Motivation and academic performance in adolescence: a systematic meta-analytic review

Motivación y rendimiento académico en la adolescencia: una revisión sistemática meta-analítica

Motivação e desempenho académico na adolescência: uma revisão sistemática meta-analítica

青春期学生的学业动机及学业成绩：通过元分析进行系统综述

لدافع والأداء الأكاديمي في مرحلة المراهقة: مراجعة منهجية تحليلية تلوية

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Resumen

La adolescencia es un período en la vida humana en el que se advierte una bajada del interés y la motivación hacia los aspectos académicos y en el que la inmadurez del estudiante puede producir complicaciones en las actividades de aprendizaje. El presente meta-análisis estudia la relación entre la motivación y el rendimiento académico, así como las variables que pueden incidir en ella como el sexo o la edad. Comprende 48 bases de datos seleccionadas a partir de la aplicación de criterios de inclusión y exclusión en torno a temas clave como temporalidad (2012-2021), estadística clara, muestra centrada en la adolescencia y rendimiento académico medido a partir de pruebas estándar. Los pasos empleados para la elegibilidad de los estudios incluidos se basaron en una revisión manual por pares sobre los títulos, sobre los abstract y finalmente, un último paso de revisión de los manuscritos de manera completa obteniendo una muestra total de 144,012 participantes con una edad media de 14.65 años. Los resultados muestran un tamaño del efecto significativo positivo moderado entre motivación y rendimiento académico (*r* =0.327; *p*<0.001) no encontrando diferencias significativas en las variables moderadoras de sexo y edad. Por lo tanto, se concluye que la motivación es un óptimo predictor del éxito académico sin encontrar un efecto moderador, en las variables estudiadas, para esta etapa vital concreta. Todo ello tiene implicaciones prácticas a nivel pedagógico susceptibles de implementar intervenciones de carácter motivacional en el aula adolescente que mejoren el rendimiento académico.

Palabras clave: *motivación, rendimiento académico, educación secundaria, sexo, edad*

Abstract

Adolescence is a period in human life where a decline in interest and motivation towards academic aspects is observed, and the immaturity of students can lead to complications in learning activities. This meta-analytic review examines the relationship between motivation and academic performance, as well as variables that may influence it, such as gender or age. It includes 48 selected databases based on inclusion and exclusion criteria focusing on key topics such as temporality (2012-2021), clear statistics, samples centered on adolescence, and academic performance measured through standardized tests. The steps employed for the eligibility of included studies were based on a peer-reviewed manual review of titles, abstracts, and ultimately, a final step of comprehensive manuscript review, resulting in a total sample of 144,012 participants with a mean age of 14.65 years. The results reveal a significant moderate positive effect size between motivation and academic performance (r = 0.327; p < 0.001), with no significant differences found in the moderating variables of gender and age. Therefore, it is concluded that motivation is a strong predictor of academic success without a moderating effect found for these specific life stage variables. These findings have practical implications in terms of pedagogy, suggesting the implementation of motivational interventions in the adolescent classroom to enhance academic performance.

Keywords: Motivation, academic achievement, secondary education, gender, age

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Resumo

A adolescência é um período da vida humana em que se verifica um declínio do interesse e da motivação face aos aspetos académicos e em que a imaturidade do estudante pode levar a complicações nas atividades de aprendizagem. Esta meta-análise estuda a relação entre a motivação e o desempenho académico, bem como as variáveis que a podem afetar, tais como o sexo e a idade. Inclui 48 bases de dados selecionadas a partir da aplicação de critérios de inclusão e exclusão em torno de temas-chave como a temporalidade (2012-2021), estatística clara, amostra centrada na adolescência e desempenho académico medido por testes standard. As etapas utilizadas para a elegibilidade dos estudos incluídos basearam-se numa revisão manual por pares sobre os títulos, os abstracts e, por fim, numa etapa final de revisão dos manuscritos de forma exaustiva, obtendo uma amostra total de 144 012 participantes com uma idade média de 14,65 anos. Os resultados revelam um tamanho do efeito significativo positivo moderado entre motivação e desempenho académico (r =0,327; p<0,001), não encontrando diferenças significativas nas variáveis moderadoras de sexo e idade. Conclui-se, portanto, que a motivação é um ótimo preditor do sucesso académico sem encontrar um efeito moderador, nas variáveis estudadas, para esta fase da vida concreta. Isto tem implicações práticas a nível pedagógico suscetíveis de implementar intervenções de caráter motivacional na sala de aula dos adolescentes que melhorem o desempenho académico.

Palavras-chave: Motivação, desempenho académico, ensino secundário, sexo, idade.

摘要

青春期是人生的一个阶段，伴随着这个阶段的出现，学生对学术领域的兴趣和动机下降，并且他们不成熟的行为会让学习活动变得更加复杂。因此该研究对学业动机和学业成绩间的关系，及影响两者关系的变量如性别、年龄等进行元分析。考虑到时间段（2012 至 2021）、清晰的统计数据、专注于青少年的样本、通过标准测试得到的学业成绩等重要因素，根据纳入和排除标准，对挑选出来的 48 个数据库进行分析。通过人工方法，对纳入的研究标题、摘要进行同行审查，之后对完整手稿进行最终审查。这样我们得到了包含 144. 012 个参与者的总样本，他们的平均年龄在 14. 65 岁。研究结果显示学业动机与学业成绩间呈中等程度正相关（r =0.327；p<0.001），没有发现性别和年龄这两个调节变量对关系的显著影响。因此得到的结论为：在这个人生阶段，学习动机是预测学业成绩的良好因素，研究涉及的变量并未显示出调节作用。该研究结论在教学领域有实际应用意义，通过在课堂上实施带有鼓励动机特点的干预措施，来提高青少年的学业成绩。

关键词： 动机、学业成绩、中等教育、性别、年龄

ملخص

المراهقة هي فترة في حياة الإنسان يحدث فيها انخفاض في الاهتمام والدافع تجاه الجوانب الأكاديمية والتي يمكن أن يتسبب فيها عدم نضج الطالب في حدوث مضاعفات في أنشطة التعلم. يدرس هذا التحليل التلوي العلاقة بين الدافع والأداء الأكاديمي, وكذلك المتغيرات التي يمكن أن تؤثر عليه, مثل الجنس أو العمر "وهي تتألف من 48 قاعدة بيانات تم اختيارها من تطبيق معايير التضمين والاستبعاد حول القضايا الرئيسية مثل الوقت (2012-2021)''(والإحصاءات الواضحة وعينة تركز على المراهقة, والأداء الأكاديمي المقاس من الاختبارات القياسية. استندت الخطوات المستخدمة لأهلية الدراسات المشمولة إلى مراجعة يدوية من قبل الزملاء على العناوين والملخصات وأخيرًا خطوة أخيرة لمراجعة المخطوطات بشكل كامل, والحصول على عينة إجمالية من 144,012 مشاركًا مع مشاركة عدم وجود فروق (0.001> p ; r = 0.327) عمرمتوسط 14.65 سنة. أظهرت النتائج وجود حجم تأثير معنوي إيجابي متوسط بين الدافع والأداء الأكاديمي ذات دلالة إحصائية في المتغيرات الوسيطة للجنس والعمر. لذلك, استنتج أن الدافع هو مؤشر أمثل للنجاح الأكاديمي دون العثور على تأثير معتدل, في المتغيرات المدروسة, لهذه المرحلة الحيوية المحددة. كل هذا له آثار عملية على المستوى التربوي والتي تكون عرضة لتنفيذ التدخلات التحفيزية في الفصل الدراسي للمراهقين التي تعمل على تحسين الأداء الأكاديمي.

