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The Link Between Self-Efficacy, Alertness, and Opportunity Recognition: Sleep Quality as a Boundary Condition

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ABSTRACT

Over the past two decades, scholarly interest in the influence of biological factors on entrepreneurship has expanded considerably. Prior studies have explored the ways in which biological processes shape entrepreneurial decisions and behaviors; nevertheless, the dynamic interaction among biological factors, cognition, and behavior within the entrepreneurial context remains insufficiently examined. Accordingly, this study seeks to address this gap by analyzing the relationships between central entrepreneurial cognitive capabilities—namely, self-efficacy and alertness—and opportunity recognition, while also assessing the moderating effect of a biological factor, i.e., sleep quality. A sample of 160 entrepreneurs who had owned and managed a business within the preceding five years was determined using the G*Power software. Data were gathered in early 2025 through a structured questionnaire administered via purposive sampling. The data were analyzed using logistic regression in SPSS version 26. The findings demonstrate that both alertness and self-efficacy exert significant and positive effects on opportunity recognition. Furthermore, sleep quality amplifies the relationship between these cognitive capabilities and opportunity recognition, indicating that biological health plays a pivotal role in enhancing entrepreneurial cognition. These results provide meaningful practical implications for the development of interventions and strategies designed to strengthen entrepreneurs' cognitive capabilities and thereby improve opportunity recognition.

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Introduction

Entrepreneurial enactment requires two key elements: enterprising individuals and viable opportunities (Naderi et al., 2025; Saba et al., 2023; Shane & Venkataraman, 2000). According to Shane and Venkataraman (2000), opportunities lie at the core of the entrepreneurial process, and the entrepreneur is the individual who engages in their recognition and exploitation. Over the past three decades, a significant body of research has sought to address why and how some individuals—but not others—are able to recognize and exploit entrepreneurial opportunities (Anwar et al., 2022; Filser et al., 2023; Shane & Venkataraman, 2000). Consequently, considerable scholarly attention has focused on understanding the mechanisms underlying opportunity recognition and identifying the factors and conditions that facilitate or strengthen this process (Filser et al., 2023).

Recent works, drawing on the cognitive perspective, have examined why certain individuals perceive and act upon entrepreneurial opportunities while others do not (Filser et al., 2023; Gaglio & Katz, 2001). Among cognitive capabilities, entrepreneurial self-efficacy and alertness have received particular attention (Anwar et al., 2022; Filser et al., 2023). Self-efficacy refers to an individual's belief in their ability to achieve desired outcomes or goals (Bandura, 1977). In the entrepreneurial context, self-efficacy shapes intentions, motivation, and real-world actions, constituting a powerful belief-based construct that influences the nature and trajectory of decision-making (McGee et al., 2009). Alertness, in contrast, reflects an individual's capacity to access, process, organize, and interpret information across diverse domains, enabling them to perceive opportunities that others overlook (Chavoushi et al., 2021; Kirzner, 1983; Tang, 2016; Tang et al., 2012).

Emerging evidence suggests that cognitive capabilities themselves may be influenced by biological factors, which remain relatively underexplored in entrepreneurship research (Nicolaou et al., 2021). In particular, sleep quality has been shown to affect individuals' ability to deploy cognitive resources effectively (Grégoire & Shepherd, 2012). Fluctuations in sleep quality can exert profound effects on entrepreneurial capabilities, choices, and behaviors (Williamson et al., 2019). Despite its importance, empirical evidence linking sleep quality to opportunity recognition—the first step in the entrepreneurial process—remains scarce (Rice et al., 2024; Shane & Venkataraman, 2000). This study seeks to address this gap by integrating cognitive and biological perspectives to examine opportunity recognition. Specifically, it investigates how sleep quality moderates the relationship between entrepreneurs' cognitive capabilities—self-efficacy and alertness—and their ability to recognize opportunities. By exploring the intersection of cognitive and biological factors, this study provides a foundation for understanding how these dimensions jointly shape entrepreneurial decision-making and contributes to advancing an interdisciplinary perspective on opportunity recognition (Gunia, 2018; Gunia et al., 2021; Nicolaou et al., 2021; Rice et al., 2024).

