent class mixed modeling. Logistic regression was used for predicting emotional and drug use disorder over age 30.

Results: Three trajectories of depressive symptoms were identified: “decreasing symptom” (decreasing trajectory of symptoms; 15.1% of participants), “increasing symptom” (initially decreasing pattern of symptoms and then increasing; 6.1% of participants), and “normative symptom” (consistently low symptom levels; 78.8% of participants). Predictors of the increasing symptom trajectory were high level of loneliness and state anxiety, presence of an emotional disorder, and low involvement in physical exercise at baseline. This trajectory membership predicted the development of anxiety disorders over age 30. Predictors of the decreasing symptom class were being female and high level of worry at baseline.

Conclusions: Long-term trajectories of depressive symptoms are heterogeneous, with each trajectory having different predictors and are associated with different outcomes during adulthood.

KEYWORDS

adolescence, anxiety, depression, developmental trajectories, trajectories

1 | INTRODUCTION

Depression is a common psychiatric disorder and is one of the leading causes of disability worldwide (Kessler et al., 2003; World Health Organization, 2017). Depression and depressive symptoms

during adolescence are associated with a wide range of impairment, including educational underachievement and increased risk of suicide (Fergusson, Boden, & Horwood, 2007; Marmorstein, 2009). Evidence suggested that depression generally begins between adolescence and early adulthood (Hankin et al., 1998; Thapar, Collishaw, Pine, &

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Thapar, 2012), which makes these periods important for our understanding of the developmental course of depression. Enhanced understanding of time course and key features of depressive symptoms across these critical developmental stages helps to identify adolescents who are at risk of developing depression (Kwong et al., 2019; Yaroslavsky, Pettit, Lewinsohn, Seeley, & Roberts, 2013). Furthermore, different trajectory patterns may be associated with different etiological processes, comorbidity clusters, prognoses, and psychosocial outcomes (Muthén & Muthén, 2000; Wardenaar, Monden, Conradi, & De Jonge, 2015). Therefore, being able to characterize trajectories of depressive symptoms may help to elucidate mechanisms that will better target prevention and intervention programs.

The long-term trajectories of depressive symptoms have been described differently across studies (see Musliner, Munk-Olsen, Eaton, & Zandi, 2016). In some studies, the trajectories of depressive symptoms have been described in terms of their main features, namely, severity (e.g., low, medium, and high; Ferro, Gorter, & Boyle, 2015) and stability (e.g., stable, increasing, and decreasing; Yaroslavsky et al., 2013). For example, Yaroslavsky et al. (2013) found three classes of depressive symptom trajectory: low decreasing, moderate decreasing, and high stable, which represented 24%, 44%, and 32% of the participants, respectively. For all classes, depressive symptoms showed a significant decrease across the first two assessment periods. For the low and moderate decreasing classes, depressive symptoms continued to decrease during the transition from late adolescence to emerging adulthood. However, in the high stable class, depressive symptoms plateaued over time. Rawana and Morgan (2014) investigated the trajectory of depressive symptoms from early adolescence to young adulthood in a nationally representative sample of young Canadians. Their findings showed depressive symptoms to decline slightly at ages 12 through 14, began to increase from ages 14 through 17, and then declined through age 21. The period of greatest vulnerability was ages 14–17. Ferro et al. (2015) examined trajectories of depressive symptoms among youths aged 12–25 years using latent class growth modeling. Three distinct trajectories were identified during emerging adulthood: minimal (55%), subclinical (39%), and clinical (6%). In all trajectories, the age group with the highest level of depressive symptoms was between 15 and 17 years.

Trajectories of depressive symptoms were predicted by gender (Ferro et al., 2015; Musliner et al., 2016; Rawana & Morgan, 2014; Vannucci & McCauley Ohannessian, 2018), and the presence of personal and parental psychiatric disorders. Kwong et al. (2019) recently compared gender differences in the trajectories of depressive symptoms over eight occasions between 11 and 22 years of age. Females, compared to males had steeper increases in depressive symptoms to age 20, after which levels of depression first plateaued and then started to show a decrease for both males and females. Furthermore, females had an earlier age of peak velocity (i.e., ages at which depressive symptoms increased most rapidly) of depressive symptoms than males (13.5 years and 16.4 years, respectively). In Ferro et al. (2015), those in the subclinical and clinical symptoms trajectories tended to be female and participants with low

self-concept, low socioeconomic status, poor interpersonal relations, and chronic health conditions. Poor coping skills (Yaroslavsky et al., 2013) and lack of connections with friends (Mazza, Fleming, Abbott, Haggerty, & Catalano, 2010) were also associated with high depressive symptom trajectories.

