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How does developmental advising impact college students? Findings from medical students in China

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ABSTRACT

This study contributes evidence on the impact of developmental advising using a national sample of students in the undergraduate clinical medicine program in China ($n = 122{,}932$). Using a combination of instrumental variable regression and structural equation modeling, the study explored beyond low-touch informative intervention and fully presented how developmental advising makes effects. A significantly positive advising effect on both academic and non-academic indicators was found, and it varies by the students' demographic features, family backgrounds, and pre-college experiences, suggesting its potential to address achievement gaps across students from different backgrounds. In addition, the mediating roles of self-efficacy and learning engagement that enable advising to impact academic improvement were verified, shedding light on how developmental advising impacts students' development.

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Developmental advising; student development; self-efficacy; learning engagement; academic improvement

Introduction

Among a host of discussions on higher education management approaches and interventions in the past decades, great importance has been attached to college advising in improving student development outcomes (Drake, Jordan, and Miller 2013; Ender, Winston, and Miller 1982; Grites 2013; Gurantz et al. 2020) . Previous studies have identified the positive impacts of advising on students' academic performance (Gordon, Habley, and Grites 2000; Heissrer and Parette 2002; Kuh et al. 2006). Whereas the body of scholarship on advising predominantly tries to explain the role of advising from perspective of how it helps bridging informative gaps. However, it fails to validate whether advising can fundamentally enhance students' cognitive and, particularly, noncognitive abilities, which is the essence of long-standing advocated developmental advising approach (Bailey and Dynarski 2011; Sneyers and Witte 2018). Current studies also lack strict examination on large-scale data basis, and thusly fail to dig deep into the effects across different populations or the impact path of college advising.

Utilizing nationwide survey data and rigorous causal effect analyses, our study delves into the less explored realm of developmental advising. Crookston (1994) proposed the most prominent modes of advising as prescriptive and developmental. As summarized by Grites (2013), compared to the

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informative service under the prescriptive mode, the essence of developmental advising is distinct with the following characters. *Holistic*. The approach concerns about the whole student in educational, career and personal development, and acknowledges that these dimensions cannot be treated independently. *Based on student growth*. The developmental approach attempts to take students from their point of entry, along each dimension, and facilitate growth. *Shared activity*, where both students and advisors contribute to this effort, and the degree of learning depends on both sides. There has been widespread call within the academic community and among educators to promote the implementation of developmental advising. However, there has been limited empirical research to examine its effectiveness (Broadbridge 1996; Crookston 1994; Ender, Winston, and Miller 1982; Harris 2018; Smith 2002).

Chinese college advising is uniformly implemented at the national level and has been attached with significant strategic importance. Initially driven by political motives, the advising system has evolved over the years into a crucial tool in university management (Sun and Yuen 2012; Zhang, Hu, and Pope 2002; Zhou, Li, and Gao 2016). Directives from central government provide guidelines on the roles, as well as professional practices, of student counselors. These align with the inherent requirements advocated by developmental advising. For instance, the student-centered concept of 'fostering integrity and promoting rounded development of people' is mandated as the fundamental mission of all universities (Central People's Government of People's Republic of China 2012). Rooted in the Confucian tradition, this concept also resonates with the expression of students' holistic development in the Chinese context. The document issued jointly by Central Committee of Communist Party of China and the State Council (2017) explicitly mandates that universities should 'adhere to educating all students comprehensively throughout the entire process,' and the assigned responsibilities in academic support, career planning and psychological counseling (Ministry of Education, 2017) outline the direction for students' holistic development in Chinese higher education. Closed counselor-student relationship is also highly encouraged in China's higher education system (Duan et al. 2015). According to the regulations issued by Ministry of Education (2017), counselors are expected to become life mentors for students' growth and success, as well as trusted companions for maintaining a healthy lifestyle. The entire process guidance, including involvement into students' personal life and campus events, makes it possible to fulfill the responsibilities of the role.

Our study used data from medical students in China who, similar to students in other disciplines, decide their study major after passing the College Entrance Examination, and shed light on the typical problems faced by general college students. Multiple studies in the extant literature on medical students have revealed their high pressure in academic studies, personal wellness, and career identification, which have been proved to be closely interconnected. For example, a high level of psychological stress among medical students is associated with their learning and training workload (Dyrbye et al. 2019; Hill, Goicochea, and Merlo 2018), and the academic burnout rate in recent decades has disclosed the declining interest in medical careers (Are et al. 2018). The condition for medical students appears to worsen after the COVID-19 pandemic, as higher levels of stress, depression, and anxiety have been found in medical students since the outbreak (Klein and McCarthy 2022; Paz et al. 2022), indicating more intensive demand for institution support. The problems faced by medical students are concentrated reflection of the common dilemmas experienced by college students. Studies on medical students call for inclusive advising services for individual needs in mental health, career planning, and academic success (Dyrbye et al. 2019; Kim et al. 2013), thereby indicating the general guidelines for the development of college students. By answering how advising addresses the students' problems and focusing on this representative group, we believe that the findings of our study can be applied to the larger population.

Evidenced by medical students' experience with advising in China's higher education system and incorporating both academic and nonacademic indicators in the outcomes, this study presented an evaluation on how the student-centered and relationship-emphasized advising services influence students' holistic growth, thusly paying attention to the effects of developmental advising. Based

on a national sample and applying causal inference approaches, our study firstly provided empirical evidence for the effects of developmental advising. Through the heterogeneity effect analysis, the study contributed to our understanding in advising by finding how this effect varies across the students' demographic features, family backgrounds, and pre-college experiences. In the last step, the study used structural equation modeling to examine early literatures that underlined the mediation effect of self-efficacy and learning behaviors that contribute to students' academic improvement.