Literature Review and Hypotheses Development

Opportunity Recognition

Opportunity recognition, a distinctive entrepreneurial capability, constitutes the first step in the entrepreneurial process (Filser et al., 2023; Shane & Venkataraman, 2000;

Tumasjan & Braun, 2012; Zhu et al., 2025). It involves the entrepreneur becoming aware of unmet needs or identifying patterns that may lead to new ventures (Davidsson, 2015). Without recognized opportunities, entrepreneurship cannot materialize, nor can new ventures be created (Ardichvili et al., 2003). Opportunity recognition typically unfolds in three interrelated stages: perceiving a market need or underutilized resources, identifying the fit between the need and resources, and creating a new fit in the form of a venture (Ferreira et al., 2019). This capability is crucial not only as the starting point of entrepreneurship (Shane & Venkataraman, 2000) but also for fostering innovation (Park, 2005) and enhancing organizational performance (Guo et al., 2017). Given its centrality, scholars have investigated why some individuals are more adept at recognizing opportunities than others (Zhu et al., 2025), leading to a focus on cognitive drivers such as self-efficacy and alertness (Filser et al., 2023; Tumasjan & Braun, 2012).

The Role of Entrepreneurial Self-Efficacy in Opportunity Recognition

Self-efficacy reflects individuals' beliefs and judgments regarding their capability to organize and execute the courses of action required to achieve and realize specific goals (Bandura, 1977). Accordingly, individuals with higher levels of self-efficacy, through perseverance and steadfastness, are able to exert control over environments characterized by limited opportunities and abundant constraints (Bandura & Wood, 1989). Entrepreneurs with high self-efficacy are highly action-oriented; even when confronted with obstacles or failures, they pursue more challenging goals than others, exert greater effort, and demonstrate enhanced adaptability (Bandura, 1977). Self-efficacy influences how individuals perform and complete tasks, responsibilities, or processes, and it affects the likelihood of achieving future success (Wardana et al., 2024). In this sense, individuals with high self-efficacy believe they can effectively launch and sustain their businesses until achieving economic returns (Liu et al., 2019). According to Elnadi and Gheith (2021), entrepreneurs with high self-efficacy continuously search for entrepreneurial opportunities, cultivate trustworthy and reliable relationships, and exercise necessary control over their ventures. Moreover, due to entrepreneurial optimism, individuals with high self-efficacy, rather than avoiding risks and threats, demonstrate an enhanced ability to perceive potentially valuable opportunities in their environment (Heredia-Portillo & Armas-Arévalos, 2023; Saeedikiya et al., 2021). Compared to those with lower self-efficacy, individuals with higher levels of this capability are more likely to engage in active and persistent opportunity search (Elnadi & Gheith, 2021). According to these arguments we propose:

Hypothesis 1 (H1): Entrepreneurial self-efficacy positively influences opportunity recognition. Accordingly, entrepreneurs with higher levels of self-efficacy are more likely to successfully recognize entrepreneurial opportunities.

The Role of Entrepreneurial Alertness in Opportunity Recognition

The concept of entrepreneurial alertness was first introduced by Kirzner (2015) to explain how individuals perceive and act upon entrepreneurial opportunities. From Kirzner's perspective, alert entrepreneurs are able to exploit information asymmetries to identify opportunities that others overlook. By detecting subtle changes in the

external environment, such individuals gain access to information that is not immediately visible or discernible to others (Saeedikiya & Aeeni, 2020; Sassetti et al., 2022). Tang et al. (2012) argue that entrepreneurial alertness facilitates the generation of new ideas and opportunities by linking dispersed prior knowledge with newly acquired information. They describe alertness as a cognitive process that begins with the active search for new information and progresses to the integration of heterogeneous information from diverse sources, followed by an evaluation of potential entrepreneurial opportunities arising from these connections. Through this process, entrepreneurs continuously scan multilayered information and knowledge across sectors, markets, and industries (Tang, 2016) and establish connections between seemingly unrelated pieces of information (Chavoushi et al., 2021). This process highlights how entrepreneurs utilize and expand the informational resources at their disposal. Because the identification of profitable opportunities rarely depends on a single piece of information, the capacity to connect and leverage information through alertness represents a central mechanism in opportunity recognition (Baron, 2006; Lee et al., 2012). Individuals with high alertness are thought to possess distinctive cognitive schemas that allow them to perceive their environment from unique perspectives, facilitating the recognition of novel and valuable opportunities (Araujo et al., 2023). According to these arguments we propose:

Hypothesis 2: Entrepreneurial alertness positively influences opportunity recognition. Accordingly, entrepreneurs with higher levels of alertness are more likely to successfully identify entrepreneurial opportunities.

