Analytical study of the impact of age chronotype and time preferences on the academic performance of secondary school students from a modest social background
Estudio analítico del impacto del cronotipo de edad y las preferencias horarias en el rendimiento académico de los estudiantes de secundaria de origen social modesto

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Abstract. The biological factors of the human being are subject to both endogenous and exogenous circadian rhythms. The effects of the latter on cognitive, psychomotor and academic performance is burdensome. During the weekdays, the adolescent interactions are regulated by the school rhythm on the one hand and the biological fluctuations on the other. However, no studies till nowdays have investigated the relationship of academic performance with age and chronotype or analyzed students' time preferences of courses reviewing and familial socioeconomic status in a young Moroccan population. For this reason, we aimed to examine the impact of these variables on the scholar outcomes of Moroccan adolescents whose average age is 13 years, based on their grade levels.These students come from low-income families of five members on average. We used the "Morningness-Eveningness questionnaire (MEQ)" through its 19 multiple-choice questions to measure chronotype, while courses reviewing preferences on school days and familial socioeconomic status were investigated using a directive interview. As for the academic performance measures, we used the grade point average (GPA), extracted from "MASSAR platform" for each school subject.The majority of the sample is intermediate type (51.91 ± 9.66), 23.5% of it is morning type while the rest is evening type. Morning type students at all grade levels had a higher grade point average compared to moderate evening type. The results showed that chronotype has a main effect on both Humanistic/linguistic ($p < .024$) and Physical education grades ($p < .031$). While age ($p < .001$), mothers' educational level and fathers financial status all have a significatif effect on students' academic performance. Our results opt for the consideration of students'circadian typology, grade levels, time preferences and familial socioeconomic status when planning the school calendar, aiming from administrators to make small changes in the scheduling patterns that may improve the academic performance at a law-cost.
Keywords: circadian preference; circadian typology; chronotype; academic performance.

Resumen. Los factores biológicos del ser humano están sujetos a ritmos circadianos tanto endógenos como exógenos. Los efectos de estos últimos sobre el rendimiento cognitivo, psicomotor y académico son gravosos. Durante los días laborables, las interacciones de los adolescentes están reguladas por el ritmo escolar, por un lado, y por las fluctuaciones biológicas, por otro. Sin embargo, hasta ahora ningún estudio ha investigado la relación del rendimiento académico con la edad y el cronotipo ni ha analizado las preferencias horarias de los estudiantes en cuanto a la revisión de los cursos y el estatus socioeconómico familiar en una población joven marroquí. Por esta razón, nos propusimos examinar el impacto de estas variables en los resultados escolares de adolescentes marroquíes cuya edad media es de 13 años, en función de su grado escolar. Estos estudiantes pertenecen a familias socialmente desfavorecidas con una media de cinco miembros. Para medir el cronotipo se utilizó el cuestionario «Morningness-Eveningness» (MEQ) a través de sus 19 preguntas de opción múltiple, mientras que las preferencias de revisión de los cursos en los días de clase y el estatus socioeconómico familiar se investigaron mediante una entrevista directiva. En cuanto a las medidas de rendimiento académico, se utilizó el promedio de notas (GPA), extraído de la «plataforma MASSAR» para cada asignatura escolar.La mayoría de la muestra es de tipo intermedio ($51,91 \pm 9,66$), el 23,5% de ella es de tipo matutino mientras que el resto es de tipo vespertino. Los estudiantes de tipo matutino en todos los niveles de grado tuvieron un promedio de calificaciones más alto en comparación con los de tipo vespertino moderado. Los resultados mostraron que el cronotipo tiene un efecto principal tanto en las calificaciones de Humanística/lingüística ($p < .024$) como en las de Educación Física ($p < .031$). Mientras que la edad ($p < .001$), el nivel educativo de las madres y la situación económica de los padres tienen un efecto significativo sobre el rendimiento académico de los estudiantes. Los resultados obtenidos abogan por la consideración de la tipología circadiana de los estudiantes, los niveles de grado, las preferencias horarias y el estatus socioeconómico familiar a la hora de planificar el calendario escolar, con el objetivo de que los administradores realicen pequeños cambios en los patrones de programación que puedan mejorar el rendimiento académico a un coste legal.
Palabras clave : preferencia circadiana; tipología circadiana; cronotipo; rendimiento académico