Specific trajectory patterns during adolescence are associated with specific outcomes during adulthood. High depressive trajectory in adolescence was associated with higher emotional problems (de la Torre-Luque, Fiol-Veny, Balle, Nelemans, & Bornas, 2019; Musliner et al., 2016), lower educational attainment in adulthood (Dekker et al., 2007), and risk-taking behaviors, such as excessive drinking and smoking (Wickrama & Wickrama, 2009). Sabiston et al. (2013) showed an elevated depressive trajectory to be associated with lower participation in physical activity and team sports in young adulthood. In Yaroslavsky et al. (2013), participants whose depressive trajectory were in the moderate and high stable classes had worse outcomes at age 30, including lower level of education, lower annual household income, poorer adjustment on each of psychosocial measures, and met the diagnosis of major depressive disorder (MDD), anxiety, and substance use disorders.

As mentioned above, inconsistent results (especially in relation to symptom trajectory enumeration) have been observed across studies on developmental course of depression in adolescence and adulthood. Some studies have short follow-up periods (e.g., de la Torre-Luque et al., 2019) which hinders the impact of transition from adolescence to adulthood. Other studies considered a unitary depressive symptom course, overlooking individual differences that may lead to heterogeneous trajectories underlying an overall course (e.g., Rawana & Morgan, 2014). Finally, findings of some studies were based on small sample (e.g., Wardenaar et al., 2015).

Given the inconsistent patterns of depressive trajectories reported in previous studies, one of the main aims of this study was to examine the developmental trajectories of depressive symptoms from adolescence to adulthood. The second aim was to identify predictors of each of these trajectories. The following socio-demographic and health-related (i.e., sex, race, self-reported health, and frequency of physical activity) and psychosocial factors (i.e., worry, self-esteem, loneliness, state anxiety, emotional disorders) were included as previous studies have consistently reported them to be associated with depression (e.g., Chaiton et al., 2013; Mazza et al., 2010; Rawana & Morgan, 2014). The third aim was to examine the outcome of each trajectories in terms of the development of mental disorders (i.e., anxiety, depression, and drug use disorders) at age 30.

2 | MATERIALS AND METHODS

2.1 | Participants

We used data from the Oregon Adolescent Depression (OADP; Essau, Lewinsohn, Olaya, & Seeley, 2014; Lewinsohn, Hops, Roberts, Seeley, & Andrews, 1993) from participants who completed all

four assessments ($N = 816$; 41.2% boys; $M = 16.58$ years old at baseline, $SD = 1.21$). Most participants were Caucasians (85.9%) and lived with their biological parents (95.6%). All participants and guardians provided a written consent to participate.

2.2 | Instruments

The Center for Epidemiologic Studies-Depression scale (CESD-20; Radloff, 1977; Radloff, 1991) was used to measure depressive symptoms from T1 to T3 assessment occasion (see the Section 2.3). Reliability indexes across measurement occasions were acceptable within the sample (Cronbach's α between .90 and .92). Moreover, correlations were moderate across measurement occasions (r from 0.29 to 0.45).

2.2.1 | Baseline instruments

Sociodemographic information (i.e., sex, race, age, family composition when living at parent's home, years of education when adult, employment status, marital status, and household income) and health-related data (i.e., self-reported health status and physical activity) were collected at T1 (see the Procedure section). Additionally, the Schedule for Affective Disorders and Schizophrenia for School-Age Children (K-SADS; Orvaschel, Puig-Antich, Chambers, Tabrizi, & Johnson, 1982) was administered.

Questionnaires used at baseline included: the UCLA Loneliness Scale (UCLA; Hays & DiMatteo, 1987; $\alpha = .79$), a short version of the Rosenbaum Self-esteem Scale to measure self-esteem (Lewinsohn, Hoberman, & Rosenbaum, 1988; $\alpha = .83$), the Anxiety State Scale (Lewinsohn et al., 1994; $\alpha = .83$) to measure anxiety state, and a 5-item scale to assess the tendency to worry (Lewinsohn et al., 1994; KR-20 = 0.71).

2.2.2 | Follow-up instruments

Some sociodemographic and health-related information was collected at T4 follow-up (i.e., years of education, employment status, marital status, household income). Moreover, a joint administration of the Longitudinal Interval Follow-Up Evaluation interview (LIFE; Keller et al., 1987) and the Structured Clinical Interview for DSM-IV (SCID-I; First, Gibbon, Spitzer, & Williams, 1996) was conducted (see Section 2.3).