The Mediating Role of Sleep Quality

Sleep quality is widely recognized as a critical mechanism for the recovery and restoration of the body's biological and psychological resources (Williamson et al., 2019). Specifically, sleep serves as a process through which vital bodily resources are replenished, directly affecting cognitive functions and brain activity (Nägel & Sonnentag, 2013). Poor sleep quality can impair essential cognitive abilities, including adaptation to new situations and mental flexibility (Harrison & Horne, 2000). Emerging evidence suggests that sleep quality accounts for a substantial proportion of variance in workplace performance. For instance, employees with lower levels of high-quality sleep exhibit marked declines in proactive and collaborative behaviors (Kühnel et al., 2016). Entrepreneurial behavior, in particular, requires active engagement in initiatives that foster the creation, discovery, and application of innovative ideas. Such behaviors are inherently uncertain, risky, and novel, necessitating high-level cognitive mechanisms (Janssen et al., 2004). Adequate sleep provides the biological and psychological resources necessary to undertake these complex and demanding activities effectively (Williamson et al., 2019). High-quality sleep is also closely linked to positive mood and affective states in professional contexts (Bouwmans et al., 2017). Research indicates that entrepreneurs' moods—both positive and negative—are significantly associated with their cognitive capabilities and entrepreneurial behaviors (Delgado García et al., 2015), and that a substantial portion of mood quality is determined by sleep quality (Bouwmans et al., 2017). Positive mood resulting from sufficient sleep increases individuals' capacity to devote time and energy to tasks (Gunia, 2018) and provides the motivation and

enthusiasm required to engage in innovative and opportunity-driven actions (Williamson et al., 2019). Conversely, inadequate sleep reduces the ability to channel effort and energy effectively toward tasks aligned with one's cognitive and entrepreneurial goals (Weinberger et al., 2018). Therefore, it can be argued that entrepreneurs who experience high-quality sleep are better able to leverage their self-efficacy in identifying and acting upon entrepreneurial opportunities. Sleep quality also influences the access to, processing of, and interpretation of information. Poor sleep has been shown to reduce individuals' informational scope, impairing the integration and synthesis of diverse data (Fredrickson & Branigan, 2005). Because sleep affects both the quantity and quality of information perceived, insufficient sleep may distort or limit individuals' perception of reality, thereby constraining the range of innovative solutions they can generate (De Jong & Den Hartog, 2010). By diminishing information-processing capacity, poor sleep compromises the ability to envision multiple possibilities and exercise cognitive flexibility—both of which are critical antecedents of innovative performance (Fredrickson & Branigan, 2005). Based on these arguments, the following hypotheses are proposed:

Hypothesis 3: Sleep quality strengthens the relationship between entrepreneurial self-efficacy and opportunity recognition. Entrepreneurs with high-quality sleep are better able to leverage their self-efficacy in recognizing opportunities.

Hypothesis 4: Sleep quality strengthens the relationship between entrepreneurial alertness and opportunity recognition. Entrepreneurs with high-quality sleep are better able to leverage their alertness in recognizing opportunities.

Figure 1 depicts the conceptual model of the present study.

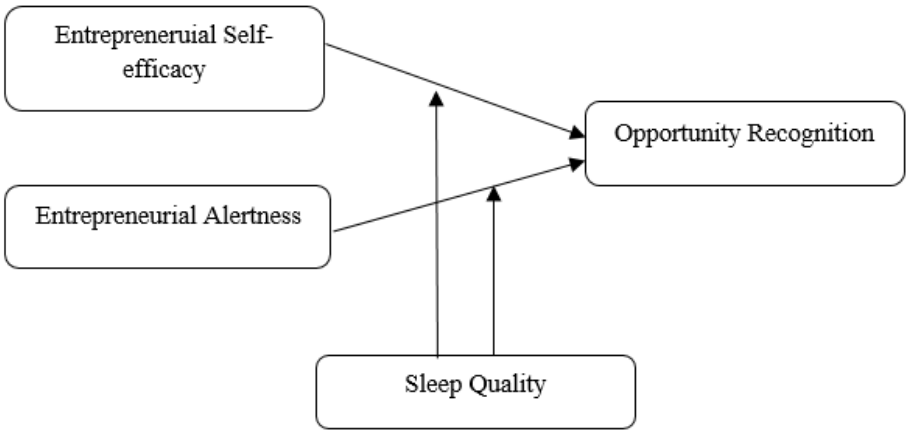

Fig 1. The conceptual model of the proposed hypotheses.