Introduction

Circadian rhythms as biological rhythms are not entirely dependent on the exogenous components, but also on

chronotype as long as it is associated with interaindividual differences in the synchronization of endogenous circadian preferences (Adan et al., 2012). The chronotype categorizes three different types notably Morning type, Evening type, both divided into extreme and moderate types, and Neither type including the majority of the population (Adan et al. 2012; Horne & Ostberg 1976). The individual's lifespan is characterized by progressive delays in the M-E continuum during development (Fischer et al., 2017; Randler, Fassl & Kalb, 2017). Children are predisposed to be early risers until the start of adolescence, when a shift to evening begins and reach the pic in late adolescence (Montaruli et al. 2017a, 2017b, 2019). The biological configuration of the chronotype at this age clashes with the students' waking-up times leading to a misalignment between their internal rythms and school life. It is what Wittman et al. (2006) called social jetlag (SJL). The increase of the latter has been associated with lower academic achievement as well as other disorders in adolescents and university students (Genzel et al., 2013; Haraszti et al., 2014; Díaz-Morales & Escribano 2015). A previous research has confirmed that during morning school hours, Morning-type adolescents perform better than the Evening-type's (Zerbini & Merrow 2017; Tonetti et al., 2015).The circadian preferences notably chronotype (Roeser, Schlarb & Kübler, 2013) not only influence cognitive abilities but also academic performance. It has been shown that there is a slightly positive relationship between eveningness and a person's cognitive abilities, but a negative relationship with academic performance; conversely for morningness (Preckel, Lipnevich, Schneider & Roberts, 2011). These findings has been confirmed later in more recent studies that investigated the role of morningness–eveningness in academic performance (Tonetti, Natale & Randler, 2015; Arrona-Palacios & Díaz-Morales, 2017). No one can deny that the child's environment is very dynamic as a result of all interactions, especially family interactions. It has been shown that parents have an effect on their children productivity in school. An American study has confirmed that the parents' level of education is associated with a better GPA, independently of all possible confounders (Assari, 2019). A year later, a chinese study came to confirm the fact that parents' educational attainment had an impact on the next generation academic performance. The higher the parents' educational level, the better of their children's academic achievement. The study also highlighted the eminent impact of the father's educational level which influences the child's performance more than that of the mother (Wang et al., 2020). However, this may not hold true for a Moroccan population, which prompts us to investigate this fact. The family influences both a child's academic behavior and academic achievement

in important ways because it is the primary and most important environment a child is exposed to (Li & Qiu, 2018). In the family structure, the socioeconomic side is very essential given its high impact on children academic achievemnent. Knowing that the occupational status is the main characteristic that marks this specific side, it has been shown that the father's occupational status had a significantly stronger impact than the mother's in many countries such us Austria, Germany, Korea, Switzerland, United Kingdom, United States and others (Marks, 2007). Academic performance has a multidimensional character involving a set of psychological (Bouiri, Lotfi & Talbi, 2021), neuroscientific (Elouafi, Lotfi & Talbi, 2021) and chronobiological (Sabaoui, Lotfi &Talbi, 2021) parameters. The latter can be manifested in the impact of the chronotype not only on cognitive aspect, but also on what is psychomotor. As one study shows, morning students are more physically active than evening ones (Schaal, Peter & Randler, 2010). Therefore, it is evident that both academic and psychomotor performances differ from one person to another due to the disparity of a set of factors and of which circadian preferences, age and socioeconomic status are an integral part. The current study has two main objectives, the first is to explore what are the predictors of better school performance, making the hypothesis that it will generally be better in students with good familial socioeconomic conditions. The second objective is to determine whether the student's age and chronotypic tendency (morning, neither, or evening) have any effect if they are postulated as predictors of academic performance. According to our second hypothesis, both age and chronotype should have a predictive effect on scholar outcomes.

Material and methods

Participants

The sample population was composed of students in the first, second, and third years of a public middle school in the provincial direction of AL Fida Mers Sultan, linked to the Academy of Education and Training of the Casablanca-Settat region. The recruitment took place at the end of the first semester of the 2019/2020 school year (January and February). Therefore, we chose our sample according to the following inclusion criteria: only schoolchildren that belong to public sector institutions in the Moroccan territory, aged between 11 and 16 years. On the other hand, any student with health problems was excluded from the study. It has involved seven classes with an average of 33 students per each, including three classes from the 7th grade, two from the 8th grade, and two others from the 9th grade, aged (13 ± 1,90) years, with a total of

231 students. Twelve of these students were absent, and 19 misused the Morningness-Eveningness Questionnaire (MEQ), which led to their cancellation. Ultimately, a total sample of 200 students was deemed eligible to participate, of which 59% were females. Participants were categorized as M-type, N-type, or E-type based on their MEQ score. They all attend school 6 days a week for 10 months a year, followed by 2 months of annual leave. School days started around 8:30 am and ended at 6:30 pm at the latest, except for Friday and Saturday, when the course ended earlier (12:30 pm). On days when students attend school in both the morning and afternoon, they go home for the lunch break at 12:30 pm and go back to school at 2:30 pm for the afternoon period. A five-minute break between classes is allowed, and a ten-minute snack break is scheduled at 10:25 am and 4:25 pm. The students' school rhythm favors the morning period. Their study hourly volume is much more concentrated in the mornings (20 hours), which practically doubles the hourly volume devoted to the afternoons (10 hours). As for the physical education sessions, they are all scheduled in the mornings for the entire sample. According to the accessibility to personal information databases and academic performance of middle school students in the previously cited area, we are able to compare these adolescents' academic outcomes in relation to chronotype, age, time preferences of courses reviewed, and familial socioeconomic status with what previous studies have shown in the educational field. According to the accessibility to personal information databases and academic performance of middle school students in the previously cited area, we are able to compare these adolescents' academic outcomes in relation to chronotype, age, time preferences of courses reviewed, and familial socioeconomic status with what previous studies have shown in the educational field.