الكلمات الدالة: عمر, جنس, التعليم الثانوي, الأداء الأكاديمي, الحافز

Introduction

The concept of motivation systematically appears in relation to education and learning. Motivation is an emotional state that predisposes individuals towards action, in this case, learning (Ruiz Martín, 2020). This definition explains the intrinsic motivation of human beings, which refers to the inclination towards learning, the so-called "desire to learn." On the other hand, motivation can also be defined as the way to make students feel attracted to the subject matter (Chomsky, 2017). This refers to extrinsic motivation, which is something external that can be constructed and is malleable (Karlen et al., 2019). In the 1980s, the study of human beings'

ability to initiate, maintain, and achieve goals, as well as the causes that provoke motivation and its opposite, led to the emergence of Self-Determination Theory (SDT). Researchers discovered that when basic psychological needs such as competence, autonomy, and relatedness are satisfied, motivation increases. Conversely, when these needs are not met, frustration can lead to maladaptation (Ryan & Deci, 2000). This tendency becomes more pronounced during adolescence, a transitional period in which individuals are not yet mature enough to sustain their attention without immediate rewards (Orbegoso, 2016), and their mood easily fluctuates due to biological causes (Fernández Poncela, 2014; Symonds et al., 2019; Tuominen et al., 2020; Vijayaukumar et al., 2018). The different motivations of students pose a challenge for educators worldwide, albeit with certain cultural differences. For example, in the Western world, it is believed that ability generates success, while in Asia, effort is considered the driver of students' progress and achievement (Xu et al., 2021). In this regard, the meta-analysis conducted by Quílez Robres et al. (2021) indicates a significant moderate effect size in the relationship between motivational aspects and academic performance. It also highlights geographical location as a moderating variable in this relationship, although at earlier ages, unlike the present study.

Adolescents are capable of perceiving a favorable motivational context both in their family environment and at school (Deci & Ryan, 2008). When there is a lack of motivation in the classroom and avoidance or complete apathy prevails, academic performance will be fair or null (Theis et al., 2019; Uka & Uka, 2020). Therefore, it is important to foster extrinsic motivation that can modulate and enhance intrinsic motivation (Jafari & Asgari, 2020). Students can perceive the lack of motivation in their peers but also value positive learning experiences (Muslim et al., 2020; Williams et al., 2018).

For some research, motivation is influenced by self-beliefs, which have a greater impact than reality (El-Adl & Alkharusi, 2020; Habóck et al., 2020). This phenomenon, known as self-efficacy, was first studied by Bandura (1997), who considered it one of the best predictors of academic success. Other studies also conclude that higher self-efficacy leads to greater academic motivation and, therefore, better performance in learning tasks (Bortoletto & Boruchovitch, 2013; Brown et al., 2008; Mendez & Peña, 2013; Nie et al., 2011; Ornelas et al., 2013; Pajares & Shunk, 2001; Valiante, 2000; Zimmerman, 2005). Thus, if the concept of failure is present in the student's mind, it leads to a decrease in expectations of success, hindering learning and personal development (Ornelas et al., 2013). There is even a positive correlation between self-efficacy and scores, task goals, and achievement motives, but no differences have been found regarding gender. Any existing differences are due to the student's perceived self-efficacy (González-Fernández et al., 2020). Similarly, the meta-analysis conducted by Quílez Robres et al. (2021) does not show a moderating effect in the gender variable. However, as previously mentioned, it is worth noting that their study focused on earlier educational stages, such as Primary Education (6-12 years).

When it comes to academic performance, considering its complexity and the different ways of understanding it, it has traditionally been interpreted as the achievement of quantitative grades that reflect the results obtained once the different learning tasks have been completed (Ariza, 2018). Efforts have been made to objectively quantify academic outcomes through grades or standardized tests, aiming for maximum objectivity in evaluation and data collection. However, there is now a recognized need to include competency-based assessments, as learning outcomes should not only measure content knowledge but go beyond that, encompassing diverse and complex learning (Formento Torres, 2019). If in addition to transmitting knowledge and competencies, forms of self-assertion and self-regulation are taught, along with the value of effort and study, academic achievements and

educational trajectories will flow, resulting in greater performance (Habök et al., 2020; Ozkal, 2019). Some research suggests that learning goals decrease as students progress from primary to secondary education, especially at higher levels. The expectations formed in the early weeks of each school year or in previous years significantly influence subsequent achievements (Rodríguez Rodríguez & Guzmán Rosquete, 2018). Therefore, supportive messages from family and school play a decisive role in changing or reinforcing those expectations (Abin et al., 2020; Gao et al., 2021).

In general, it is considered that higher motivation leads to better academic performance (Broc-Cavero, 2012; Kusnierz et al., 2020; Toivainen, 2021; Yau et al., 2021). To achieve this motivation, essential factors include family support that fosters positive self-concepts and self-efficacy, support and guidance from teachers, the use of cognitive and metacognitive strategies, a positive classroom climate, and close relationships with peers to reduce stress and emotionally prepare for the challenge of new learning experiences (Ansong et al., 2019; Engels et al., 2021; Ortega-Torres et al., 2020; Trigueros et al., 2019; Usan Supervía & Salavera, 2020; Uka & Uka, 2020; Yau et al., 2021). Furthermore, motivation should be directed towards autonomous interests, and pedagogical accessibility should be adapted or facilitated, taking into account the risk of school dropout. It is important to consider education based on perceived competence, intrinsic motivation, and the usefulness of content (Shi et al., 2021; Vasalampi et al., 2018).

In this regard, it should be noted that adolescence is a stage of life characterized by a cognitive development leap. Additionally, adolescents enter a phase of their education where increasingly abstract aspects come into play (de Faroh, 2007), making it a critical period for academic motivation (Darr, 2011). The latter is related to the shift in influence from the family to peer groups (Preckel et al., 2013). The importance of relationships with friends and peers increases, leading to a

devaluation of motivation for academic success compared to social prestige among students (Li et al., 2011).

Based on the information presented so far, the importance of motivation in explaining academic achievement during adolescence is emphasized, as well as its fundamental role in learning. Thus, the objective of this meta-analysis is to establish the relationship between motivation and academic performance, as well as the potential moderating effect of variables such as gender and age. This study aims to investigate some of the variables involved in the process that leads adolescents towards learning, that is, the desire to learn, and those that may modify the relationship between motivation and academic performance. The ultimate goal is to provide a foundation for future educational interventions that promote meaningful and competency-based learning.

Materials and Methods

Search Procedures and Inclusion Criteria

Following the approach outlined by Botella and Sánchez Meca (2015), several search strategies were conducted by two researchers, with the first phase of the procedure carried out between December 2021 and January 2022. The databases used were Scopus, Science Direct, and PubMed. These selected databases are known for their potential scientific repository, manuscript quality, thematic diversity, and language diversity in publications, ensuring a systematic and comprehensive search of high quality while avoiding potential biases.

The initial search keywords used were "Motivation" and "Academic Achievement." Subsequently, the search was refined by adding publication criteria such as "Open Access," publication years between "2012-2021," publication type as "Article," and languages as "English" and "Spanish." Finally, Boolean operations were performed by introducing additional terms such as "Secondary Education" and "Relationship." After this preliminary digital search, a manual review was conducted on the title and abstract

of the identified studies. This process established the final list of research studies included in this meta-analysis, which were summarized in a corresponding contingency table to analyze the agreement between researchers.