The questionnaires used at T4 follow-up were: the Coping Skills Questionnaire ($\alpha = .76$); the Social Adjustment Scale (SAS; Weissman, 1976; $\alpha = .70$), the Rosenberg Self-esteem Scale (RSS; Rosenberg, 1965; $\alpha = .92$), the Perceived Social Support scale (PSS; Procidano & Heller, 1983; $\alpha = .83$, for the PSS-friend scale, and 0.89 for the PSS-family scale), and the Unpleasant Events Schedule (UES; Lewinsohn, Mermelstein, Alexander, & MacPhillamy, 1985; $\alpha = .88$).

2.3 | Procedure

Detailed information about the OADP has been reported elsewhere (Lewinsohn et al., 1993; Rohde et al., 2007). A baseline assessment (T1; 1987–1989) was conducted on a random sample of adolescents who attended high school in Western Oregon (ages 14–18). The participants who completed the T1 assessment ($n = 1,709$) were invited to a follow-up assessment (T2; 1988–1990) 1 year later ($M = 17.72$ months, $SD = 1.24$). From those who completed the T2 assessment ($n = 1,507$), all the adolescents with a history of Axis I psychopathology ($n = 644$) and a random sample of adolescents with no mental disorders ($n = 457$) were followed (T3; 1993–2000) when most were 24 years of age. In total, 941 participants ($M = 23.87$, $SD = 0.90$, range = 19–27) completed all the assessments in this T3 follow-up. The last follow-up (T4; 2000–2004) was conducted when most participants reached age 30 ($M = 29.70$, $SD = 0.70$, range = 28–33) and 816 participants completed all the assessments in this final follow-up occasion.

The K-SADS and baseline scales (i.e., UCLA, Rosenbaum Self-esteem Scale, ASS, and worry scale) were administered at T1. Participants completed the CESD-20 three times, from T1 to T3. Diagnostic interviews were conducted at T2 and T3. Finally, the LIFE/SCID-I interview and a set of questionnaires were administered at T4 (i.e., Coping Skills Questionnaire, SAS, RSS, PSS, and UES).

2.4 | Data analysis

Latent class mixed modeling (LCMM) was used to depict the course of depressive symptoms over follow-up (from T1 to T3). LCMM allows for the identification of underlying trajectories (Proust-Lima & Jacqmin-Gadda, 2005; Proust-Lima, Philipps, & Liquet, 2017). The course of depressive symptoms was modeled using age (centered on the minimum) as a time factor. Considering the mixed model tradition, depressive symptom course was mathematically formulated by means of an intercept (depressive symptom scores) and a time slope (under a linear or quadratic growth) on three model terms: fixed (population level), random (individual-specific level) and mixture (class-specific level). Based on the LCMM approach, we compared the fit of models with an increasing number of trajectories (classes) by means of two indexes (sample-adjusted Bayesian information criterion [SABIC], Sclove, 1987; and Akaike information criterion [AIC], Akaike, 1974), and two meaningfulness indexes (mean of posterior probabilities of belonging to each trajectory class >0.70 ; and meaningful percentage of participants within each class).

Trajectory class membership profile was examined by means of logistic regression. We followed a forward covariate entry and three models were tested: the unconstrained model, a model with baseline sociodemographic and health-related covariates (i.e., sex, race, self-reported health and frequency of physical activity); and another model adding baseline psychosocial factors (i.e., worry, self-esteem, loneliness, anxiety state and diagnosis of emotional disorders). To control for uncertainty in class membership, the posterior probability

of belonging to assigned class was used as a weighting variable. Model selection relied on the AIC. The relative risk ratio (RRR) was used as an estimate of the probability of being member of the concrete class (in comparison to the normative one) given a concrete covariate.

Finally, prediction of mental disorders (i.e., MDD, anxiety disorders, drug use disorders) over age 30 (T4 follow-up) used bias-reduction generalized linear modeling (brglm; Kosmidis, 2014; Kosmidis & Firth, 2009). This approach allows accurate estimates being derived when binary outcomes have a very large separation between categories. A model including the following covariates was performed for each outcome: depressive symptom trajectory membership, T4 sociodemographic (i.e., sex, marital status, working status) and psychosocial factors (i.e., social support, self-esteem, coping skills, unpleasant events, social adjustment). The diagnosis of a psychiatric disorder (i.e., MDD, anxiety, or drug use disorders) at baseline was used as a weighting variable. The area under the receiver operating curve was used as a measure of classification accuracy. The curve represents the relationship between true positive rates (sensitivity) in function to false positive rate (1-specificity). Area under the curve (AUC) values > 0.70 indicate accurate model classification.

Further analytic details are provided in the Supporting Information material. All analyses were performed using the R software (R Core Team, 2018) ×64 3.0.1 (lcmm, mice, ROCR and brglm packages) and STATA v. 14 (StataCorp, 2015).