Research Method

Sample

Participants of this study were recruited from among Iranian entrepreneurs who, within the past five years, had founded or owned a business and whose ventures remained active at the time of data collection. Accordingly, the research sample was purposively drawn from entrepreneurs meeting these criteria. To determine the required sample size for a population of unknown size, the G*Power software was employed. Based on three independent variables, i.e., a total of 47 questionnaire items, a significance level of 0.05, and an effect size of 0.15, the minimum required sample was estimated at 160 respondents. To ensure sufficient data for analysis, 175

questionnaires were distributed. Eligible participants were identified via the LinkedIn social network, and they were provided with an online version of the questionnaire for completion. The sample consisted predominantly of young entrepreneurs, with a mean age of 30 years, and was overwhelmingly dominated by males (87%). Most participants operated small- and medium-sized enterprises (SMEs), primarily ventures less than five years old. The majority of respondents held university degrees in engineering fields and had prior entrepreneurial experience (63%).

Measurement of Variables

The data collection instrument was a standardized questionnaire comprising 47 items, each measured on a five-point Likert scale. Table 1 presents the sources of the items used to measure the study variables.

Table 1. Measurement proxies of variables

variable	Number of Items	Source
Opportunity Recognition	1	Global Entrepreneurship Monitor (2021)
Entrepreneurial Self-efficacy	14	Chen et al. (1998)
Entrepreneurship Alertness	13	Tang et al. (2012)
Sleep Quality	19	The Pittsburgh Sleep Quality Index (PSQI), Buysse et al. (1989)

Opportunity recognition was assessed using a single-item measure from the Global Entrepreneurship Monitor (GEM) Adult Population Survey (Hill et al., 2022). The item asks: *"In the next six months, will there be good opportunities for starting a business in the area where you live?"* Responses were coded dichotomously as "yes" or "no."

Entrepreneurial alertness was measured using the questionnaire developed by Tang et al. (2012), which captures three principal dimensions: scanning and search, association and connection, and evaluation and judgment. For instance, to assess the scanning and search dimension, one item states: *"I am good at combining information in new ways."*

Entrepreneurial self-efficacy was measured across five dimensions of marketing, innovation, business management, risk-taking, and financial control adapted from Chen et al. (1998). In this manner, participants reported their perceived capabilities to start and manage a business regarding each dimension.

Sleep quality was assessed using the well-known Pittsburgh Sleep Quality Index (Buysse et al., 1989), evaluating participants' habitual sleep patterns over the past six months. This instrument comprises 13 items spanning seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction.

To evaluate the reliability of the instrument, Cronbach's alpha coefficient was computed for all study variables, yielding a value of 0.798.

Data Analysis

To examine the relationships between the independent variables and the dependent variable, as well as the effect of each independent variable on variations in the dependent variable, regression analysis was employed (Mirakzadeh et al., 2021). Given that the dependent variable—opportunity recognition—was measured as a single binary item (0 = no, 1 = yes), logistic regression was selected as the appropriate

analytical method. The value of 1 was assigned when an entrepreneur successfully recognized an opportunity, and 0 otherwise.

Logistic regression is a type of generalized linear model that estimates the probability of a binary outcome based on one or more predictor variables. It uses the logit function to model the relationship between the independent variables and the log-odds of the dependent variable. Formally, the model is defined as:

$$\text{Logit}\ (p)=\text{Ln}\left(\frac{p}{1-p}\right)=\alpha+\beta_1 x_{1,i}+\ldots+\beta_k x_{k,i};i+1,\ \ldots,\ n$$

where $x_{k,i}$ denotes the i^{th} independent variable, β_i represents the coefficient associated with the i^{th} predictor, and p indicates the probability of the dependent variable occurring as a function of the independent variables. Equivalently, the generalized form of the logistic regression model can be expressed as:

$$p=p_r(Y_i=1)\rightarrow p=p_r(Y_i=1\left|X\right.)=\frac{e^{\alpha+\beta_{1x1,i}+\ldots+\beta_k x_{k,i}}}{1+e^{\alpha+\beta_1 x_{1,i}+\ldots+\beta_k x_{k,i}}}$$

In this equation, p_r represents the probability of opportunity recognition based on the set of independent variables, and β_i indicates constants in the logistic regression model. This modeling approach allows for the estimation of the influence of cognitive capabilities (i.e., self-efficacy and alertness) and the moderating biological factor (i.e., sleep quality) on the likelihood of recognizing entrepreneurial opportunities.