The inclusion criteria applied for article selection were as follows: a) clear and correlational statistical presentation between motivation and academic achievement; b) the study had to be published within the last decade (2012-2021); c) the age range of the sample had to correspond to the adolescent stage; d) academic achievement had to be measured based on grades or standardized tests; e) the geographical scope of the studies was worldwide. Likewise, the following exclusion criteria were applied: a) studies with samples consisting entirely of a non-typical development population; b) studies without clear quantitative data or not adjusted to express the relationship between variables; c) studies published outside the time frame of the last decade; d) samples outside the age range corresponding to adolescence. The application of these inclusion and exclusion criteria, as well as the systematic search for research studies, resulted in the collection of 48 studies and 48 samples representing a total of 144,012 participants (Figure 1).

Figure 1. Flowchart of the search strategy
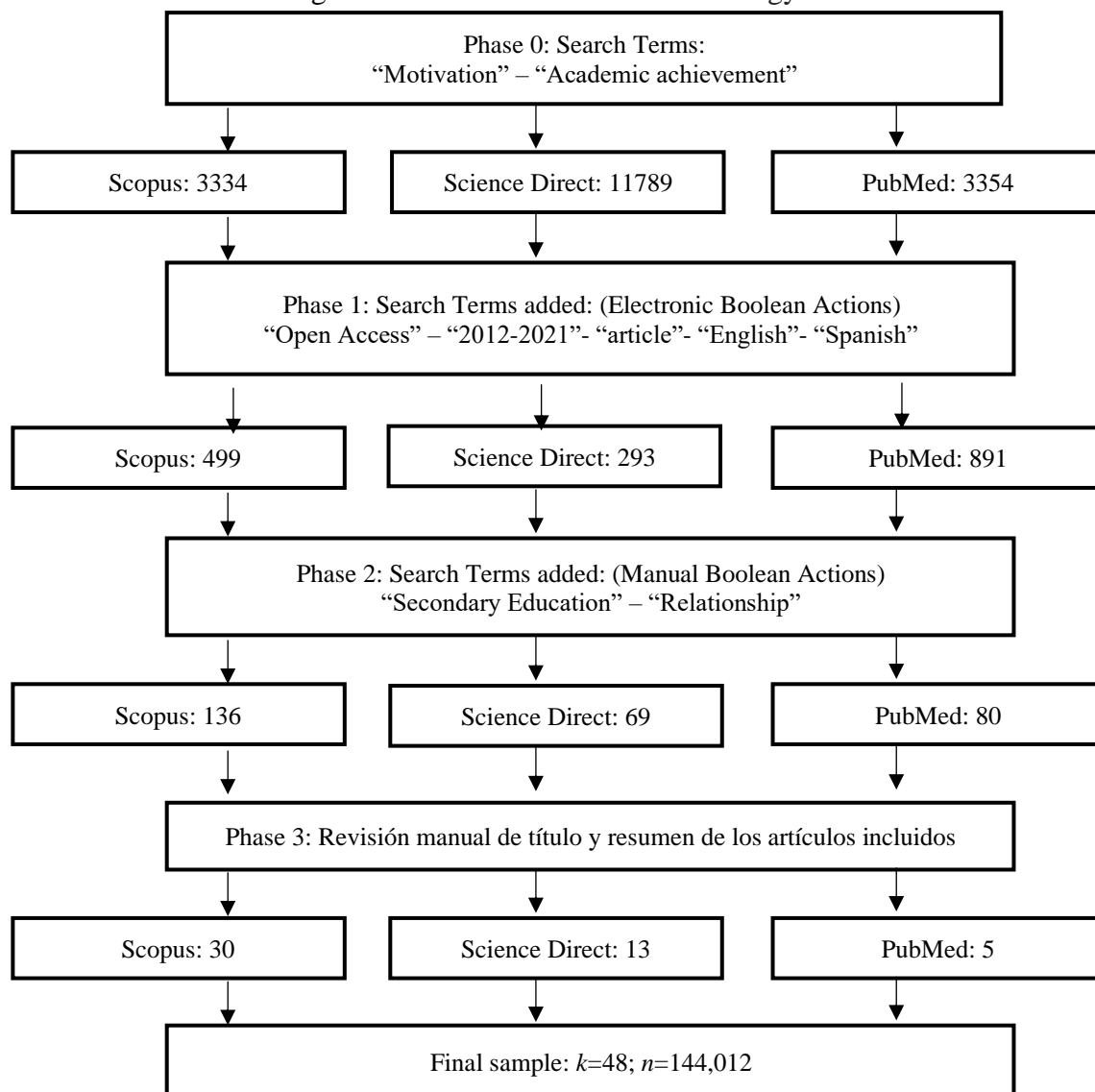
Study Selection and Coding Procedure

The coding process followed the guidelines provided by PRISMA (2015), specifically the point 1.2.2 of the Manual for Systematic Reviews of Interventions, Cochrane 5.1, for a proper formulation of objectives and search terms with reference to eligibility criteria (Higgins & Green, 2011). The article search and selection process was conducted by two researchers and structured into 3 search phases (Phase 0 = keywords; Phase 1 = Boolean actions based on electronic criteria from the used databases; Phase 2 = Boolean actions based on manually introduced criteria; Phase 3 = manual review of preselected articles by both researchers). This procedure yielded an agreement level between the researchers of 0.83 (Cohen's kappa coefficient), indicating almost perfect agreement (Landis & Koch, 1977). Discrepancies between the two researchers responsible for the search were resolved by involving a third reviewer who acted as an arbiter in case of differences. Additionally, the measurement of the "motivation" variable, which was presented in some articles as overall direct scores and in others as decomposed into types of motivation, was standardized. In the latter case, the average score of the different motivation measures was recalculated by weighting their values and transforming the effect sizes into Z-scores to ensure their stability and reliability. Similarly, for the academic achievement variable, overall evaluations reported by teachers were taken into account in 74% of the sample. In the remaining 26% of the studies, academic achievement was indicated by the mean scores in the areas of Language and Mathematics. Finally, the treatment of information provided by the studies included in the meta-analysis was analyzed following the PRISMA 2020 procedure. In this way, standardized criteria were applied for literature review (Hutton et al., 2016).

In the statistical analysis, Comprehensive Meta-Analysis (CMA) software was used for meta-analytic data processing (meta-analysis and meta-regression), and the EZAnalyce add-in (Microsoft Excel, 2013) was used for descriptive analysis. It is important to note that the research focuses on analyzing the effect size in the relationship between motivation and academic achievement in adolescents, as well as studying the potential moderation of age and gender. Therefore, following a coherent order, the effect size was calculated based on the collected data and expressed as Pearson's r values. Subsequently, these values were standardized into Z scores, and the heterogeneity and variability of the sample were analyzed to detect possible bias using the Egger's test and developing a Funnel Plot graph. Finally, different meta-regression models were analyzed to study the moderation effect of gender and age, and to determine the significance and potential of predictive models regarding motivation and academic achievement.

Calculation of effect size

The effect sizes were calculated based on a total of 136 coded effect sizes, using Pearson's r values representing the relationship between motivation and academic achievement. The corresponding standard errors and confidence intervals were calculated. All effect sizes were reviewed up to four times by two independent researchers and recalculated in cases that required averaging factors and weighting scores. Additionally, in order to stabilize the data and prevent the weight of values from being solely determined by sample size, all effect sizes were transformed into Fisher's Z values. Finally, following Cohen's guidelines (2013), the effect size was considered large if correlation values exceeded 0.50, medium for values between 0.30 and 0.49, and small for values below 0.29.