Literature review and research hypotheses

Evaluation on the effects of advising

Crookston (1994) categorized advising into prescriptive mode and developmental mode. Prescriptive advising describes the traditional relationship in which the advisors take the initiative to fulfill their role's requirements by providing useful information on students' limitations. Several randomized controlled trials have evidenced that such informative advising has positive effects on college retention or graduation, as it helps understanding in the enrollment policies, mapping the institution's resources, and planning their academic career (Castleman and Goodman 2018; Hoxby and Turner 2013; Smith 2002). Some studies found a greater impact on female students (Castleman and Goodman 2018; Young-Jones et al. 2013) and ethnic minorities (Bettinger and Evans 2019; Phillips and Reber 2022), while first-generation students benefit less (Li and Bao 2016; Young-Jones et al. 2013). However, Gordon (Gordon, Habley, and Grites) have early pointed out the disadvantage of this advising mode, as advisors refrain from involving into students' personal life limited by time and expertise. This argument was evidenced by recent studies that undermined the effects of low-touch advising interventions (Dobronyi, Oreopoulos, and Petronijevic 2019; Gurantz et al. 2020; Phillips and Reber 2022). Several other experiments found a significant influence on students' perceived gains, but not grades (Mu and Fosnacht 2019; Young-Jones et al. 2013). Researchers suspect that the scope of advising aspects is responsible for this differential relationship, as self-reported gains reflect students' evaluation of their overall development while grades measure academic performance (Young-Jones et al. 2013). These results implied that academic advising is not only for diagnosis and intervention of academic difficulties, but also for students' holistic development.

Compared to the prescriptive mode, the developmental advising seeks to improve the students' cognitive, affective, and moral growth, and the degrees of learning depend on engagement by both sides (Broadbridge 1996; Crookston 1994; Ender, Winston, and Miller 1982; Harris 2018; Smith 2002) . However, little empirical research has explored in detail the process of advising or addressed the other metrics of students' learning outcomes as described under the developmental advising mode (Mu and Fosnacht 2019). Additionally, as most studies draw on program-based evaluations or local statistics, existing examinations on advising effects may be subject to bias. This study aims to fill the gaps with causal effects analyses on developmental advising.

How advising impacts students' development

Within the context of extensive theoretical discussions explaining how advising influences students' development, the significance of self-efficacy and learning engagement can never be overstated (Bandura 1977; Becker and Gable 2009; Wu et al. 2020; Yusuf 2011). Bandura (1977) described self-efficacy as a student's belief in the capability of solving problems and completing tasks while more specifically, it refers to the capability of learning concerning time management and goal setting. Learning engagement is defined as 'student's active participation in academic and co-curricular or school-related activities, and commitment to educational goals and learning' (Christenson, Reschly, and Wylie 2012). As summarized by Reeve (2012), student engagement has been addressed with behavioral, emotional, and cognitive components. Behavioral engagement refers to students' participation, effort, on-task attention, and persistence in school-related tasks. Emotional

engagement includes students' feelings like interest, enthusiasm, curiosity, and enjoyment about the tasks while cognitive engagement refers to using learning and self-regulatory strategies.

Bandura's Social Cognitive Theory (Bandura 1986) explains how individual, behavior and environment reciprocally interact with each other, providing theoretical basis for understanding the influence mechanism for developmental advising. According to this theory, the environment influences individuals' judgement about their capacities, which are important determining factors of how they behave. This explains how informal contacts or personal relationships with teachers in the context of developmental advising aid in the students' self-efficacy (Stuart Hunter and White 2004;), and efficacy beliefs influence motivation, cognitive processing, educational practices and skill development (Hayat et al. 2020; Linnenbrink and Pintrich 2003; Sökmen 2021; Yun and Park 2020). In understanding the interplay between students' self-efficacy and their learning activities, studies underscored the intermediate role of career-related motivation in the transformation of students' efficacy belief into their engaging behaviors (Komarraju and Nadler 2013; Lent, Brown, and Hackett 1994), and others explained how advising could facilitate career-making process by aiding in developing students' efficacy belief. For example, the recent studies of a comprehensive college transition program showed how institutional supports like advisor meetings were responsive to students' asset to build their self-efficacy, which was linked to career interests and satisfaction with courses and majors, and eventually promoted student success (Hypolite, Kitchen, and Kezar 2022; Kitchen et al. 2021).

Research purposes and hypotheses

While the majority of existing studies lack a rigorous evaluation of advising effects on students' holistic outcomes, as emphasized in the developmental mode, our study seeks to address this gap. Through strict causal inference analyses with nationwide sample, we aim to provide compelling evidence regarding the impact of developmental advising on students and elucidate its influence mechanism. This paper is guided by the following research purposes.

Research purpose 1: Examine the relationship between developmental advising and the students' holistic development.

Research purpose 2: Examine the effects of advising across different populations.

Research Purpose 3: Examine the influence pathway of developmental advising. Based on existent theories and findings, this paper used students self-perceived improvement in academic achievements as the measure of academic performance and hypothesizes the following to address our last research purpose.

H1 College advising ultimately predicts student academic performance by affecting their self-efficacy.

H2 Learning engagement mediates self-efficacy and academic performance.

H3 Students' subject interests and future career identity at least partly mediate their self-efficacy and learning engagement.