Variables and instruments

To gather the database, including collecting information through the survey conducted during this study, it was necessary to contact the school's administration for the students' personal data and scholar grades.

The students in our sample filled out an information sheet about their personal data, notably: gender, age, family members, ranking among siblings, parents' educational level, and occupation. Both the administration and the guardians confirmed the information they provided.

Regarding their temporary preference for scholar activities during their free time on school days, they were asked to reply to the following question: "What time do you prefer to review H/L and scientific subjects in your free time during weekdays?" and "What time do you prefer to practice physical activities in your free time during weekdays?" On the one hand, the students' answers to these two questions provided us with an idea about the time preferences of reviewing H/L and scientific subjects and physical exercise in their free time, when they are outside school. On the other hand, we used the "Morningness-Eveningness Questionnaire" to measure the students' chronotype and compare it with their academic performance.

Morningness-Eveningness Questionnaire (MEQ). Participants completed the validated version of the Morningness-Eveningness Questionnaire (MEQ) designed by Horne and Ostberg (1976), and it aims to specify the circadian typology (morning or evening preferences) of each profile with good reliability (Cronbach's a = 0.82) (Smith, Reilly and Midkiff, 1989). For our sample, the reliability of the questionnaire was studied, obtaining a Cronbach's alpha coefficient of 0.79. Higher MEQ values indicate a greater preference for the morning. Circadian typology, or chronotype, is also a marker that closely influences performance. Several studies have used this questionnaire as a relevant tool to conduct their research, often related to chronobiology. The questionnaire consists of 19 multiple-choice questions with a point scale ranging from 0 to 6 for each choice. The total score indicates the circadian type of the profile tested. The (MEQ) as a quasi-countiuous variable was converted to the chronotype as a categorial variable.

Questions about course review and physical activity time preferences. They were used to collect data about the preferred time for both H/L and scientific subjects' review and physical activity. Each of the two questions was associated with a list of time ranges, namely: morning, afternoon, and evening. Students then checked off the period of time at which they preferred to review their courses or do physical activity. They had to choose only one period per question.

Grade point average (GPA) of humanistic/linguistic, scientific and practical school subjects. The school grades (GPA) were extirpated from the "MASSAR platform", a school management system adopted by the Moroccan Ministry of National Education. These school subjects are: Earth and Life Sciences (ELS), Physics and Chemistry (PC), Mathematics (Mth), Arabic language (AL), French language (FL), Islamic Education (IE), History and Geography (HG), and Physical Education (PE). Known that the Moroccan grading system is coded from 0 (the lowest) to 20 (the highest), the students' minimum grade in our sample is 6,13, and the maximum is 19,20. To treat the academic outcomes of the eight school subjects, they were divided into three categories: scientific subjects (ELS, PC and Mth), humanistic/linguistic subjects (IE, HG, AL and FL) and practical subjects (PE), with average scores of (12,32 ± 3,02; 13,63 ± 2,99; and 14,21 ± 2,09) respectively.

Familial socioeconomic status. To collect data on socioeconomic familial status, we asked questions about the number of family members, ranking among siblings, the educational level of parents, as well as their occupation, since there is a common view that the socioeconomic background of a family is best measured by the father's occupation, because in the vast majority of families, the adult male remains the most attached to the labour market throughout the life cycle. In the current study, we gathered data regarding both parents' occupations to compare the effects of each one of them on the children's academic performance.

Design and Procedure

Our study highlights the correlation between the circadian typology and a student's academic performance. The quantitative analysis of the data collected by the questionnaire was chosen for its systemic logic, which allows us to explain the interaction between the student's chronotype, his school level (age) and his academic performance. The choice of the MEQ questionnaire also refers to the simplicity of the language used. The latter is clear, coherent, and precise, a thing that facilitates the understanding of what is asked of the students despite the disparity between their school levels and familial socioeconomic conditions. For each class, paper questionnaires were distributed, explained, and detailed. To ensure the maximum reliability of the necessary data, the answers were recorded immediately after the explanation of each question. It should also be noted that this research took place in 2019 before the spread of the COVID-19 pandemic, and therefore the results concern the biological rhythms of a pre-COVID population.