Heterogeneity, Variability, and Publication Bias

Regarding the study of heterogeneity and variability in the sample, Cochran's Q values were analyzed to test the null hypothesis of homogeneity, and I^2 values were examined to assess the proportion of variability. In this regard, Higgins et al. (2003) state that I^2 values below 25% are considered low, values up to 50% are considered moderate, and values

exceeding 75% indicate high variability. This variability can be attributed to genuine variation in effect size and variance, the influence of other moderating variables, or sampling error. The presence of sampling error suggests a potential risk of publication bias, which will be assessed using the Egger's test.

Moderator analysis

To study potential moderator variables such as age or gender on the relationship between motivation and academic performance, different meta-regression models were conducted, including both variables as covariates. These analyses aimed to examine the significance of the designed meta-regression models and, if significant, determine the proportion of explained variance (Borenstein et al., 2021).

Results

General description of included studies

This section provides a description of the specific characteristics (sample, continent, gender, and age) of the studies included in the meta-analytic review. Representative studies from four continents were selected: Europe, America, Asia, and Africa. The final selection of included studies consisted of 48 articles with 50 units of analysis and a total sample of 144,012 participants. Of the total individuals, 42.68% were male, 42.89% were female, and 14.43% were not specified. Regarding the mean age of participants, it was found to be 14.65, with the study by Kuśnierz et al. (2020) having the highest mean age (M=20.01) and the study by Habók et al. (2020) having the lowest age (M=11.65). In terms of geographical areas, the European continent accounted for 56.16% of the sample, followed by the American continent with 27.33%, Asia with 8.36%, and finally, the African continent with 8.15% of the sample (Table 1). Considering the demographic data, it is noteworthy that the European continent has a significant weight, which will require specific explanation in the statistical analysis.

Table 1. Descriptive data of the studies

Research	Continent	Nº Participants	Men	%	Women	%	Age in years
Abín et al. (2020)	Europa	2365	1185	50,1	1180	49,9	15
Ansong et al. (2019)	África	4282	2077	48,5	2205	51,5	16
Broc-Cavero (2012)	Europa	113	53	46,9	60	53,1	16,5
Castro-Sánchez et al. (2019)	Europa	2452	1047	42,7	1405	57,3	14,4
Chen & Hesketh (2021)	Asia	606	303	50	303	50	14,8
Chia Liu (2021)	Asia	1176	596	50,7	580	49,3	14,6
De Smedt (2020)	Europa	615	307	49,9	308	50,1	13,2
Dings & Spinath (2021)	Europa	612	288	47,1	324	52,9	14,6
Doménech-Betoret et al. (2017)	Europa	797	404	50,7	393	49,3	14,5
El-Adl & Alkharusi (2020)	Asia	338	165	48.8	173	51,2	15
Engels et al. (2021)	Europa	5382	2637	49	2745	51	13
Fan & Williams (2018)	América	14639	7317	50	7322	50	15
Gao et al. (2021)	Asia	8000	4226	52.8	3774	47,2	15
González et al. (2013)	Europa	642	315	49,1	327	50,9	15,2

González-Fernández et al.	Europa	74	39	52,7	35	47,3	13,9
Habók et al. (2020)	Europa	4079	2068	50,7	2011	49,3	11,6
Hoft & Bernholt (2021)	Europa	1053	479	45,6	573	54,4	12,6
Jafari & Asgari (2020)	Asia	200	-		-		18
Karlen et al. (2019)	Europa	1215	524	43,1	691	56,9	17,5
Korpershoek (2016)	Europa	8884	-		-		14
Kuśnierz et al. (2020)	Europa	342	215	62,9	127	37,1	20
Lee et al. (2012)	Europa	670	-		-		16
Luong et al. (2017)	Europa	2792	-		-		14,5
Meyer et al. (2019)	Europa	3611	1622	44,9	1989	55,1	19,9
Ortega-Torres et al. (2020)	Europa	364	-		-		15
Ozkal (2019)	Asia	651	292	44,9	359	55,1	12,7
Regueiro et al. (2015)	Europa	1257	573	45,6	684	54,4	12,5
Rodríguez et al. (2019)	Europa	1899	972	51,2	927	48,8	14
Rodriguez et al. (2020)	Europa	730	318	43,6	412	56,4	14
Rodríguez y Guzmán (2018)	Europa	596	302	50,7	294	49,3	14,2
Senkbeil (2018)	Europa	2075	1049	50,6	1025	49,4	15
Shi et al. (2021)	Asia	385	126	32,7	259	67,3	16
Sotavento et al. (2012)	Europa	670	294	43,9	376	56,1	15
Sutter-Brandenberger et al.	Europa	348	169	48,6	179	51,4	12,7
Symonds et al. (2019)	Europa	878	460	52,4	418	47,6	15
Bal-Tastan et al. (2018)	Asia	790	505	63,9	285	36,1	15,5
Theis et al. (2019)	Europa	2105	1055	50,1	1050	49,9	10,4
Toivainen et al. (2021)	Europa	1306	530	40,6	776	59,4	12,3
Torrecilla et al. (2019)	Europa	26775	13450	50,2	13325	49,8	15
Trigueros et al. (2019)	Europa	615	318	51,7	297	48,3	16
Tuominen et al. (2012)	Europa	579	291	50,3	288	49,7	15
Tuominen et al. (2020)	Europa	419	183	43,7	236	56,3	12,5
Uka & Uka (2020)	Europa	80	33	41,3	47	58,7	12,2

Effect Size and Statistical Significance

Effect Size and Statistical Significance: Overall Analysis

In the initial meta-analytic analysis, the random-effects model was used to estimate the effect sizes reported, with a 95% confidence interval and a significance level of $p<0.001$. The result reveals a moderate, positive, and statistically significant weighted effect size (0.327), indicating a strong relationship between motivation and academic achievement in a sample of adolescents (Figure 2).