Methods

Data and participants

This study utilized nationwide data from the China Medical Student Survey (CMSS) 2020. Jointly created by the National Center for Health Professions Education Development and the Association for Health Professions Education Research in China, CMSS remains the largest and most detailed survey of medical education in China to date. In 2020, CMSS involves 107 out of 165 schools offering clinical medicine education programs in China. Over 150,000 verified responses were collected in survey. CMSS 2020 covers six sections enquiring about the students' basic information, pre-college experiences, academic learning and extracurricular activities, teaching and services, clinical

learning, and academic success and placement (NCHPED, 2020). We limited the sample to include only students from undergraduate medical education institutions and excluded students from schools with fewer than 100 survey participants.

Our final sample included 122,932 students from 102 schools. 59.6% of the participants were female, 11.8% were ethnical minority students. Students from only-child families and urban families accounted for 38.2% and 55.6%, respectively. 53.9% of the schools were comprehensive universities and 46.1% were independent colleges. The distribution was quite equal regarding the schools' locations, with 26.5% from Western regions, 32.4% from Middle regions and 41.2% from Eastern regions. All these demographic and institutional figures aligned with the distribution in the CMSS total sample.

Measures

The first two research purposes in our study are concerned with whether college advising affects the academic and non-academic metrics in the students' development. Our treatment variable was the students' overall satisfaction with advising. The outcome measures in these sections involved the students' interests in medical studies, learning engagement, self-efficacy in learning, identity of medical careers, self-reported improvement of academic achievements, and estimation of their year-end ranking. The outcomes reflect the students' holistic development in mental, vocational, and academic aspects.

Satisfaction with advising

Participants indicated on a Likert scale ranging from 1 (Totally disagree) to 5 (Totally agree) the extent to which they agree that they are satisfied with school's academic advising, psychological counseling, and career advising services. As the three variables cover all the main functions of college advising, they were used in principal component analysis (PCA) to identify the latent structure related to students' satisfaction with school's advising services. Cronbach's reliability test was conducted, and the test results of Cronbach's alpha achieved an overall high of 0.932 suggesting overall reliability of the research instrument for factor analysis (Chan and Idris 2017). The Kaiser-Meyer-Olkin index (KMO) measure was 0.765, indicating a suitable level of sampling adequacy, and Bartlett's test of sphericity was significant ($p < .001$), supporting the factorability of the correlation matrix. The results of PCA using varimax rotation are presented in Table S1 as supplementary material of this journal.

Interests in medical study

This was a dummy variable that was generated from a five-point scale measuring how much the participant agreed with the statement that he or she was interested in the current field of study, given options of Very much agree, Agree, Neutral, Disagree, and Very much disagree. For students who agreed or very much agreed, we counted 1 for this variable; otherwise, we counted 0.

Learning engagement

The second outcome variable observed how much participants were engaged in learning. A scale of 1 (Never) to 5 (Always) was used to indicate the frequency of eight behaviors of learning, which were used in PCA to identify the latent structure of participants' learning engagement. The Cronbach's alpha was 0.769 and KMO was 0.811, indicating the appropriation of this analysis. The loadings after rotation are presented in Table S1.

Self-efficacy

Similarly, four variables indicating participants' learning status were used in PCA to identify their self-efficacy level. One component was extracted. The Cronbach's alpha was 0.704 and KMO was 0.717. We summarize the results of PCA in Table S1.

Career identity

We also obtained this variable via PCA on career identification and behavior scales. Two components appear to capture the essence of participants' career identify. The Cronbach's alpha was 0.912 and KMO was 0.943. See the results of PCA in Table S1.

Improvement in academic achievements

The estimation of improvement in academic achievements was obtained via PCA on the students' self-reported increases in acquisition of science and academics, clinical skills, understanding of health and society and professional qualifications. We used this variable to estimate the students' improvements in medical study. The Cronbach's alpha was 0.892 and KMO was 0.814, as presented in Table S1.

Ranked in top 10%

The last outcome variable was a dummy variable that asked participants to report their year-end overall ranking. We counted 1 for students ranked in the top 10% of the class; otherwise, we counted 0. In this way, the variable virtually measured whether the student was positioned among the best group in medical study.

We controlled for a series of covariates of the students' demographic characteristics, such as gender, only-child condition, family category and ethnicity. Measures associated with family background, pre-college experience and experience in college education are included in our control variables. Detailed descriptive statistics of these nominal variables are presented in Table 1.

Analytical methods

Instrumental variable regression

We began our analysis by using a linear regression that regresses the medical students' development outcomes on their satisfaction with advising. Considering the possibility of endogeneity of self-reported advising satisfaction, we employed the instrumental variable (IV) approach and carried

Table 1. Descriptive statistics of the control variables ($N = 122,932$).

	Number	Percentage		Number	Percentage
Gender			**Medical Background Family**		
Female	73,215	59.6	No	108,717	88.4
Male	49,717	40.4	Yes	14,215	11.6
Only Child			**High School Experience**		
No	75,976	61.8	From key high school	59,698	48.6
Yes	46,956	38.2	From ordinary school	63,234	51.4
Family Category			**Whether College Admission Result is Expected**		
Rural Family	54,566	44.4	Below expectation	45,773	37.2
Urban Family	68,366	55.6	Around expectation	69,175	56.3
Ethnic			Above expectation	7,984	6.5
Others	14,556	11.8	**Mistreatment Experience in College**		
Han	108,376	88.2	No	103,298	84.03
Father's Education	Yes	19,634	15,97		
No college	107,251	87.2	**Satisfaction with Medical Education**		
College and above	15,681	12.8	Strongly disagree	1,825	1.48
Mother's Education	Disagree	5,782	4.70		
No college	111,53	7.1	Neutral	44,044	35.83
College and above	11,402	23.7	Agree	61,950	50.39
Family Income (¥)	Strongly agree	9,331	7.59		
Below 50,000	52,627	42.8			
50,000-100,000	41,885	34.1			
100,000-200,000	20,435	16.6			

out two-stage least squares (2SLS) regression to address this issue. The primary instrumental variable used was the median of the students' satisfaction with college advising in each grade and each college. We verified the validity of this IV as proposed by Angrist and Krueger (2001).