3 | RESULTS

Descriptive statistics of participants are displayed in Table 1. The mean of depressive symptoms decreased over time. Very few participants reported poor health status at baseline and almost half of the adolescents reported doing physical exercise at a frequent basis. Table 1 also displays attrition analyses between participants who were followed across the four follow-up waves (i.e., sample in analysis) and those who dropped out. Significant differences were found between samples in terms of some T1 sociodemographic (sex, race) and health-related factors (self-reported health, worry, loneliness, anxiety, emotional disorder diagnosis, and depressive symptoms). However, differences showed marginal or small effect size ($d < 0.50$ or $V < 0.30$).

3.1 | Trajectory class identification

Model comparison revealed that a model comprising three heterogeneous trajectory classes showed the best data fit (Table S1), showing low fit indexes (AIC = 17,935.14 and SABIC = 17,955.08) and satisfactory meaningfulness indexes (means of posterior probabilities between 0.76 and 0.92).

Trajectories of observed CESD-20 scores are displayed across the identified classes in Figure 1. The first class, which was comprised 15.1% of participants ($n = 124$), was identified (called “decreasing

symptom”) with a significant linear slope of time ($B = -0.69$, $SE = 0.12$, $Z = -5.86$, $p < .01$) and quadratic ($B = 0.03$, $SE = 0.01$, $Z = 3.52$, $p < .01$). This class showed a decreasing trajectory of symptoms, leveling off in the mid-twenties. The second class comprised 6.1% ($n = 50$) of the participants (called the “increasing symptom”). Symptom trajectory in this class was featured by a significant quadratic effect of time ($B = 0.06$, $SE = 0.02$, $Z = 2.27$, $p < .05$); it showed a decreasing pattern of symptoms, reaching its lowest level at age 20, and raising subsequently. The third class (called the “normative symptom”) comprised 78.8% of the participants ($n = 646$). This class was featured by a significant intercept ($B = -3.77$, $SE = 0.34$, $Z = -11.19$, $p < .01$) in comparison to the first class identified (reference class); and the absence of either linear or quadratic time effect. Participants classified in this class showed low and flat trajectories of depressive symptoms.

3.2 | Trajectory class membership profile

The multinomial regression revealed that the full model (model with all covariates) showed the best fit (AIC = 944.40). This model showed the highest likelihood to fully predict the outcome ($R^2 = 0.16$). Fit indexes and covariate coefficients are displayed in Table 2. Membership in the decreasing symptom class was predicted (compared to the normative class) by sex (RRR = 0.56, $CI_{95} = 0.51, 0.95$; $Z = -2.28$, $p < .05$), loneliness (RRR = 1.06, $CI_{95} = 1.00, 1.11$; $Z = 2.05$, $p < .05$), and worry (RRR = 1.24, $CI_{95} = 1.04, 1.48$; $Z = 2.41$, $p < .05$). Being female was associated with higher risk of being classified into the decreasing symptom class. In fact, participants in this decreasing symptom class were mostly female (71.3% of class members) in comparison to the normative symptom class (56.1%). Additionally, member of this class showed higher levels of loneliness and worry at baseline.

Membership in the increasing symptom class (compared to the normative symptom class) was predicted by physical activity frequency (RRR = 1.77, $CI_{95} = 1.07, 2.94$; $Z = 2.21$, $p < .05$), loneliness (RRR = 1.09, $CI_{95} = 1.03, 1.16$; $Z = 3.15$, $p < .01$), and state anxiety (RRR = 1.11, $CI_{95} = 1.05, 1.17$; $Z = 3.64$, $p < .01$). Specifically, participants who did not engage in physical activity frequently were at higher risk of being classified into the increasing symptom class. Additionally, those who showed higher levels of loneliness and anxiety at baseline were at higher risk to being classified into this class.

3.3 | Diagnosis prediction at age 30

The accuracy measure and covariate coefficients for each outcome prediction solutions are displayed in Table 3. All models showed good accuracy in predicting a psychiatric diagnosis, with AUC > 0.80 for the anxiety disorder and major depression solutions.

Regarding the predictors of anxiety disorders, two covariates showed a significant loading: the increasing depressive symptom class membership (OR = 2.69, $CI_{95} = 1.31, 5.61$; $Z = 2.77$, $p < .01$) and self-esteem (OR = 0.88, $CI_{95} = 0.82, 0.95$; $Z = -3.56$, $p < .01$).