Statistical Analysis

The statistical analysis of the means and standard deviations of the results obtained is established by the ANOVA analysis of variance. The purpose of this analysis is to examine the effects of familial socioeconomic status, age, circadian preferences, and chronotype on students' academic performance. We used the post-hoc test and paired multiple comparisons test to identify the means that contributed to the effect. while we calculated the size effect by Cohen's d (Cohen, 1998). The Student's test and the Chi II test were also used.

Results

Students familial socioeconomic status and academic performance

To study the effect of parental educational and financial levels on their children's school performance, we divided these two variables into five categories. The parents' educational levels include: unschooled (25.5% vs 14.5%), primary school (19% vs 11%), middle school (18.5% vs 25%), high school (24.5% vs 29%), and university (12.5% vs 20.5%) for mothers and fathers respectively. For the occupations, 77% of mothers are housewives, 9.5% are female workers, 6.5% are employees, and 7% are public servants, while 8.5% of fathers are unemployed, 6% are retired, 55.5% are workers, 12.5% are employees, and 17.5% are public servants. According to the statistical results, the vast majority of parents have not gone beyond high school (79.5% of fathers and 87.5% of mothers). One-way ANOVA of the total sample indicated a significant effect of the mothers' education on the students' academic performance of both scientific subjects (F = 3,539, p =.008, partial 2=,068, 95% confidence interval CI = 0.005-0.128) and humanistic/linguistic (H/L) subjects (F = 3,469, p =.009, 2=,066, 95% CI = 0.005-0.126). The post-hoc test confirmed a very significant difference between the mothers who have reached the university level and the ones who haven't gone to school in their impact on both scientific (p .02) and H/L grades (p .012). While no significant effect of mothers' education on practical subject grade, nor the effect of fathers' education on students' academic performance were found (Tables 1 and 2). Contraiwise, fathers' occupation shows a very significant effect on the H/L grades (F = 3,894, p =. 005, 2 =,074, 95% CI = 0.008-0.137). The post-hoc test confirmed a very significant difference between employed and unemployed fathers (p.003), indicating that higher family income matters. none of the mothers' occupations was associated with students' grades (Tables 1 and 2).

The association of age and academic performance

To determine whether age impacts the academic achievements of students, we performed a one-way analysis of variance (ANOVA) as the dependent variable and students' school grades (7th , 8th, and 9th grade) as factors. We found a main effect of age (F= 9.828, p <.001, η2= .091, 95% CI=0.025-0.167) showing better grades in H/L subjects for younger adolescents (7th grade) compared to the older ones in both 8th and 9th grade (14,83±2,17 vs 13,33±3,14, p <.008) and (14,83±2,17 vs 12,68±3,20, p <.001) respectively. Conversely for practical subject grades, a main age effect (F= 9,027, p <.001, η2=.084, 95% CI=0.021-0.159) was observed and significant differences between students showed that older ones in both 8th and 9th grade had better PE performances compared to the younger ones in 7th grade (14,79±1,35 vs 13,38±1,55 , p <.001) and (14,45±2,85 vs 13,38±1,55, p <.008) respectively (Tables 1 and 2).

Table 1.
One way Anova correlations of both endogenous and exogenous variables and students' academic performance

Parameters															
	Academic performance (ANOVA)														
	Scientific subject					Huumanistic/Linguistic subjects					Practical subject				
	M±SD	F	p	η²	95% CI	M±SD	F	p	η²	95% CI	M±SD	F	p	η²	95% CI
Chronotype		1,247	ns	,012	0-0.52		3,808	,024*	,037	0-0.095		2,051	.031*	,020	0-0.068
Scholar grade (Age)		1,050	ns	,011	0-0.048		9,828	<,001***	,091	0.025-0.167		9,027	<,001***	,084	0.021-0.159
TPCR		_	ns	_	_		_	ns	_	_		_	ns	_	_
Mother's educational level		3,539	,008*	,068	0.005-0.128		3,469	,009*	,066	0.005-0.126		1,760	ns	,035*	0-0.080
Father's educational level	12,32± 3.02	_	ns	_	_	13,63± 2.99	_	ns	_	_	14,21± 2.09	_	ns	_	_
Mothers occupation		_	ns	_	_		_	ns	_	_		_	ns	_	_
Father's occupation		2,053	ns	,040	0-0.089		3,894	,005**	,074	0.008-0.137		,785	ns	,016*	0-0.045
Number of family members		_	ns	_	_		_	ns	_	_		_	ns	_	_
Ranking among siblings		_	ns	_	_		_	ns	_	_		_	ns	_	_

(*) p-value < .05 is statistically significant. (**) p-value < .01 is statistically very significant. (***) p-value < .001 is statistically highly significant.