First, an individual's satisfaction level with advising services would not affect other students' development outcomes; thus, our IV met the *stable unit treatment value assumption*. Second, the IV in this study was obtained by calculating the arithmetic median of every participant's satisfaction in each school grade, enabling the equal access of individuals to the IV. Hence, the *random assignment assumption* was met. Next, satisfying the *exclusion restriction assumption* required that the IV affected the students' development outcomes only through the individual's satisfaction level with college advising. It is arguable that student learning behaviors may be associated with the entire learning environment, such as the courses and teaching or unsatisfactory experiences in school, which would be correlated to our IV. Therefore, we added students' satisfaction with overall medical education and their experience with mistreatment in college as control variables in the regression models. We also used fixed effects of provinces, colleges, and grades to control the factors at these levels.

The *nonzero average causal effect of the instrument on the treatment assumption* required a strong relationship between the IV and an individual's satisfaction with advising. We performed a set of tests to address this concern in Table 2. Specifically, Model 1 and Model 2 used different fixed effects, and in Model 3, we added all the control variables. Kleibergen-Paaprk Wald F statistic ($F = 110.57$, $p = .000$) in the weak identification test helped us reject the null hypothesis, thus qualifying

Table 2. Advising effects: first-stage regression results.

	College-grade median			Mean of two other grades
Dependent variable: advising satisfaction	Model 1	Model 2	Model 3	Model 4
IV	0.296***	0.294***	0.183***	−0.267***
	(0.025)	(0.025)	(0.025)	(0.088)
First-stage F-value	144.07	141.02	715.31	724.67
Gender			−0.008	−0.008
			(0.006)	(0.006)
Ethnic			0.004	0.004
			(0.011)	(0.011)
Only-child condition			0.011*	0.011*
			(0.006)	(0.006)
Father's education in college	0.001	0.000		
			(0.010)	(0.010)
Mother's education in college		0.006	0.004	
			(0.011)	(0.011)
Family category			0.004	0.005
			(0.005)	(0.005)
Family annual income	0.003	0.003		
			(0.004)	(0.004)
Medical background family	−0.011	−0.010		
			(0.008)	(0.008)
High school experience	0.023***	0.022***		
			(0.005)	(0.005)
College admission results			0.058***	0.058***
			(0.005)	(0.005)
Satisfaction with medical study	0.545***	0.546***		
			(0.007)	(0.007)
Mistreatment experience in college	−0.272***	−0.271***		
			(0.010)	(0.010)
College fixed effects	Yes	Yes	Yes	Yes
Grade fixed effects	Yes	Yes	Yes	Yes
Home province fixed effects	No	Yes	Yes	Yes
R-squared	0.058	0.061	0.254	0.256

Notes: Each column in each panel is from a separate linear regression. All the regressions control for college and grade fixed effects. The number of observations is 122,932. Robust standard errors in parentheses are clustered at college. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

this assumption. This result was consistent with the following theoretical justification: a higher overall satisfaction of the advising service largely represents a higher advising quality. Finally, the *monotonicity* assumption required the relationship between the IV and dependent variable to be either positive or negative for all individuals. Our IV was likely to fully satisfy this assumption as higher quality advising would positively affect most students' satisfaction. However, we acknowledge the possible existence of defiers, the number of which should be minimal.

To eliminate any potential biases arising from endogenous advisor assignment in the college across grades or in extreme cases, in a particular grade, we used the mean of two other random grades as IVs in Model 4 for robustness checks. The idea was that the average advising quality in a college was predictive of the quality of the sub-teams of advisors across grades, but the assignment of the advisors in the other grades was still random.

Interaction term regression

In the second section of our research, heterogeneity treatment effect analysis was carried out. In estimating the effects on the student groups, we generated the interaction terms of the treatment variable and each of the control variables and added them into the 2SLS model, which helped us identify the heterogeneity in the advising effects across demographic features, family backgrounds, and pre-college experiences.

Structural equation modelling

To understand the advising's influencing mechanisms on the students' academic results, structural equation modeling (SEM) was performed to test the hypotheses of our research model, and the mediation analyses are discussed. We used the improvement in academic achievements to represent academic performance, and structural equation modeling was performed.

Results

Advising effects on students' development outcomes

We performed 2SLS regression to address the first research question. The ordinary least squares (OLS) results (Table 3) indicated positive correlations with the first five indicators at the 99% significance level. However, those OLS results were likely to be underestimated by negative omitted variable biases; students who on average had lower development outcomes were likely to report a higher satisfaction with the advising as they were more likely to receive the advising services.

The 2SLS estimates showed statistically significant effects of satisfaction with college advising on the students' interests in medical studies ($\beta = 0.121$), engagement ($\beta = 0.341$), self-efficacy ($\beta = 0.385$), and career identity ($\beta = 0.290$) at the 99% significance level. Additionally, we found positive effects on the students' chances of ranking in the top tier ($\beta = 0.050$) at the 90% significance level. A positive correlation was identified between advising experiences and improvement in academics, but it failed in the significance tests. We present the second-stage results in Table 4. The robustness checks using the other two instrumental variables in Table 5 showed similar results.

Heterogeneity treatment effects

The interaction regression facilitated our understanding of the heterogeneity of the effects. Our results in Table 6 showed that traditionally disadvantaged students benefited more from college advising. Specifically, advising would be more conductive to the formation of subject interests and self-perceived academic improvements for first-generation students whose parents did not obtain college education, students from rural families, low-income families, families with multiple children, and ordinary high schools. Advising appeared to provide more benefits to students from families with no medical background on nonacademic indicators, including subject interests, self-

Table 3. Advising effects: OLS regression results.