TABLE 1 Sample features

	Sample in analysis	All participants ^a	Attrition analysis	
			Contrast test	Effect size
Sociodemographic factors				
Sex (female)	58.80	52.14	26.38***	0.13
Race (<i>white Caucasian</i> vs. other)	89.22	91.11	6.14*	0.06
Baseline factors				
Age	16.58 (1.21)	16.56 (1.19)	-0.81	-0.04
Self-reported health (<i>poor</i> vs. good)	10.91	8.99	6.36*	0.06
Exercise frequency (<i>frequently</i> vs. sometimes or less)	50.49	53.04	6.24*	0.06
Worry (Worry scale)	1.57 (1.56)	1.49 (1.53)	-2.08*	0.10
Self-esteem (Rosenbaum scale)	9.68 (1.72)	9.75 (1.70)	1.65	0.08
Loneliness (UCLA)	15.42 (4.37)	15.07 (4.30)	-3.19**	-0.15
Anxiety state (ASS)	17.96 (5.54)	19.59 (5.31)	-2.85**	-0.14
Emotional disorder diagnosis ^b (yes)	6.49	5.21	6.61*	0.06
CESD-20				
T1	18.09 (11.05)	16.98 (10.61)	-4.04**	-0.20
T2	14.68 (10.48)	14.27 (10.43)	-1.79	0.09
T3	13.20 (9.98)	13.07 (9.88)	-0.90	-0.11
Follow-up factors (T4)				
Marital status (<i>married</i> vs. not-married)	56.13			
Working status (<i>employed</i> vs. not-working)	73.16			
Social support from family	8.58 (2.49)			
Social support from friends	8.62 (2.41)			
Self-esteem (RSS)	33.11 (5.39)			
Coping skills	49.54 (7.04)			
Unpleasant events (UES)	43.08 (11.53)			
Social adjustment (SAS)	1.74 (0.35)			
Major depression diagnosis ^c (yes)	5.51			
Anxiety disorder diagnosis ^{c,d} (yes)	5.15			
Drug abuse diagnosis ^c (yes)	6.13			
Drug dependence diagnosis ^c (yes)	8.95			

Note: Percentage of cases (for binary/categorical factors) and means and standard deviations (for scalar factors), between brackets, are displayed. Italic-faced category percentages are displayed. T1 to T4 represent the assessment occasion from baseline (T1) to the last follow-up at age 30 (T4). The attrition analysis involved comparing the sample in analysis with the sample dropped out across waves in all the sample features. The *t* test for independent sample (scalar variables) and the χ^2 -based test (dichotomous/categorical variables) were used as contrast tests. The Cohen's *d* (scalar variables) and the Cramer's *V* (dichotomous/categorical variables) were used as effect size estimates. Social support was measured using the PSS. Abbreviations: ASS, Anxiety State Scale; CESD-20, Center for Epidemiologic Studies-Depression Scale; PSS, Perceived Social Support Scale; RSS, Rosenberg Self-esteem Scale; SAS, Social Adjustment Scale; UCLA, UCLA Loneliness Scale; UES, Unpleasant Event Scale.

^aTotal number of participants in each wave (T1 *n* = 1,709; T2 *n* = 1,507; T3 *n* = 941). The sample size at T4 corresponded with the total number of participants who were surveyed in all the measurement occasions, the so-called sample in analysis (*n* = 816).

^bDSM-III-TR major depression and/or anxiety disorders (generalized anxiety, panic anxiety, agoraphobia, specific phobia, separation anxiety, and overanxious disorder).

^cDSM-IV diagnosis.

^dPanic disorder (with or without agoraphobia), social phobia, specific phobia, separation anxiety, and/or generalized anxiety disorder.

Participants with any anxiety disorders over age 30 were likely to depict an increasing depressive symptom trajectory and lower levels of self-esteem. For MDD, covariates with significant loading were: female sex (OR for being male = 0.34, *CI*₉₅ = 0.13, 0.69; *Z* = -2.85, *p* < .01), lower self-esteem (OR = 0.93, *CI*₉₅ = 0.86, 0.99; *Z* = -2.15,

p < .05), poorer coping skills (OR = 0.93, *CI*₉₅ = 0.88, 0.97; *Z* = -3.01, *p* < .01) and lower social adjustment (OR = 3.80, *CI*₉₅ = 1.43, 10.85; *Z* = 2.71, *p* < .01).