Figure 2. Forest Plot, Motivation vs Academic Achievement

Meta Analysis

| Study name	Correlation	Lower limit	Upper limit	Z-Value	p-Value
Abín et al. (2020)	0,350	0,314	0,385	17,761	0,000
Ansong et al. (2019)	0,330	0,303	0,356	22,426	0,000
Broc-Cavero (2012)	0,420	0,255	0,561	4,695	0,000
Castro-Sánchez et al. (2019)	0,290	0,253	0,326	14,775	0,000
Chen & Hesketh (2021)	0,370	0,299	0,437	9,538	0,000
Chia Liu (2021)	0,400	0,351	0,447	14,510	0,000
De Smedt (2020)	0,540	0,481	0,594	14,946	0,000
Dings & Spinath (2021)	0,370	0,300	0,436	9,585	0,000
Doménech-Betoret et al. (2017)	0,510	0,457	0,560	15,857	0,000
El-Adl & Alkharusi (2020)	0,440	0,331	0,537	7,239	0,000
Engels et al. (2021)	0,130	0,104	0,156	9,589	0,000
Fan & Williams (2018)	0,210	0,194	0,225	25,789	0,000
Gao et al. (2021)	0,130	0,108	0,151	11,692	0,000
González et al. (2013)	0,370	0,301	0,435	9,819	0,000
González-Fernández et al. (2020)	0,420	0,212	0,592	3,772	0,000
Habók et al. (2020)	0,103	0,073	0,133	6,599	0,000
Habók et al. (2020)b	0,528	0,506	0,550	37,500	0,000
Hoft & Bernholt (2021)	0,270	0,213	0,325	8,971	0,000
Jafari & Asgari (2020)	0,552	0,448	0,642	8,720	0,000
Karlen et al. (2019)	0,190	0,135	0,244	6,696	0,000
Korpershoek (2016)	0,140	0,120	0,160	13,281	0,000
Ku?nierz et al. (2020)	0,170	0,065	0,271	3,161	0,002
Lee et al. (2012)	0,124	0,049	0,198	3,219	0,001
Luong et al. (2017)	0,280	0,245	0,314	15,193	0,000
Meyer et al. (2019)	0,610	0,589	0,630	42,736	0,000
Meyer et al. (2019)b	0,230	0,198	0,262	13,583	0,000
Ortega-Torres et al. (2020)	0,250	0,151	0,344	4,853	0,000
Ozkal (2019)	0,370	0,302	0,434	9,888	0,000
Regueiro et al. (2015)	0,300	0,249	0,349	10,961	0,000
Rodríguez et al. (2019)	0,190	0,146	0,233	8,375	0,000
Rodríguez et al. (2020)	0,350	0,285	0,412	9,853	0,000
Rodríguez y Guzmán (2018)	0,360	0,288	0,428	9,178	0,000
Senkbeil (2018)	0,630	0,603	0,655	33,749	0,000
Shi et al. (2021)	0,770	0,726	0,808	19,942	0,000
Sotavento et al. (2012)	0,260	0,188	0,329	6,873	0,000
Sutter-Brandenberger et al.(2018)	0,330	0,233	0,421	6,368	0,000
Symonds et al. (2019)	0,390	0,332	0,445	12,181	0,000
Tastan et al. (2018)	0,390	0,329	0,448	11,552	0,000
Theis et al. (2019)	0,150	0,108	0,191	6,929	0,000
Toivainen et al. (2021)	0,200	0,147	0,252	7,318	0,000
Torrecilla et al. (2019)	0,330	0,319	0,341	56,094	0,000
Trigueros et al. (2019)	0,350	0,279	0,418	9,041	0,000
Tuominen et al. (2012)	0,110	0,029	0,190	2,651	0,008
Tuominen et al. (2020)	0,120	0,047	0,192	3,195	0,001
Uka & Uka (2020)	0,450	0,256	0,609	4,253	0,000
Usan & Salavera (2020)	0,220	0,183	0,256	11,511	0,000
Vasalampi et al. (2018)	0,260	0,212	0,306	10,365	0,000
Williams et al. (2018)	0,310	0,133	0,468	3,362	0,001
Xu et al. (2021)	0,240	0,228	0,252	38,223	0,000
Yau et al. (2021)	0,240	0,111	0,361	3,606	0,000
	0,327	0,289	0,365	15,579	0,000

Effect Size and Statistical Significance: Analysis without Outliers.

To ensure the absence of bias and the robustness of the obtained effect size, a second analysis is conducted by excluding data points that are considered outliers, both in terms of high and low values. Thirteen studies are excluded from the analysis (Engels et al., 2021; Gao et al., 2013; Habok et al., 2020; Karlen et al., 2019; Korpershoek et al., 2016; Kusnierz et al., 2020; Lee et al., 2012; Rodríguez et al., 2019; Senkbeil, 2018; Shi et al., 2021; Theis et al., 2019; Tuominen et al., 2012; Tuominen et al., 2020), resulting in a final sample size of k=35 and n=106,400. In this new analysis, the resulting effect size does not show a significant increase, and there is no variation in the distribution by gender (r=0.349 and p<0.001) (Figure 3). Therefore, since the excluded studies do not represent at least 50% of the sample weight, the decision is made to continue with the original analysis, acknowledging the suitability of all included studies.