Variables	Interest	Engage	Efficacy	Career identity	Academic achievement	Top rank
Advising	0.117***	0.250***	0.381***	0.288***	0.140***	0.011***
	(0.003)	(0.004)	(0.007)	(0.005)	(0.003)	(0.001)
Gender	−0.026***	−0.108***	0.088***	−0.006	−0.002	−0.052***
	(0.003)	(0.005)	(0.006)	(0.004)	(0.006)	(0.003)
Ethnic	0.013***	0.008	0.011	−0.004	0.007	0.029***
	(0.004)	(0.008)	(0.010)	(0.008)	(0.010)	(0.004)
Only-child condition	0.006*	0.024***	0.035***	0.012***	−0.026***	0.001
	(0.003)	(0.005)	(0.006)	(0.004)	(0.006)	(0.003)
Father's education in college	0.004	0.056***	0.039***	0.017**	−0.018*	0.012***
	(0.005)	(0.007)	(0.011)	(0.007)	(0.009)	(0.003)
Mother's education in college	0.012**	0.061***	0.067***	0.015**	−0.007	0.005
	(0.005)	(0.008)	(0.012)	(0.007)	(0.009)	(0.004)
Family category	0.008***	0.025***	0.065***	0.021***	−0.006	0.007***
	(0.003)	(0.004)	(0.006)	(0.004)	(0.005)	(0.002)
Family annual income	0.015***	0.012***	0.042***	0.021***	0.004	0.003**
	(0.001)	(0.003)	(0.003)	(0.002)	(0.003)	(0.001)
Medical background family	−0.012***	0.001	0.007	−0.005	−0.060***	0.001
	(0.004)	(0.008)	(0.011)	(0.006)	(0.007)	(0.004)
High school experience	0.030***	0.078***	0.108***	0.058***	0.006	0.026***
	(0.003)	(0.004)	(0.006)	(0.004)	(0.005)	(0.002)
College education results	−0.002	−0.051***	−0.060***	−0.004	0.002	−0.040***
	(0.003)	(0.004)	(0.005)	(0.003)	(0.004)	(0.002)
Satisfaction with medical study	0.099***	0.168***	0.150***	0.156***	0.108***	0.001
	(0.002)	(0.004)	(0.005)	(0.004)	(0.004)	(0.001)
Mistreatment experience in college	0.026***	0.082***	0.196***	0.047***	−0.050***	0.071***
	(0.004)	(0.008)	(0.009)	(0.007)	(0.009)	(0.004)
Constant	0.307***	−0.590***	−0.708***	−0.641***	−0.374***	0.144***
	(0.011)	(0.017)	(0.026)	(0.019)	(0.018)	(0.007)
R-squared	0.147	0.244	0.216	0.291	0.322	0.038

Notes: Each column in each panel is from a separate linear regression. All the regressions control for college and grade fixed effects. The number of observations is 122,932. Robust standard errors in parentheses are clustered at college. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

efficacy, learning engagement and career identity. Students from ordinary high schools were also associated with more improvements in self-efficacy with advising service, compared to those from key high schools. Meanwhile, male students appeared to receive more benefits in self-perceived academic improvements and chances of being ranked in top 10%, both at 95% significant level. It should be noted that the effects of advising on the indicator of top ranking varies across different student groups. For instance, traditionally advantaged students such as males, students from Han ethnicity, those whose fathers received college education, urban students, and those from key high schools were more likely to be ranked in top 10% after advising. On the other hand, indicators such as having a mother without college education, receiving college admission below their expectation, coming from a low-income family, families with multiple children, or families with no medical background tend to show advantages in top rankings. However, these test results are not statistically significant, thus caution is warranted in discussing the effects of advising on top rankings across different student groups. Different groups do not show significant variations in learning engagement. For most development outcomes, the effects of advising do not show significant variations across grades, ethnic groups, and levels of college admission results, but advising services were linked to higher chances of top ranking for students who fell short of their expected college admission results.

How developmental advising impact students' development

Our final step aims to explore the cause-and-effect dynamics behind the advising effects. The estimation results are summarized in Table 7. We report two goodness-of-fit indices, namely the

Table 4. Advising effects: 2SLS regression results.

Variables	Interest	Engage	Efficacy	Career identity	Improvement in achievement	Top rank
Advising	0.121***	0.341***	0.385***	0.290***	0.155	0.050**
	(0.039)	(0.111)	(0.115)	(0.094)	(0.189)	(0.020)
Gender	−0.026***	−0.107***	0.088***	−0.006	−0.001	−0.052***
	(0.003)	(0.005)	(0.006)	(0.005)	(0.006)	(0.003)
Ethnic	0.013***	0.008	0.011	−0.004	0.007	0.029***
	(0.004)	(0.008)	(0.010)	(0.008)	(0.010)	(0.004)
Only-child condition	0.006*	0.023***	0.035***	0.012***	−0.026***	0.001
	(0.003)	(0.005)	(0.006)	(0.004)	(0.007)	(0.003)
Father's education in college	0.004	0.056***	0.039***	0.017**	−0.018*	0.012***
	(0.005)	(0.008)	(0.011)	(0.007)	(0.009)	(0.003)
Mother's education in college	0.012**	0.061***	0.067***	0.015**	−0.007	0.005
	(0.005)	(0.008)	(0.012)	(0.007)	(0.010)	(0.004)
Family category	0.008***	0.025***	0.065***	0.021***	−0.006	0.006***
	(0.003)	(0.004)	(0.006)	(0.004)	(0.005)	(0.002)
Family annual income	0.015***	0.012***	0.042***	0.021***	0.004	0.002*
	(0.001)	(0.003)	(0.003)	(0.002)	(0.003)	(0.001)
Medical background family	−0.012***	0.002	0.007	−0.005	−0.060***	0.001
	(0.004)	(0.008)	(0.011)	(0.006)	(0.008)	(0.004)
High school experience	0.030***	0.076***	0.108***	0.058***	0.006	0.025***
	(0.003)	(0.004)	(0.006)	(0.004)	(0.007)	(0.002)
College education results	−0.002	−0.056***	−0.061***	−0.005	0.001	−0.042***
	(0.004)	(0.007)	(0.008)	(0.006)	(0.011)	(0.002)
Satisfaction with medical study	0.097***	0.118*	0.148**	0.155***	0.100	−0.020*
	(0.021)	(0.060)	(0.062)	(0.051)	(0.102)	(0.011)
Mistreatment experience in college	0.027**	0.107***	0.197***	0.048*	−0.046	0.081***
	(0.012)	(0.032)	(0.035)	(0.028)	(0.053)	(0.007)
R-squared	0.129	0.192	0.195	0.251	0.052	0.011