Three covariates showed significant loadings in predicting drug use disorder over age 30: sex (OR = 2.16, *CI*₉₅ = 1.44, 3.33; *Z* = 3.68,

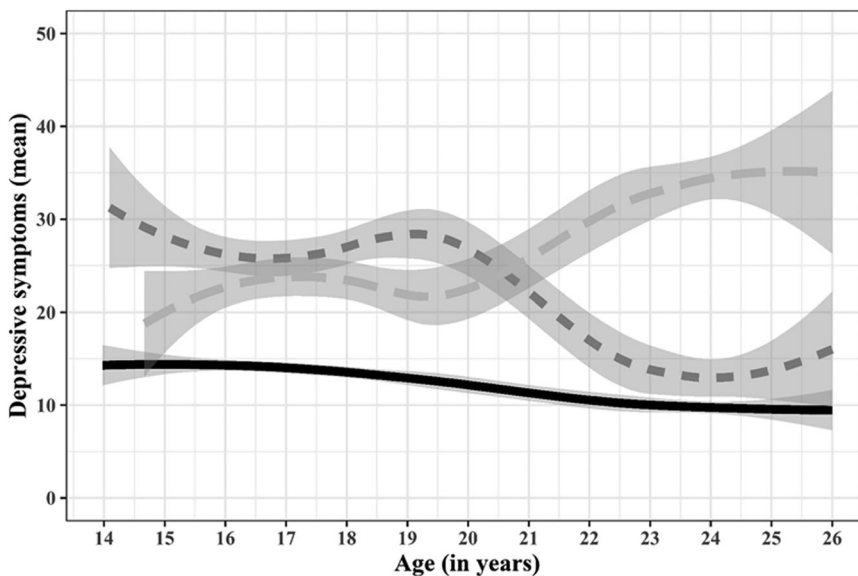


FIGURE 1 Heterogeneous trajectories of depressive symptoms from adolescence to emerging adulthood. Shadow area depicts the 95% confidence interval of the mean. Dark solid line, normative symptom trajectory. Dark-grey-dashed line, decreasing symptom trajectory. Light-grey-dashed line, increasing symptom trajectory

$p < .01$), marital status ($OR = 2.99$, $CI_{95} = 1.97, 4.74$; $Z = 5.09$, $p < .01$) and coping skills ($OR = 0.94$, $CI_{95} = 0.90, 0.97$; $Z = -3.86$, $p < .01$). Specifically, participants with a drug use disorder were likely to be male, not married and had poorer coping skills than those without this disorder.

4 | DISCUSSION

The aims of this study were to determine the number and nature of trajectories of depressive symptoms from adolescence to adulthood, and examine factors in adolescence that predicted these trajectories. Three trajectories were identified, which were labeled “decreasing symptom” (characterized with a decreasing trajectory of symptoms), “increasing symptom” (characterized by a decreasing pattern of symptoms but raising after age 20), and “normative symptom” (characterized by consistently low symptom levels). These trajectory patterns are consistent to those reported in previous studies from adolescence across to adulthood (Stoolmiller, Kim, & Capaldi, 2005; Yaroslavsky et al., 2013). Moreover, our results are in line with previous studies (Hankin et al., 1998; Thapar et al., 2012) which showed adolescence to be a sensitive period for the manifestation of depressive symptoms; in the present study, high levels of depressive symptoms were found in two of the three classes among participants age 14–16.

Like previous studies (Chaiton et al., 2013; Ferro et al., 2015; Mezulis, Salk, Hyde, Priess-Groben, & Simonson, 2014), most participants (78.8%) experienced low levels of depressive symptoms from adolescence to adulthood. This is not surprising given that participants were from a community sample. Also consistent with previous studies (Costello, Swendsen, Rose, & Dierker, 2008; Rawana & Morgan, 2014; Yaroslavsky et al., 2013), we found a pattern of decreasing depressive symptoms. Interestingly, we found an increasing

symptom trajectory with a unique shape which has not been reported elsewhere. This trajectory was present in 6.1% of the participants, which showed a general increase with a slight decrease near age 20. This increase may have been related to the transition from adolescence to emerging adulthood, a period which is characterized by significant psychological changes (e.g., autonomy, identity) and distinct psychosocial events (e.g., residence, career pursuits). These changes are often associated with both risk and opportunities, which in turn could have a significant impact in mental health (Schulenberg, Sameroff, & Cicchetti, 2004). As reported by Rohde, Lewinsohn, Klein, Seeley and Gau (2013), emerging adulthood is significantly related to both first incidence and recurrence of MDD.

Each of the three trajectories seemed to have different predictors. At baseline, members of the increasing trajectory relative to the normative trajectory showed high levels of loneliness and state anxiety. These findings are in agreement with studies that reported elevated emotional symptoms to be a predictor of anxiety and/or depression in adulthood (Balázs et al., 2013; Essau et al., 2014). To our knowledge the present study is the first to show the impact of low involvement in physical exercise on the long-term trajectory of increasing depressive symptoms. The positive health benefits of physical exercise are well-documented (Biddle & Asare, 2011; Lee et al., 2012). For example, as reported in a large recent U. S. study, exercising was associated with reduced self-reported mental health burden (Chekroud et al., 2018); participants who exercised were approximately 1.5 fewer days of poor mental health in the past month compared to those who did not exercise. Furthermore, those who were engaged in team sports and cycling had the lowest mental health burden; in interpreting these findings, the authors argued that engagement in sports was related to social activity that promoted resilience to stress and reduced depression, and reduced social withdrawal and isolation. Gender (i.e., being female) has been reported in previous studies as a predictor of increasing depressive