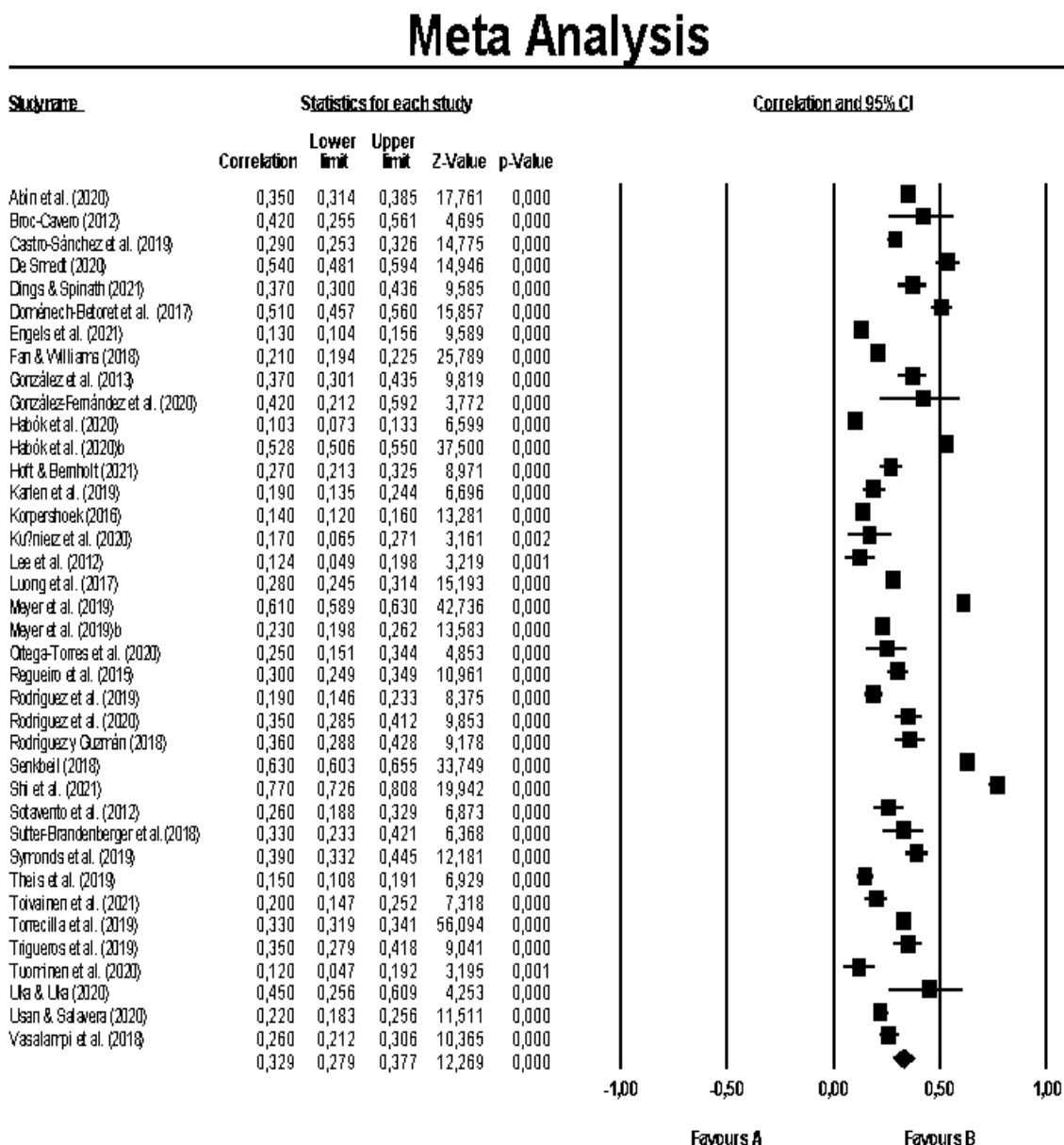Figure 3. Forest Plot, Motivation vs Academic Achievement: No extreme data
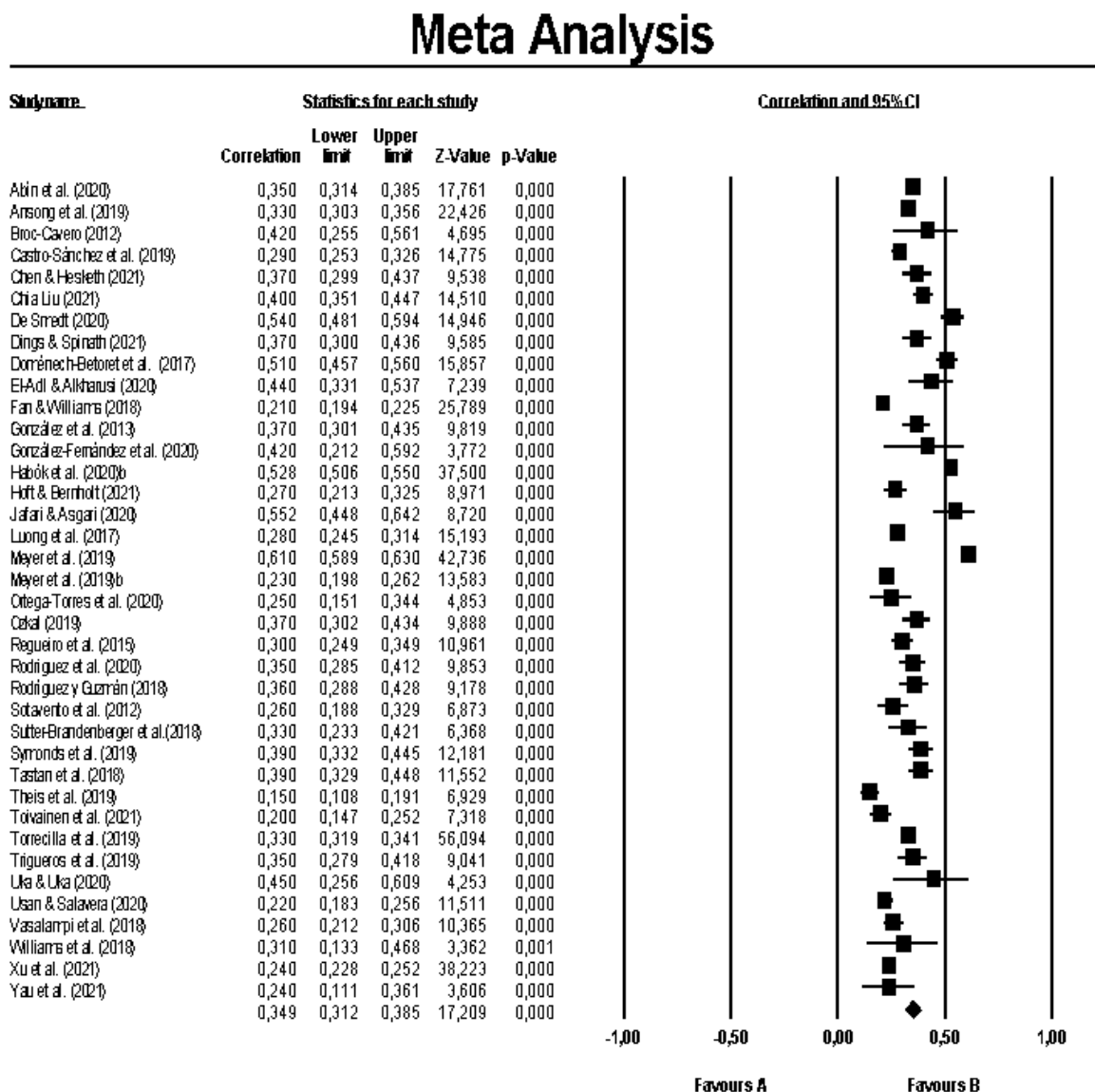
Effect Size and Statistical Significance: The European Case

Due to the substantial representation of European studies in the sample (56.16%), a third meta-analysis is conducted specifically for this continent, with a total number of participants of n=95,543 (k=36). The distribution of participants by gender is 42.80% males, 44.21% females, and 12.97% unspecified. The mean age remains relatively unchanged from the initial sample, with an average of 14.54 years. The effect size in this analysis remains similar to the original findings (r=0.329 and p<0.001) (Figure 4). In conclusion, both the original analysis and the specific analysis of the European sample, as well as the analysis excluding outliers, show no significant changes. Based on these results, it is decided to proceed with the remaining meta-analytic analyses using the initial sample as the reference.

Figure 4. Forest Plot, Motivation vs Academic Achievement: European case.

Meta Analysis

Study name	Correlation	Lower limit	Upper limit	Z-Value	p-Value
Abin et al. (2020)	0,350	0,314	0,385	17,761	0,000
Broc-Cavero (2012)	0,420	0,255	0,561	4,695	0,000
Castro-Sánchez et al. (2019)	0,290	0,253	0,326	14,775	0,000
De Smedt (2020)	0,540	0,481	0,594	14,946	0,000
Dings & Spinath (2021)	0,370	0,300	0,436	9,585	0,000
Doménech-Betoret et al. (2017)	0,510	0,457	0,560	15,857	0,000
Engels et al. (2021)	0,130	0,104	0,156	9,589	0,000
Fan & Williams (2018)	0,210	0,194	0,225	25,789	0,000
González et al. (2013)	0,370	0,301	0,435	9,819	0,000
González-Fernández et al. (2020)	0,420	0,212	0,592	3,772	0,000
Habók et al. (2020)	0,103	0,073	0,133	6,599	0,000
Habók et al. (2020)b	0,528	0,506	0,550	37,500	0,000
Hoft & Bernholt (2021)	0,270	0,213	0,325	8,971	0,000
Karlen et al. (2019)	0,190	0,135	0,244	6,696	0,000
Korpershoek (2016)	0,140	0,120	0,160	13,281	0,000
Ku?niez et al. (2020)	0,170	0,065	0,271	3,161	0,002
Lee et al. (2012)	0,124	0,049	0,198	3,219	0,001
Luong et al. (2017)	0,280	0,245	0,314	15,193	0,000
Meyer et al. (2019)	0,610	0,589	0,630	42,736	0,000
Meyer et al. (2019)b	0,230	0,198	0,262	13,583	0,000
Ortega-Torres et al. (2020)	0,250	0,151	0,344	4,853	0,000
Regueiro et al. (2015)	0,300	0,249	0,349	10,961	0,000
Rodríguez et al. (2019)	0,190	0,146	0,233	8,375	0,000
Rodríguez et al. (2020)	0,350	0,285	0,412	9,853	0,000
Rodríguez y Guzmán (2018)	0,360	0,288	0,428	9,178	0,000
Senkbeil (2018)	0,630	0,603	0,655	33,749	0,000
Shi et al. (2021)	0,770	0,726	0,808	19,942	0,000
Sotavento et al. (2012)	0,260	0,188	0,329	6,873	0,000
Sutter-Brandenberger et al. (2018)	0,330	0,233	0,421	6,368	0,000
Symonds et al. (2019)	0,390	0,332	0,445	12,181	0,000
Theis et al. (2019)	0,150	0,108	0,191	6,929	0,000
Toivainen et al. (2021)	0,200	0,147	0,252	7,318	0,000
Torrecilla et al. (2019)	0,330	0,319	0,341	56,094	0,000
Trigueros et al. (2019)	0,350	0,279	0,418	9,041	0,000
Tuominen et al. (2020)	0,120	0,047	0,192	3,195	0,001
Uka & Uka (2020)	0,450	0,256	0,609	4,253	0,000
Usan & Salavera (2020)	0,220	0,183	0,256	11,511	0,000
Vasalampi et al. (2018)	0,260	0,212	0,306	10,365	0,000
	0,329	0,279	0,377	12,269	0,000

Heterogeneity and Variability Analysis

Both the variability and heterogeneity observed in the studies included in this meta-analysis are significantly high (Q = 2940.540, df = 49, I² = 98.334%, p < 0.001). Given these results, the sensitivity of the sample is evaluated through various meta-regressions. The complementary analyses, although showing lower variability, do not significantly contribute to the representation as they do not reach at least 50% of the specific weight of the sample. Furthermore, these analyses do not yield any significant changes or improvements in the effect size.