Notes: Each column in each panel is from a separate linear regression. All the regressions control for college and grade fixed effects. The number of observations is 122,932. Robust standard errors in parentheses are clustered at college. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Comparative Fit Index (CFI) and the Tucker-Lewis index (TLI) as well as two badness-of-fit measures, that is, the root mean square error of approximation (RMSEA) and the standardized root mean square residual (SRMR). In addition, we report Chi-square statistics and the associated *p*-value. The best practice in SEM analysis, in general, is to consider a model with good fit if it meets the thresholds across all four indices: TLI ≥ 0.95, CFI ≥ 0.95, RMSEA ≤ 0.06, and SRMR ≤ 0.07 (Bagozzi and Yi 1988; Fan and Sivo 2007). Per the fit indices reported in Table 7, our model should be accepted. Sobel-Goodman tests (Abu-Bader and Jones 2021) were carried out to examine the mediation roles in these hypotheses (Table 8).

The structural equation modeling (SEM) results offer comprehensive insights into the influence pathway of advising on students' academic improvement, shedding light on the hypotheses posited in the study. Firstly, H1 posited that college advising predicts student academic performance by affecting their self-efficacy. The SEM results affirmed this hypothesis, showing a significant direct effect of advising on self-efficacy ($\beta = 0.565$). Additionally, the mediation analysis supported H1, revealing a substantial mediation effect through learning engagement ($\beta = 0.406$) based on the Sobel-Goodman test ($p = .000$). It should be noted that the direct impact of advising on engagement was also identified, indicating the informative intervention as described in prescriptive mode, introduction of learning resources for example, was also in effect. Secondly, H2 suggested that learning engagement mediates the relationship between self-efficacy and academic performance. The SEM results corroborated this hypothesis, indicating a significant direct effect of self-efficacy on learning engagement ($\beta = 0.251$), and a subsequent mediation effect on academic improvement ($\beta = 0.485$). Finally, H3 postulated that students' subject interests and future career identity mediate their self-efficacy and learning engagement. The SEM results supported H3, indicating significant direct

Table 5. Robustness check of 2SLS IV regression.

Variables	Interest	Engage	Efficacy	Career identity	Improvement in achievement	Top rank
Advising	0.120***	0.374***	0.449***	0.309***	0.158	0.027*
	(0.022)	(0.074)	(0.063)	(0.046)	(0.107)	(0.015)
Gender	−0.026***	−0.107***	0.089***	−0.006	−0.002	−0.052***
	(0.003)	(0.005)	(0.006)	(0.005)	(0.006)	(0.003)
Ethnic	0.012***	0.008	0.011	−0.005	0.007	0.029***
	(0.005)	(0.008)	(0.010)	(0.008)	(0.010)	(0.004)
Only-child condition	0.006*	0.023***	0.035***	0.012**	−0.025***	0.001
	(0.003)	(0.005)	(0.006)	(0.004)	(0.006)	(0.003)
Father's education in college	0.004	0.057***	0.040***	0.018**	−0.017*	0.012***
	(0.005)	(0.008)	(0.011)	(0.007)	(0.009)	(0.004)
Mother's education in college	0.012**	0.060***	0.067***	0.015**	−0.006	0.005
	(0.006)	(0.008)	(0.012)	(0.007)	(0.010)	(0.004)
Family category	0.008**	0.025***	0.064***	0.020***	−0.006	0.007***
	(0.003)	(0.004)	(0.006)	(0.004)	(0.005)	(0.002)
Family annual income	0.015***	0.011***	0.041***	0.021***	0.004	0.003**
	(0.001)	(0.003)	(0.003)	(0.002)	(0.003)	(0.001)
Medical background family	−0.013***	0.002	0.009	−0.005	−0.061***	0.000
	(0.004)	(0.008)	(0.011)	(0.006)	(0.007)	(0.004)
High-school experience	0.030***	0.075***	0.106***	0.058***	0.007	0.026***
	(0.003)	(0.004)	(0.006)	(0.004)	(0.006)	(0.002)
College education results	−0.002	−0.058***	−0.064***	−0.005	0.001	−0.040***
	(0.003)	(0.005)	(0.005)	(0.004)	(0.008)	(0.002)
Satisfaction with medical study	0.098***	0.099**	0.114***	0.145***	0.098*	−0.008
	(0.012)	(0.038)	(0.033)	(0.024)	(0.057)	(0.008)
Mistreatment experience in college	0.027***	0.115***	0.213***	0.053***	−0.046	0.075***
	(0.008)	(0.020)	(0.020)	(0.016)	(0.030)	(0.006)
R-squared	0.107	0.159	0.178	0.223	0.043	0.016