Table 2.
ANOVA and post-hoc analysis: grades vs cronotype, gardes vs students garade level, gardes vs mother's educational level and grades vs father's occupation

Parameters		Academic performance						
		Scientific subject		Humanistic/Linguistic subjects		Practical subject		
		Mean ± Sd	p	Mean ± Sd	p	Mean ± Sd	p	
Chronotype	M vs E type	12,89±2,99 ; 11,89±2,77	ns	14,61±2,47 ; 12,91±3,02	,032*	14,21±1,25 ; 13,58±3,08	ns	
	M vs N type	12,89±2,99 ; 12,22±3,10	ns	14,61±2,47 ; 13,46±3,10	ns	14,21±1,25 ; 14,39±1,98	ns	
	N vs Etype	12,22±3,10 ; 11,89±2,77	ns	13,46±3,10 ; 12,91±3,02	ns	14,39±1,98 ; 13,58±3,08	.033	
Scholar grade (Age)	7th vs 8th grade	12,75±2,45 ; 12,11±3,12	ns	14,83±2,17 ; 13,33±3,14	,008*	13,38±1,55 ; 14,79±1,35	<.001***	
	7th vs 9th grade	12,75±2,45 ; 12,08±3,44	ns	14,83±2,17 ; 12,68±3,20	<,001***	13,38±1,55 ; 14,45±2,85	.008*	
	8th vs 9th grade	12,11±3,12 ; 12,08±3,44	ns	13,33±3,14 ; 12,68±3,20	ns	14,79±1,35 ; 14,45±2,85	ns	
Mother's educational level	University Vs unschooled	13,73±2,42 ; 11,47±3,05	,020*	15,14±1,84 ; 12,80±2,97	.012	14,79±1,42 ; 14,13±1.34	ns	
Fathers's occupation	Employee vs Unemployed person	13,64±2,79 ; 11,22±3.96	ns	15,10±2,54 ; 11,75±3,75	,003**	14,51±1,44 ; 14,47±2,10	ns	

(*) p-value < .05 is statistically significant. (**) p-value < .01 is statistically very significant. (***) p-value < .001 is statistically highly significant.

Courses reviewing preferences on school days and academic performance

According to Table 3, courses' reviewing preferences in schooldays' free time differ in the three daytime periods. The preference rates in H/L subjects, scientific subjects and physical activity practice have been shown to be 26% vs 14.5% vs 86.5% in the morning; 47% vs 39.5% vs 5% in the afternoon; and 27% vs 46% vs 8.5% in the evening.

Generally, students in our sample are more likely to practice physical activity in the morning, review their H/L courses in the afternoon, and their scientific subjects in the evening. According to the TPCR effect study, only age had an effect on the reviewing time preferences of both H/L (p< .023) and scientific subjects (p< .041).

The post-hoc test showed a statistically significant difference between older and younger students (9th vs 7th grade) in the H/L subjects morning reviewing preference (p< .017). Conversely, the difference between younger and older students (7th vs 9th grade) was observed in the evening preference of the same subjects (p<.040). Younger students (7th grade) have also shown differences in morning reviewing preferences of scientific subjects compared to the older ones (8th grade),(p<.046). Meanwhile, no significant differences between students' grade and their practical subject preferences, nor any significant effect of TPCR on academic performance were found (Table 1).

Evaluation of the relationship between chronotype & academic performance

According to the MEQ score, the three chronotype ranges were represented in our sample at different rates. The first one (42–58) refers to the intermediate type with a mean score of 51.91±9.66 and it was the most common chronotype in our sample (59%). The second (59-86) and the third (16-41) ranges refer to the morning and the evening types, representing 23.5% and 17.5% of the total sample, respectively.Chronotype was assigned as follows: 46 moderate M-type (29 F; 17 M); 1 extremely M-type (F); 118 N-type (68 F; 50 M); 34 moderate E-type (19 F; 15 M) and 1 extremely E-type (F). However, our study was conducted based on the three main categories of chronotype (M-, N- and E-types).We found a main effect of both age (p< .001) and mothers' educational level (p< .049) on students' chronotype. Significant differences were found between the chronotypes of students of the same garde level: M-type vs N-type 7th grade students (p< .016) and M-type vs E-type 7th grade students (p< .023); and between students from different grade levels: N-type 8th grade vs M-type 9th grade students (p< .006). Significant differences in chronotype were also found in students whose mothers had a primary school level, notably E-type vs N-type and M-type students respectively (p< .012 vs p< .032). While age and mother's education had

Table 3.
Correlations of all study variables with the TPCR of H/L, scientific and practical subjects according to Bonferroni, Chi square and ANOVA tests