Results

To assess the normality of the research data, the Shapiro–Wilk test was employed. According to this test, a significance level greater than 0.05 indicates that the data do not significantly deviate from a normal distribution, thereby justifying the use of parametric methods (Table 2).

Table 2. Shapiro–Wilk Test Results for Normality

Variable	Statistic	df	Significance (p)
Alertness	0.966	160	0.001
Self-Efficacy	0.985	160	0.079
Sleep Quality	0.962	160	0.000
Opportunity Recognition	0.496	160	0.000

The results of the Shapiro–Wilk test revealed that alertness, sleep quality, and opportunity recognition significantly deviated from normality ($p < 0.05$), whereas self-efficacy did not ($p = 0.079$). These findings indicate that non-parametric approaches, such as logistic regression, are appropriate for analyzing opportunity recognition and its predictors.

Logistic Regression Outputs

The Case Processing Summary provides information on the number of cases included in our analysis. According to Table 3, there was no missing data in our analysis.

Table 3. Case Processing Summary

Unweighted Cases		N	Percent
Selected Cases	Including Analysis	160	100.0
	Missing Cases	0	0
	Total	160	100.0
Unselected Cases		0	0
Total		160	100.0

Model Fit of the Logistic Regression

The Omnibus test evaluates the overall fit and explanatory power of the logistic regression model. In this test, a chi-square statistic with a significance level below 0.05 indicates that the model demonstrates adequate fit, and that the independent variables collectively possess predictive capability for the dependent variable. Table 4 presents the overall indicators of model quality, including three statistical tests: step, block, and model. The results indicate that the logistic regression model is statistically significant across all tests, with all independent variables entered simultaneously and all coefficients reaching significance.

Table 4. Overall Model Coefficient Test

Step	Test Type	Chi-Square	df	Significance (p)
1	Step	56.844	29	0.002
	Block	56.844	29	0.002
	Model	56.844	29	0.002

The overall test of model coefficients indicates that the predictors collectively contribute significantly to the logistic regression model ($\chi^2 = 56.844$, df = 29, p = 0.002). This result confirms that the included independent variables improve the prediction of opportunity recognition, compared to a null model with no predictors.

The Hosmer–Lemeshow test, a widely recognized and robust method for assessing logistic regression model fit, evaluates the correspondence between the predicted probabilities generated by the model and the observed outcomes of the dependent variable. A significance level greater than 0.05 indicates an adequate fit.

Table 5. Hosmer-Lemeshow Test Results

Step	Chi-Square	df	Significance (p)
1	4.901	8	0.768

As shown in Table 5, the Hosmer–Lemeshow test yielded a non-significant result (p = 0.768), suggesting that the model's predicted probabilities do not significantly differ from the observed values. These findings indicate that the logistic regression model demonstrates good fit and adequately represents the data, supporting the reliability of its predictions for opportunity recognition.

Table 6 presents the logistic regression model summary, including key indicators of goodness-of-fit and the explanatory power of the independent variables. The Cox and Snell R^2 and Nagelkerke R^2 values serve as approximate analogues to the R^2 statistic in multiple regression, reflecting the proportion of variance in the dependent variable accounted for by the model.

Table 6. Model Fit Summary

Step	-2 Log-Likelihood	Cox & Snell R^2	Nagelkerke R^2
1	106.019	0.299	0.468

Note: Estimation stopped at the fifth iteration because changes in parameter estimates were smaller than 0.001, indicating model convergence.

The logistic regression model demonstrated strong overall fit, as summarized in Table 6. The model's -2 log-likelihood value was 106.019, and the pseudo-R^2 measures indicated that the independent variables explained a substantial proportion of variance in opportunity recognition (Cox & Snell $R^2 = 0.299$; Nagelkerke $R^2 = 0.468$). Model estimation converged after five iterations, with changes in parameter estimates smaller than 0.001, reflecting stable and reliable coefficients. These findings

suggest that the logistic regression model provides an adequate and robust representation of the relationships between the predictors and opportunity recognition.

Block 0 Output of the Logistic Regression Model

Table 7 presents the classification results for the dependent variable in the initial logistic regression model. In Step 0, where no independent variables were included, the model correctly predicted 100% of observed "Yes" cases but failed to correctly classify any "No" cases, resulting in an overall prediction accuracy of 65.6%.

Table 7. Classification Table

Observed			Predicted		
			Opportunity Recognition		Percentage Correct
			Yes	No	
Step 1	Opportunity Recognition	Yes	115	0	100.0
		No	55	0	0.0
	Overall Percentage			65.625	

This outcome indicates that baseline classification is largely determined by the prior probabilities of the dependent variable. Specifically, the probability of opportunity recognition among the sampled entrepreneurs is approximately 66%, while the probability of non-recognition is approximately 34%.