Notes: Each column in each panel is from a separate linear regression. All the regressions control for college and grade fixed effects. The number of observations is 122,932. Robust standard errors in parentheses are clustered at college. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

effects of self-efficacy on both interest ($\beta = 0.214$) and career identity ($\beta = 0.362$), and significant indirect effects on learning engagement through interest ($\beta = 0.204$) and career identity ($\beta = 0.295$). It should be noted that among the four variables having direct effects on learning engagement, the scale of self-efficacy was the largest. Moreover, it can indirectly affect engagement through the mediating factors of interest and career identity. This highlighted the strong link between self-efficacy and engagement. Building upon the aforementioned analyses, we depicted the validated influence pathway of advising on students' perceived academic improvements in Figure 1.

Discussion and conclusion

Utilizing nationwide survey data in China and causal inference analyses, this study fully presented the effect of developmental college advising on medical school students and how it operates, and the findings will apply to general college students. First, our findings revealed that college advising contributes to the medical students' subject interests, career identity, self-efficacy levels, learning engagement, and year-end ranking in the top tier. Incorporating both academic and non-academic indicators, this finding went beyond a mere low-touch informative intervention and addressed attention to developmental advising. It is noteworthy that the observed effects on the noncognitive indicators are statistically significant, in contrast to the insignificant albeit positive effect on self-reported academic improvement. Additionally, the impact on achieving top-ranking status is relatively modest. This suggests the need for heightened attention to the influence of developmental

Table 6. Interaction regression results.

Covariate	Dependent variables	Treatment	Covariate	Interaction
	Interest	0.123***	−0.026***	**−0.006**
	Engage	0.337***	−0.107***	**0.011**
Gender (Reference Group: Female)	*Self-efficacy*	0.372***	0.088***	**0.035**
	Identity	0.303***	−0.006	**−0.038***
	Academic achievements	0.126	−0.001	**0.081****
	Top rank	0.040*	−0.052***	**0.026****
Grade (Reference Group: Freshmen)	*Interest*	0.143***	0.013***	**−0.004**
	Engage	0.479***	−0.104***	**−0.024**
	Self-efficacy	0.537***	0.092***	**−0.026**
	Identity	0.248***	−0.003	**0.007**
	Academic achievements	0.116	0.000	**0.007**
	Top rank	0.042	−0.051***	**0.001**
Ethnic (Reference Group: Ethnic minority)	*Interest*	0.157***	0.006*	**−0.039**
	Engage	0.319***	0.007	**0.024**
	Self-efficacy	0.426***	0.013	**−0.044**
	Identity	0.345***	−0.003	**−0.059**
	Academic achievements	0.220	0.009	**−0.070**
	Top rank	0.033	0.028 ***	**0.017**
Only-child condition (Reference Group: children with siblings)	*Interest*	0.139***	0.006*	**−0.047*****
	Engage	0.358***	0.023***	**−0.046**
	Self-efficacy	0.397***	0.035***	**−0.031**
	Identity	0.305***	0.012***	**−0.040***
	Academic achievements	0.192	−0.026***	**−0.099****
	Top rank	0.052**	0.001	**−0.006**
Father's education in college (Reference Group: No college)	*Interest*	0.126***	0.004	**−0.049*****
	Engage	0.346***	0.056***	**−0.048**
	Self-efficacy	0.390***	0.039***	**−0.052**
	Identity	0.291***	0.017**	**−0.010**
	Academic achievements	0.162	−0.017*	**−0.070***
	Top rank	0.050**	0.012***	**0.001**
Mother's education in college (Reference Group: No college)	*Interest*	0.125***	0.014**	**−0.073*****
	Engage	0.343***	0.062***	**−0.040**
	Self-efficacy	0.385***	0.067***	**−0.001**
	Identity	0.291***	0.016	**−0.030**
	Academic achievements	0.158	−0.005	**−0.063***
	Top rank	0.050**	0.005	**−0.005**
Family category (Reference Group: Rural family)	*Interest*	0.136***	0.008**	**−0.028***
	Engage	0.359***	0.002	**−0.033**
	Self-efficacy	0.411***	0.065***	**−0.041**
	Identity	0.308***	0.021***	**−0.034**
	Academic achievements	0.218	−0.006	**−0.116*****
	Top rank	0.045*	0.006***	**0.008**
Family annual income (Reference Group: Below 50,000)	*Interest*	0.161***	0.015***	**−0.023*****
	Engage	0.371***	0.011***	**−0.017**
	Self-efficacy	0.413***	0.042***	**−0.016**
	Identity	0.328***	0.021***	**−0.022**
	Academic achievements	0.260	0.003	**−0.060*****
	Top rank	0.057**	0.002*	**−0.004**
Medical background family (Reference Group: No medical background)	*Interest*	0.129***	−0.012***	**−0.052*****
	Engage	0.351***	0.002	**−0.064****

	Self-efficacy	0.396***	0.006	**−0.073****
	Identity	0.300***	−0.005	**−0.069***
	Academic achievements	0.165	−0.060***	**−0.066**
	Top rank	0.053**	0.001	**−0.020**
High school experience (Reference Group: Ordinary high school)	*Interest*	0.147***	0.030***	**−0.045*****
	Engage	0.348***	0.076***	**−0.012**
	Self-efficacy	0.418***	0.107***	**−0.057****
	Identity	0.306***	0.059***	**−0.028**
	Academic achievements	0.204	0.006	**−0.083*****
	Top rank	0.042**	0.026***	**0.011**
College admission results (Reference Group: Below expectation)	*Interest*	0.126***	−0.002	**−0.003**
	Engage	0.291***	−0.056***	**0.030**
	Self-efficacy	0.370***	−0.061***	**0.009**
	Identity	0.293***	−0.005	**−0.002**
	Academic achievements	0.121	0.001	**0.020**
	Top rank	0.085***	−0.042***	**−0.021***

Notes: Each row in each panel is from a separate linear regression. All the regressions control for college and grade fixed effects. The number of observations is 122,932. Robust standard errors in parentheses are clustered at college. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 7. Structural equation modeling results.