Publication Bias Analysis

To ensure that the obtained results are not due to potential publication bias, a common error in meta-analyses (Borenstein et al., 2021), two complementary analysis actions are conducted. Firstly, the assessment and verification of bias presence are focused on using a funnel plot (Figure 5). The plot demonstrates that the Z-values of each study are small, falling within the range of -1 and 1.

These results indicate the absence of bias since the presence of bias would be indicated by significantly different values from zero (outside the range of -1 and 1). Secondly, the Egger's test is performed, yielding non-significant results with $p = 0.114$ and an intercept value of 2.7 on the Y-axis, confirming the complete absence of publication bias (Egger et al., 1997).

Figure 5. Funnel Plot of Standard Error by Fisher´s Z.
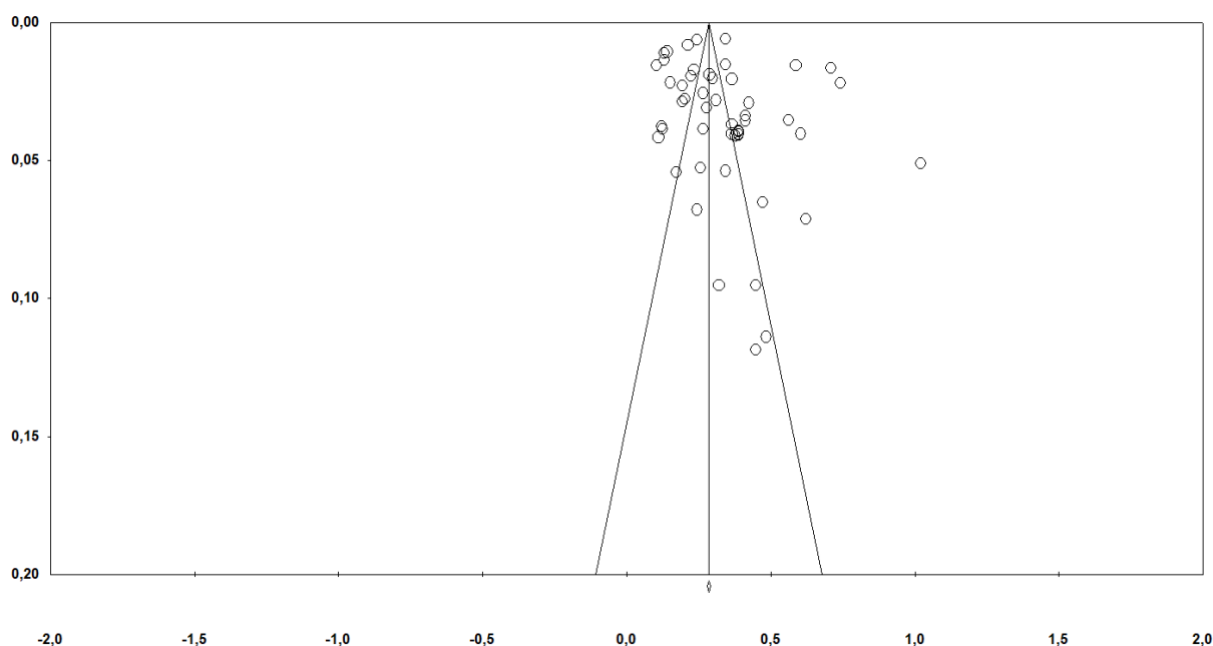
Funnel Plot of Standard Error by Fisher´s Z.

Finally, the study examines whether gender and age act as moderators in the relationship between motivation and academic performance in adolescence. Two separate regression models are conducted, but neither of them yields significant results. Regarding gender, both males and females exhibit non-significant findings with p-values of 0.211 and 0.232, respectively. Similarly, age also shows a non-significant relationship with a p-value of 0.165. Therefore, neither gender nor age are considered potential moderating variables in this context.

The aim of the present study was to investigate the relationship between motivation and academic performance, as well as the presence of moderating variables such as gender and age, using a meta-analytic review approach.

Discussion

The results indicate a moderate effect size in the relationship between motivation and academic performance. This finding is consistent with many previous studies that have emphasized the importance of motivation as a significant predictor of academic success (Broc-Cavero, 2012; Kusnierz, 2020; Rodríguez-Rodríguez & Guzmán Rosquete, 2018; Toivainen, 2021; Yau et al., 2021). Similarly, no significant differences were observed when studying the total selected studies, when excluding outlier data, or when analyzing only the European sample. These findings are consistent with studies conducted in previous stages, which also indicated a moderate effect size between motivational factors and academic performance (Quílez Robres et al., 2021). However, regarding the moderating variables, both meta-analyses did not yield consistent results. Specifically, the

current study did not find significance in the moderation of sex and age in the relationship between motivation and academic performance, which contrasts with the findings of Quilez et al. (2021). These results suggest greater stability of motivational aspects during adolescence compared to potential changes influenced by age or sex. Some of the consulted studies consistently show a relationship between motivation and academic performance, linking poor academic results with low motivation (Korpershoek, 2016; Lee et al., 2012; Rodríguez et al., 2019). Therefore, motivation for learning entails greater academic effort, higher expectations, and greater commitment to the completion of school tasks (González-Fernández et al., 2020; Liu, 2021; Regueiro et al., 2014). It is important to consider that academic motivation during adolescence is associated with self-efficacy, as this is the stage when students develop their own ideas about their efficacy and goals in relation to peers, teachers, and parents, and when competition among peers emerges (Ansong et al., 2019; Doménech-Beteret et al., 2017). On the other hand, self-efficacy accompanied by high self-esteem directly influences motivation, as adolescents believe in their abilities and capacities to achieve set goals (Xu et al., 2021). In conclusion, motivation for learning involves self-evaluation of effectiveness, goal setting, and the use of appropriate strategies to achieve success. However, when focusing on subjects such as mathematics or other science-related areas, the concept of perceived utility becomes a prominent motivational aspect in adolescents' learning. Exactly, it is considered useful because it is socially valued, and a direct professional utility is perceived. As a result, motivation increases, driven by high achievement expectations (Abin et al., 2010; Meyer et al., 2019; Rodríguez et al., 2020; Symonds et al., 2019). In the case of language learning, motivation for reading and writing tasks generally declines towards the end of primary education and increases during secondary education (De Smedt, 2020). Some research highlights that to improve motivation, it is necessary to enhance creativity in writing,

as it relates to motivation and promotes greater educational development (Toivainen et al., 2021).