Parameters		Circadien preferences of courses reviewing (Bonferroni and chi square)											
		%Scientific			p	%Humanistic/Linguistic			p	%Practical			p
		Morning	Afternoon	Evening		Morning	Afternoon	Evening		Morning	Afternoon	Evening	
Chronotype	M	19,1%	51,1%	29,8%	ns	34,0%	46,8%	19,1%	ns	87,2%	6,4%	6,4%	ns
	N	12,7%	38,1%	49,2%		25,4%	44,9%	29,7%		89,8%	4,2%	5,9%	
	E	14,3%	28,6%	57,1%		17,1%	54,3%	28,6%		74,3%	5,7%	20,0%	
Level grades	7th	8,8%	42,6%	48,5%	ns	16,2%	45,6%	38,2%	.023 *	92,6%	4,4%	2,9%	.040*
	8th	19,1%	42,6%	38,2%		25,0%	51,5%	23,5%		77,9%	5,9%	16,2%	
	9th	15,6%	32,8%	51,6%		37,5%	43,8%	18,8%		89,1%	4,7%	6,3%	
Mother's educational level	N.Sc	13,7%	49,0%	37,3%	ns	31,4%	43,1%	25,5%	ns	94,1%	2,0%	3,9%	ns
	P.Sc	13,2%	28,9%	57,9%		21,1%	44,7%	34,2%		84,2%	84,2%	10,5%	
	M.Sc	10,8%	37,8%	51,4%		18,9%	56,8%	24,3%		91,9%	5,4%	2,7%	
	H.Sc	22,4%	36,7%	100,0%		28,6%	44,9%	26,5%		79,6%	8,2%	12,2%	
	Univ	8,0%	44,0%	48,0%		28,0%	48,0%	24,0%		80,0%	4,0%	16,0%	
Father's educational level	N.Sc	13,8%	51,7%	34,5%	ns	24,1%	58,6%	17,2%	ns	89,7%	3,4%	6,9%	ns
	P.Sc	13,6%	40,9%	45,5%		13,6%	40,9%	45,5%		90,9%	4,5%	4,5%	
	M.Sc	12,0%	36,0%	52,0%		12,0%	36,0%	52,0%		88,0%	4,0%	8,0%	
	H.Sc	20,7%	37,9%	41,4%		20,7%	37,9%	41,4%		86,2%	6,9%	6,9%	
	Univ	9,8%	36,6%	53,7%		9,8%	36,6%	53,7%		80,5%	4,9%	14,6%	
Mothers occupation	H.Wi	14,3%	39,0%	46,8%	ns	26,0%	46,1%	27,9%	ns	88,3%	1,9%	9,7%	ns
	F.Wor	10,5%	42,1%	47,4%		21,1%	42,1%	36,8%		73,7%	21,1%	5,3%	
	Empl	23,1%	23,1%	53,8%		15,4%	53,8%	30,8%		76,9%	15,4%	7,7%	
	P.Ser	14,3%	57,1%	28,6%		42,9%	57,1%	0,0%		92,9%	7,1%	0,0%	
Fathers occupation	Unem	23,5%	35,3%	41,2%	ns	23,5%	47,1%	29,4%	ns	88,2%	11,8%	0,0%	ns
	Ret	8,3%	75,0%	16,7%		33,3%	50,0%	16,7%		91,7%	0,0%	8,3%	
	Wor	9,0%	37,8%	53,2%		26,1%	41,4%	32,4%		87,4%	4,5%	8,1%	
	Empl	8,0%	40,0%	52,0%		20,0%	60,0%	20,0%		68,0%	4,0%	28,0%	
	P.Ser	34,3%	34,3%	31,4%		28,6%	54,3%	17,1%		94,3%	5,7%	0,0%	
(Anova)		Mean ± Sd			p	Mean ± Sd			p	Mean ± Sd			p
Number of family members		4,97±1,149			ns	4,97±1,149			ns	4,97±1,149			ns
Ranking among siblings		1,04± 0,86			ns	1,04± 0,86			ns	1,04± 0,86			ns

(*) p-value < .05 is statistically significant. (**) p-value < .01 is statistically very significant. (***) p-value < .001 is statistically highly significant.

a significant effect on chronotype, the latter had a main effect on academic performance and specifically on H/L grades (F= 3,808, p < .024, $\eta2$= .037, 95% CI=0-0.095) and PE grades (F= 2,051, p < .031, $\eta2$= .020, 95% CI=0-0.068). The M-type students had better H/L subjects grades compared to the E-type students (14,61±2,47 ; 12,91±3,02, p< .032) and the N-type students had better PE grades compared to the E-type students (14,39±1,98 ; 13,58±3,08, p <.033). Meanwhile, the one way-ANOVA revealed that there were no significant differences (p > .05) among Scientific subject grades in chronotype scores (Tables 1 and 4).