TABLE 2 Regression coefficients to explain depressive symptom trajectory membership

	Decreasing symptom trajectory				Increasing symptom trajectory			
	RRR	CI ₉₅ LB	CI ₉₅ UB	Z	RRR	CI ₉₅ LB	CI ₉₅ UB	Z
(Intercept)	0.11	0.00	3.17	-1.29	0.00	0.00	0.13	-3.08**
Sex (ref. = Female)								
Male	0.56	0.51	0.95	-2.28*	0.83	0.49	1.39	-0.62
Race (ref. = White)								
Non-White	1.08	0.51	2.29	0.20	1.42	0.72	2.83	1.01
Age	0.92	0.77	1.11	0.20	1.07	0.88	1.31	0.67
Self-reported health (ref. = good)								
Poor	0.89	0.45	1.77	-0.34	0.66	0.29	1.50	-0.98
Physical activity frequency (ref. = frequently)								
Sometimes or less	1.46	0.92	2.32	1.61	1.77	1.07	2.94	2.21*
Worry (Worry scale)	1.24	1.04	1.48	2.41*	0.96	0.78	1.18	-0.37
Self-esteem (Rosenbaum scale)	0.94	0.83	1.07	-0.94	0.88	0.76	1.01	-1.79
Loneliness (UCLA)	1.06	1.00	1.11	2.05*	1.09	1.03	1.16	3.15**
Anxiety state (ASS)	1.05	1.00	1.10	1.87	1.11	1.05	1.17	3.64***
Emotional disorder diagnosis (ref. = No)								
Current diagnosis	0.77	0.29	2.01	-0.53	2.22	0.94	5.25	1.82
<i>Model comparison indexes</i>								
Unconstrained model								
AIC	948.82							
Cragg and Uhler's R ²	0.00							
Model with sociodemographic covariates								
AIC	983.75							
Cragg and Uhler's R ²	0.03							
Full model								
AIC	944.40							
Cragg and Uhler's R ²	0.16							

Note: Depressive symptom trajectory membership was the outcome. Class of reference was normative symptom trajectory membership. Models were weighted by the posterior probability of belonging to assigned class.

Abbreviations: AIC, Akaike information criterion; ASS, Anxiety State Scale; CI₉₅LB, lower bound of the 95% confidence interval of estimate. CI₉₅UB, upper bound of the 95% confidence interval of estimate. Ref., category of reference; RRR, relative risk ratio; UCLA, UCLA Loneliness Scale; Z, Z-based statistic for Wald's test.

* $p < .05$.

** $p < .01$.

trajectory (Chaiton et al., 2013; Côté et al., 2009; Vannucci & McCauley Ohannessian, 2018), however, in the current study, participants in the decreasing symptoms class were mostly female. Other studies have shown comparable gender distribution across various patterns of depressive trajectories (Arizaga, Polo, & Martinez-Torteya, 2018). The reason for this inconsistent finding is not clear, although participant's age has been speculated as accounting for gender difference in depressive symptoms (Legerstee et al., 2013).

In terms of outcomes, it is interesting that the increasing trajectory predicted development of anxiety disorders during adulthood, but not the development of MDD. The latter diagnostic outcome was related to lower levels of self-esteem, and poorer

copied skills and social adjustment. As found by Yaroslavsky et al. (2013), these findings could be interpreted as supporting the interpersonal models of depression persistence (Pettit & Joiner, 2006).

Major strengths of the OADP data set are its rigorous methodological design (e.g., longitudinal design, systematic data collection protocols, implementation of diagnostic interviews) and lengthy follow-up period, which enabled participants to be followed from childhood and adolescence (14–18 years) to adulthood (30 years) via four assessments conducted over a 16-year period. As such, potential cofounders could be controlled and potential recall bias could be reduced. As the participants were comprised of a large community sample, they do not have the selection bias inherent in clinical samples.