The statistical analysis of this research did not find a moderating effect of the variables of sex and age. The scientific literature is inconsistent, as some authors discuss different academic performance based on sex, but it could be due to the influence of other variables, such as greater emotional maturity among girls compared to their male peers (Broc-Cavero, 2012; Castro-Sánchez et al., 2019; Regueiros et al., 2015; Rodríguez Rodríguez & Guzmán Rosquete, 2018; Sotavento et al., 2012; Symonds et al., 2019; Torrecilla et al., 2019). When contrasting intrinsic motivation and extrinsic motivation, different profiles emerge. In general, males tend to exhibit more extrinsic motivation, seeking rewards and recognition (being more competitive), while females show greater significance in intrinsic motivation, which is more reflective in nature (Neihart, 2020). However, the research by Cerezo and Casanova (2004), focusing on academic performance in mathematics in secondary education, found lower levels of extrinsic motivation in females but did not find differences in intrinsic motivation.

On the other hand, there is also no unanimity when explaining the moderating effect of age. Some research studies agree with the results obtained in this study, indicating the absence of such an effect (Gao et al., 2021; Symonds et al., 2019), while others indicate significant differences with increasing age (De Smedt et al., 2020). Therefore, no differences are found in the relationship between motivation and academic performance in both child and adolescent populations in the two meta-analyses. It can be deduced that age will play a moderating role in this relationship when the study has a longitudinal nature (Moyano et al., 2020). In other words, when focusing on a specific age or educational stage where potential differences are barely perceived, no significance is found. If we consider that motivation arises from within and is considered as an emotional response (it is difficult to separate motivation from emotion),

and that individuals undergo developmental processes involving cognitive, behavioral, and emotional changes that occur over relatively extended periods of time, it could explain the results of this study in relation to age (Tokuhama-Espinosa, 2015). On the other hand, there are studies that expose how motivation to learn decreases with age and relate it to Maslow's Hierarchy of Needs theory. As needs are met, motivation diminishes with each completed stage until reaching the peak of self-actualization and satisfaction (Carrillo et al., 2009).

The review of scientific literature used in this meta-analysis allows us to study the relationship between motivation and academic performance in adolescents from different countries around the world, with a notable emphasis on European countries. The majority of studies consider motivation as a strong predictor of academic success (Rodríguez-Rodríguez & Guzmán Rosquete, 2018). Additionally, the literature discusses topics such as self-regulation (Ansong et al., 2019), beliefs about oneself or one's own learning (Doménech-Betoret et al., 2017; Karlen et al., 2019; Ozkal, 2019), and the influence of the family and school environment (Engels et al., 2021; Yau et al., 2021). Additionally, the different types of motivation (intrinsic-extrinsic) are mentioned, as well as the variables that influence the inclination towards learning in students during this developmental stage (Abin et al., 2020; De Smedt, 2020; Karlen et al., 2019; Luong et al., 2017; Regueiro et al., 2015; Rodriguez et al., 2020; Williams et al., 2018), while others do not specify (González et al., 2013; Kusnierz et al., 2020; Meyer et al., 2019; Ortega-Torres et al., 2020; Rodriguez et al., 2019; Senkecobeil, 2018; Symonds et al., 2019; Xu et al., 2021; Yau et al., 2021). The perceived competence is highlighted as important depending on the type of motivation, as it is something that individuals construct and can be modified for the benefit of learning (malleable skills) (Abin et al., 2020; Habók et al., 2020; Karlen et al., 2019). On the other hand, some studies focus on academic performance, understood as

general quantitative results in different subjects, while others specifically examine mathematics and language (Broc Cavero, 2014; El-Adl & Alkharusi, 2020; Fan & Williams, 2018; Habók et al., 2020; Méndez & Peña, 2013). Some studies also indicate that the emotional state influences the level of motivation, which in turn affects academic performance, either increasing or decreasing it (Trigueros et al., 2019; Toivainen et al., 2021; Usán-Supervia & Salavera-Bordás, 2020). Furthermore, students are more engaged in activities that they perceive as valuable, necessary, and rewarding. However, if they do not find these qualities in the learning context, there is a risk of a negative impact on academic achievement (Lee et al., 2012; Regueiro et al., 2015). These findings are consistent with numerous previous studies (Chen & Hesketh, 2021; Chia Liu, 2021; Hoft & Bernholt, 2021; Tastan et al., 2018; Theis et al., 2019; Tuominen et al., 2012).

Conclusions and Limitations

Like the majority of research studies, the present study identifies motivation as one of the strongest predictors of academic success, but it should also be considered in the context of future professional and personal success.

Regarding the age of the sample, it should be noted that adolescence is characterized as a developmental stage that involves transitioning into adulthood, moving from basic education to higher education. It is marked by a decrease in interest in learning as students progress through grades (De Smedt et al., 2020), a lack of maturity to assimilate distant rewards, and influential self-created or peer-created expectations that make the teaching-learning process challenging, slow, and less rewarding (Tokuhama-Espinosa, 2015). In this educational stage, gender and age do not significantly influence the relationship between motivation and academic performance.

However, this research did not include other variables such as self-beliefs, self-concept, self-efficacy, self-regulation, family-school

relationships, or socioeconomic status in the statistical analysis. These variables should be considered in future studies, and longitudinal designs that encompass primary education, secondary education, and high school could provide a broader understanding of the topic. Additionally, the absence of control and statistical analysis of potential individual biases in the studies should be taken into account in future research to improve the design and approach. In this regard, beliefs about oneself, the ability to learn, and task orientation can potentially hinder the entire learning process. Furthermore, variables such as self-concept, self-efficacy, and self-regulation mutually influence and interact with motivation, resulting in the development of different types of motivation that impact the desire to learn. The social, familial, and school environments also play a role in shaping motivation (Ansong et al., 2019; Doménech-Betoret et al., 2017; Engels et al., 2021; Karlen et al., 2019; Ozkal, 2019; Yau et al., 2021).

The implications derived from this study are directed towards the need for teachers to go beyond being mere knowledge transmitters. It is suggested that strategies be employed to reinforce self-concept (viewing mistakes as opportunities for improvement) and eliminate negative beliefs. Additionally, a combination of active and traditional teaching methodologies, improvement of attitudes such as responsibility, effort, and empathy, and ongoing monitoring and evaluation of students' work through well-planned tasks should be considered.

Furthermore, considering that personal and social well-being is crucial for adolescents' development and motivation towards their studies, it is proposed that strategies promoting positive peer relationships and the implementation of well-organized tutorial action plans tailored to their age and needs, along with support from school counseling departments, can enhance motivation. Therefore, further research is necessary to explore the extent, effectiveness, and application of methodologies addressing all these aspects, as well as the planning and

implementation of necessary psychological support encompassing personal, social, and educational dimensions to achieve the holistic and harmonious development of students.

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Appendix 1

1º First Boolean action through automated screening.

Causes of elimination if they did not meet the following criteria:

1. They were open studies.

2. They were studies from the last ten years, 2012-2021.

3. They were articles.

4. They were in English or Spanish.

Total studies eliminated: 6,494.

2ª Boolean action by adding two new topics.

Causes of elimination if they did not correspond to:

1. Secondary Education.

2. Relationship.

Total studies eliminated: 1,398.

3ª Manual review of the resulting studies.

Causes of elimination if they did not correspond to:

1. Interrelation of motivation and academic performance.

2. If the age range did not correspond to adolescence.

3. If the study did not correspond to the school context.

Total studies eliminated: 237.

TOTAL: 8,129 Studies eliminated in the different Boolean actions.

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RELIEVE

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