Table 4.
Correlation of chronotype and all study variables (ANOVA, Bonferroni and Chi square tests)

n = 200	Chronotype (ANOVA, Bonferoni and Chi square)
TPCR	ns
Level grades	,001***
Mother's educational level	,049 *
Father's educational level	ns
Mothers occupation	ns
Fathers occupation	ns
Number of family members	ns
Ranking among siblings	ns

(*) p-value < .05 is statistically significant. (**) p-value < .01 is statistically very significant. (***) p-value < .001 is statistically highly significant.

Discussion

We remind you that the purpose of our study is to investigate the impact of both endogenous and exogenous factors on the academic performance of secondary school students from a modest social background, whose age category is around 13 years. The purpose of our study is to test the validity of the hypotheses assuming that academic performance is impacted by both environmental factors such as family socioeconomic status and endogenous factors such as age, chronotype, and times' preferences. It is important to note that socioeconomic and educational characteristics are among the exogenous factors that determine academic performance (Enright & Refinetti., 2017). This led us to investigate the impact of parents' educational and economic level on their children's scholarly outcomes. Our findings indicated a significant difference in the effects of mothers' education levels on both scientific (p< .02) and H/L (p< .012) grades between those who have attended college and those who have not. This aligns partially with Tõeväli and Kikas' findings (2016), demonstrating that positive relations were evident between mothers' ability attributions and the children's math performance (Tõeväli & Kikas, 2016). According to Silinskas and colleagues (2012), mothers are more stable and consistent in their support of their children's learning than fathers are, and they respond more strongly to their children's math performance (Silinskas et al., 2012). A few years later, Crede et al. (2015) have highlighted the significant impact of the mothers' educational background on the academic success of their children (Crede et al., 2015). Mothers are also more likely to provide greater care and support to their kids, as well as more effective household resource management, which positively affects their children's academic achievement (Currie &

Moretti, 2003; Plug, 2004; World Bank Group, 2019). Despite the fact that fathers' educational attainment in our sample has no effect on their children's academic performance, Aturupane et al.'s findings (2013) showed that both parents' educational level can have a favorable impact on their children's achievement (Aturupane et al., 2013). Further research in this direction is needed, especially since the literature barely addresses the relationship between the two parents' educational background and their children's academic performance in both scientific and H/L subjects.

On the other hand, mothers' positions in our study have no impact on how well their children perform academically in H/L subjects, regardless of their dads' economic status. According to reports, mothers are more involved in their children's interactions while husbands provide for their family financially in both western and eastern cultures (Cabrera, Volling & Barr, 2018; Chuang & Zhu, 2018). In the United States, for instance, fathers work twice as much as mothers do. While mothers read to their kids nearly twice as often (Froiland & Davison, 2014), the same in China, mothers are more involved in their children's educational activities compared to fathers (Chuang & Zhu, 2018). However, socioeconomic characteristics remain one among many other factors that could affect a child's academic achievement.

The H/L mean grades of younger students, who did better than older students, were impacted by age as an endogenous factor in our study. This might somewhat refer to memory. In some instances, it has been demonstrated that younger children have more accurate memories (Brainerd, Reyna & Holliday, 2018; Deng & Sloutsky, 2016). According to other studies, young children often propose explanations and solutions that are more in line with the observed data than older children or adults do. (Lucas et al., 2014; Seiver, Gopnik & Goodman, 2013; Walker, Bridgers & Gopnik, 2016). The latter can also be victims of synaptic pruning that causes memory deterioration, which may explain their poor performance on the H/L subjects. In contrast to the impact that age had on the performance of physical education in our students, the older ones performed better. Adolescents will most likely need to assert themselves more and boost their self-esteem more because they no longer find elementary school physical education as enjoyable as younger children do; especially since a positive physical education experience may increase children's involvement and value for learning (Garcia Bengoechea, Lorenzino & Gray, 2019). In a previous study, researchers confirmed that due to pubertal changes, adolescents become more aware of their bodies and compare themselves to others, which frequently leads to body image issues (Gestsdottir

et al., 2018). It is also important for them to demonstrate their abilities and make a positive impression, especially when other students have a significant influence on an individual's experience and participation in physical education (Wiltshire, Lee & Evans, 2017). During puberty, the child's body undergoes several morphological (Figueiredo et al., 2009) and hormonal changes (Malina, Bouchard & Bar-Or, 2004). The formation of bone and muscle mass increases (Phillip & Lazar, 2003), enabling the improvement of more complicated motor functions, including movement, as well as the development of muscle strength (Gallahue, Ozmun & Goodway, 2013). According to Gallahue, Ozmun and Goodway (2013), the child goes through three different phases that promote motor performance. The first is from the age of 7 to 10, a period that corresponds to the combination of fundamental movements such as running and jumping. The second, from the age of 11 to 13, is a period in which the child improves his or her movements, develops a better athletic orientation, and increases adaptation to training; and the third phase, from the age of 14, in which the child maximizes his or her abilities and physical, psychological, and tactical preparation. From the above, it would be understandable if children in the second and third phases were much more successful in physical education at school compared to those in the first one. Older students in our sample had indeed better grades in physical education compared to younger students. However, further research on the effect of age on school physical education grades is desirable to highlight these findings. Besides, students in our sample reveal their time preferences for courses reviewing between mornings for physical activity, afternoons for H/L subjects, and evenings for scientific subjects. Nevertheless, afternoons, as reported in the circadian rhythm literature, are the best time of the day to study for adolescents since their activity level is higher (Crowley, Acebo & Carskadon, 2007; Shapiro & Williams, 2015). However, no relationship was established between these time-review preferences and their academic performance. This is partially consistent with what Non and Templeaar report in their research on the relationship of time preference to academic performance. The latter is concentrated among relatively capable students and appears to be rather weak among low-achieving students (Non & Tempelaar, 2016).