TABLE 3 Prediction of emotional and drug disorders at age 30

	Any anxiety disorder ^a				Major depression				Drug use disorder ^b			
	OR	LB	UB	Z	OR	LB	UB	Z	OR	LB	UB	Z
(Intercept)	0.64	0.01	39.11	-0.22	3.10	0.05	193.23	0.56	0.44	0.02	7.53	-0.56
Trajectory membership (ref. = normative)												
Decreasing trajectory	1.46	0.54	3.31	0.87	0.77	0.26	1.81	-0.58	0.86	0.41	1.60	-0.46
Increasing trajectory	2.69	1.31	5.61	2.77**	1.24	0.56	2.57	0.57	1.37	0.76	2.39	1.09
Sex (ref. = female)												
Male	0.56	0.25	1.12	-1.61	0.34	0.13	0.69	-2.85**	2.16	1.44	3.33	3.68
Marital status (ref. = married)												
Not-married	1.43	0.75	2.81	1.11	1.05	0.56	1.98	0.17	2.99	1.97	4.74	5.09***
Working status (ref. = not working)												
Working	0.97	0.5	2.03	-0.09	0.70	0.38	1.37	-1.11	0.89	0.56	1.44	-0.51
Social support from family	0.98	0.88	1.12	-0.27	0.96	0.87	1.08	-0.66	1.00	0.92	1.09	-0.05
Social support from friends	1.06	0.93	1.22	0.84	1.10	0.97	1.27	1.48	1.08	0.99	1.18	1.58
Self-esteem (RSS)	0.88	0.82	0.95	-3.56***	0.93	0.86	0.99	-2.15*	0.99	0.95	1.04	-0.33
Coping skills	0.99	0.94	1.04	-0.27	0.93	0.88	0.97	-3.01*	0.94	0.90	0.97	-3.86***
Unpleasant events (UES)	1.01	0.99	1.04	1.05	0.99	0.96	1.02	-0.69	1.00	0.98	1.02	0.68
Social adjustment (SAS)	1.41	0.49	4.09	0.67	3.80	1.43	10.85	2.71*	1.58	0.78	3.23	0.20
AUC	0.82				0.82				0.75			

Note: Estimates relied on penalized general linear model regressions under binomial distribution. Mental disorder (depression, anxiety or drug disorders) at baseline was used as a weighting variable. Disorder diagnosis was the outcome. Class of reference was the absence of diagnosis. Social support was measured using the PSS.

Abbreviations: AUC, area under curve; LB, lower bound of the 95% confidence interval of estimate; OR, odds ratio; PSS, Perceived Social Support Scale; Ref., category of reference; RSS, Rosenberg Self-esteem Scale; SAS, Social Adjustment Scale; UB, upper bound of the 95% confidence interval of estimate; UES, Unpleasant Event Scale; Z, Z-based statistic for Wald's test.

^aDiagnosis of any of these anxiety disorders: panic disorder (with or without agoraphobia), social phobia, specific phobia, separation anxiety, generalized anxiety disorder.

^bDiagnosis of either drug abuse or drug dependence disorder.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

In interpreting the present findings, study limitations need to be considered. First, different instruments were used across the various assessment periods (e.g., self-esteem was measured at T1 and T4 by means of different instruments) and that not all factors were examined in all waves. This made it somewhat difficult to compare changes across developmental stages. Second, being a 16-year longitudinal study covering adolescence and adulthood, changes in the diagnostic criteria and assessment approaches were inevitable. Third, information on depressive symptoms and other psychosocial factors was assessed via self-report, which is subjected to social desirability demands. Fourth, the use of mental health services (as an indicator of attempting to treat or reduce a depressive symptom episode) was not taken into account in the present study. However, the impact of service use may be limited in community sample studies due to mental disorder prevalence (emotional disorder diagnosis showed a prevalence rate of over 5%) and because many adolescents with a mental disorder fail to seek or receive treatment (e.g., Merikangas et al., 2011 reported that less than 40% of adolescents attended mental health services due to

depressive problems). Another potential limitation is related to race/ethnicity. Most study participants were non-Hispanic White/Caucasian despite the fact that sample recruitment was based on random sampling. In this respect, it is worth noting that several studies have revealed the influence of race/ethnicity on depressive symptom course (Adkins, Wang, Dupre, van den Oord, & Elder, 2009; Arizaga et al., 2018; Brown, Meadows, & Elder, 2007). Racial and ethnic differences in depression developmental trajectories may be related to family disadvantages and inequalities derived from less stable environments (Mossakowski, 2008; Walsemann, Gee, & Geronimus, 2009). Further studies should therefore include higher samples of participants from other racial/ethnic groups. Finally, anxiety symptoms were not monitored during the follow-up period in this study. As some studies suggested (e.g., Chaiton et al., 2013; de la Torre-Luque et al., 2019), trajectories of depressive symptoms could be linked to anxiety symptom course.

These limitations notwithstanding, our findings have potentially valuable clinical implications. The identification of different patterns

of depressive trajectories and factors that predict each trajectory membership and outcome could provide insight into the impact of depression symptoms and its course on the development of mental health problems in the general population.

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CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

DATA AVAILABILITY STATEMENT

The authors confirm the absence of shared data.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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