Structural	Direct effects	Indirect effects	Total effects
Self-efficacy			
Advising	0.565***		0.565***
Interest			
Self-efficacy	0.214***		0.214***
Advising	0.155***	0.121***	0.276***
Career identity			
Self-efficacy	0.362***		0.362***
Advising	0.353***	0.205***	0.558***
Engage			
Self-efficacy	0.251***	0.121***	0.371***
Interest	0.211***		0.211***
Career identity	0.209***		0.209***
Advising	0.201***	0.316***	0.517***
Academic improvement			
Engage	0.207***		0.207***
	$\chi2 = 636.751$, $p = 0.000$		
	RMSEA = 0.036		
	SRMR = 0.018		
	CFI = 0.997		
	TLI = 0.987		

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 8. Mediation estimation results.

			Sobel-Goodman mediation test	
Hypothesis	Path	Mediation Proportion	coef.	*P*
H1	advising →self-efficacy → engage	0.406	0.201	0.000
H1&H2	self-efficacy → engage → improve	0.485	0.063	0.000
H3	self-efficacy → interest → engage	0.204	0.083	0.000
H3	self-efficacy → identity → engage	0.295	0.121	0.000

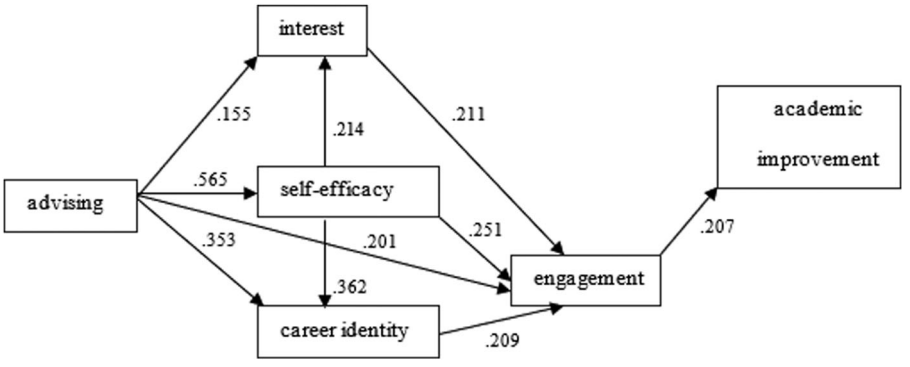

Figure 1. Influence pathway of advising on academic improvement.

advising on noncognitive abilities. The mechanism inherent in developmental advising, emphasizing holistic student development through shared activities, may offer insights into these outcomes.

Secondly, our analysis of the heterogeneous treatment effects unveiled a more intricate pattern of effects across various student groups. Traditionally disadvantaged students, including those who are first-generations, grow from rural families, belong to low-income households, come from families with multiple children or attend ordinary high schools, derive greater benefits from college advising. The advising process demonstrates a pronounced positive influence on the development of subject interests and self-perceived academic improvements for these students. Students from families without a medical background also exhibit notable improvements in nonacademic indicators, such as subject interests, self-efficacy, learning engagement and career identity. The compensation effect is evident, wherein developmental advising bridges the gaps arising from demographic and family characteristics or pre-college experiences for traditionally disadvantaged students. The greater room for improvement (Castleman and Goodman 2018) and stronger sense of responsibility (Young-Jones et al. 2013) may explain part of the mechanism for this effect. This finding sheds light on the multifaceted impact of advising, suggesting its potential in addressing achievement gaps across students from different background.

Our study substantiates the mediating roles of self-efficacy beliefs and learning engagement in the advising process leading to academic improvement, providing empirical support for Social Cognitive Theory concerning the interplay between environment, individual and behaviors. Exploring the influence pathway also enhances our understanding of developmental advising. On the one hand, the intricate relationship between cognitive and noncognitive abilities underscores the importance of student-centered advising for holistic development. One the other hand, the pivotal role of self-efficacy serves as a reminder of the significance of providing students with emotional support through positive advisor-student relationship and interactions, precisely in line with the principles advocated in developmental advising. The investigation into mechanisms of advising also contributes to the discussion of the heterogeneous analysis in our study. The compensation effect of advising suggests that disadvantaged students may benefit more from developmental advising process, as they may experience a greater enhancement in noncognitive factors such as self-efficacy, which may subsequently translate into heightened career-related motivation and academic improvement.

The study has a few limitations. For example, failing to obtain more objective information on college advising services, we used individual satisfaction with advising services as an independent variable, which does not necessarily represent advising quality. The improvement in academic achievement variable in this study was also a self-reported item, which is probably less reliable than the administrative data. Another limitation arises with our data, as CMSS 2020 was conducted after the COVID-19 pandemic, which may influence participants' satisfaction with their advising experiences or advisors while the details need to be explored in future studies. However, given

the large body of observations, the error should be ignorable. The findings of this study offer meaningful insights supported by current theories, presenting practical implications for practitioners, and providing a foundation for future research aimed at enhancing our understanding and refining the college advising process for students.

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