Our results also highlighted the significant effect of students' chronotype on their academic performance, particularly in H/L ($p < .024$) and physical education grades ($p < .031$). The M-type grades in both H/L and scientific subjects were higher ($12,88\pm2.99$ vs $14,61\pm 2.47$) than for either the N-type ($12,22 \pm3.10$; $13,46 \pm 3.10$) or the E-type students ($11,89\pm2.77$; $12,91\pm 3.02$).

In a previous study, the average score of the theory exams for MT students was higher than for ET or NT students (Montaruli et al., 2019). It is to be noted that the majority of our students' study sessions are scheduled in the morning period, which could explain why the morning profiles in our sample had better academic grades compared to the N-type and E-type students. This is consistent with Van Der Vinne et al. (2014) findings, which support that early chronotypes scored significantly higher in both the early and late morning. The reason they support postponing school hours is that they propose to schedule exams in the early afternoon to give all students an equal opportunity to study (Van Der Vinne et al., 2014). Tristan Enright and Roberto Refinetti assumed that the cause of lower grades in E-type students could refer to the sleep deprivation that results from the early schedule of most schools that impairs the evening chronotypes' performance throughout the school day. However, they showed that the difference between the morning and evening profiles persists even after taking into consideration the time of day of classes (Enright & Refinetti 2017).

When compared to other theoretical subjects, physical education and students' chronotype have a nearly identical relationship. ET ($13,58\pm3,08$) performed worse than either the MT ($14,21\pm1,25$) or the NT($14,39\pm 1.98$) students on the PE. Montaruli et al (2019) shared the same findings regarding practical exams, when ET (26.6 ± 0.2) performed worse than either the MT (27.8 ± 0.2) or the NT students (26.9 ± 0.1). Otherwise, early morning types are more efficient, physically active, and pay more attention to the effects of physical activity (Schaal, Peter & Randler, 2010).

Limitation and suggestion

The uniqueness of our research in the context of our study made it difficult to discuss the findings in relation to the body of previous literature. There is no research that contrasts how children's performance in scientific and H/L subjects is affected by mothers' versus fathers' educational attainment. There is also surprisingly little research that compares the professions of mothers and fathers in relation to these same variables, as well as students' physical activity in relation to the education and financial status of each parent separately. The need for more study in this area is highly desirable.

Conclusions & perspectives

According to the results obtained in this study, neither the number of family members nor ranking among siblings had an effect on academic performance.

While both parents' educational attainment and economic status had an impact on school achievement, hence the importance of the family environment in the productivity of children. The biological rhythms of the different markers, of which circadian typology is mainly addressed in our study, contribute to the regulation of performance, particularly academic performance. From this study, it is found that the majority of students are intermediate. Due to diurnal changes, adolescents are generally alert in the late evening and therefore go to bed late at night (Gail, 2001). As a result, the morning types performed slightly better than the evening types and intermediates; they had higher academic scores in all H/L, scientific, and practical subjects. We also conclude that the late afternoon is the best time for course reviews on school days, while the morning is better for physical activity practice. This confirms what research has found about the circadian rhythm of alertness. Contrary to the majority of findings, we came to the conclusion that entering an upper scholar grade (becoming older) in our sample had a detrimental effect on the academic performance: students received lower H/L subject scores ($p<. 001$) and higher PE scores ($p< .001$) as they advanced in grades. This could be explained by the effect of cognitive, psychological, or behavioral constraints and changes that adolescents undergo as they grow up in a modest and disadvantaged social background.

This study can be conducted by educational managers in the interest of enhancing the student's time preferences when scheduling the school timetable both for the learning cycle and the assessment period. In order to obtain more relevant results in the field of chronobiology in relation to education, this research could be extended to a more diversified sample, including high school students, which would make it possible to compare the chronotype according to two different age groups, or rather between the two phases of adolescence: prepubertal and pubertal. This research can also be extended to the university environment to compare the chronotypes of students from different fields.

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