As shown in Table 8 (Variables in the Equation), when independent variables are not included in the model, the estimated odds of opportunity recognition are 0.26, reflecting the baseline likelihood of the event.

Table 8. Variables in the Equation (Without Entering Independent Variables)

Step	Standardized Coefficient (β)	Standard Error	Wald Statistic	df	Significance (p)	Odds Ratio
Step 0	-1.348	0.195	47.574	1	0.000	0.26

Note: "Step 0" refers to the initial model where no independent variables have been entered.
"Standardized Coefficient (β)" indicates the effect size in standard units.
"Odds Ratio" corresponds to the exponentiated coefficient, reflecting the likelihood of the outcome.

In Step 0 of the logistic regression, prior to including any independent variables, the intercept was significant ($B = -1.348$, $p < 0.001$), with an odds ratio of 0.26. This establishes the baseline log-odds of opportunity recognition when no predictors are incorporated.

Table 9 presents the assessment of outliers within the research sample. Standardized residuals exceeding ±2 indicate cases that may be inconsistent with the research model. For instance, respondent 8 falls into this category: while the model predicted a positive response regarding opportunity recognition, the actual response was negative, suggesting a potential deviation from expected patterns.

Table 9. Examination of Outlier Cases

Case	Selection Status	Observed Opportunity Recognition	Predicted	Predicted Group	Residual	Normalized Residual	Standardized Residual
8	Selected	1**	0.137	0	0.863	2.508	2.149
17	Selected	1**	0.112	0	0.888	2.822	2.570
29	Selected	1**	0.114	0	0.886	2.789	2.242
51	Selected	1**	0.134	0	0.866	2.537	2.084
85	Selected	1**	0.132	0	0.868	2.564	2.175
89	Selected	1**	0.031	0	0.969	5.594	2.796

Note: 1.1 = Unclassified cases.
2. Cases with residuals greater than 2 are listed.

Six cases with standardized residuals exceeding ±2 were identified as potential outliers. Although these cases had minimal impact on the overall stability of the model, their presence underscores the importance of evaluating influential observations in logistic regression analyses.

Block 1 Output of the Logistic Regression Model

In this section of the binary logistic regression analysis, the research model is examined with the predictor variables included. Table 10 illustrates the extent to which the regression model accounts for variance in the dependent variable. The results indicate that, after including the independent variables, the model's explanatory power increased from 65.625% in Step 0 (Table 7) to 85%, demonstrating a substantial improvement in predictive accuracy.

Table 10. Classification Table

Observed			Predicted		
			Opportunity Recognition		Percentage Correct
			Yes	No	
Step 1	Opportunity Recognition	Yes	118	9	92.9
		No	15	18	54.5
	Overall Percentage			85	

After including the independent variables, the model's overall classification accuracy increased to 85%. The accuracy for predicting opportunity recognition as "Yes" reached 92.9%, whereas the accuracy for "No" cases was 54.5%, indicating that the model is more effective at identifying individuals who recognize entrepreneurial opportunities.

Additionally, the *Variables in the Equation* table (Table 11) presents information on the contribution of each independent variable to the model. The Wald test assesses the significance of each predictor, while the coefficient values indicate the direction of the relationships between the independent and dependent variables. The odds ratios further reflect the relative strength of the predictors in explaining the likelihood of opportunity recognition.

Table 11. Variables in the Equation (Step 1)

Step	Variable	B (Coefficient)	Standard Error	Wald Statistic	Significance (p)	Exp (B) (Odds Ratio)	95% Confidence Interval for Odds Ratio
Step 1	ESE	1.202	0.757	2.52	0.010	3.33	1.21-9.14
	EA	3.033	0.975	9.74	0.002	20.74	3-13.92
	SQ	0375	0.265	2.00	0.045	1.45	1.06-2.18
	ESE*SQ	0.50	0.22	5.17	0.023	1.65	1.07-2.55
	EA*SQ	0.78	0.31	6.33	0.012	2.18	1.19-3.99
	Gender (1=Male)	-0.762	0.914	0.69	0.405	0.47	1.06-16.11
	Entrepreneurial Exp (1)	0.403	0.994	0.16	0.658	1.50	0.20-11.0
	Entrepreneurial Exp (2)	0.829	1.034	0.64	0.422	2.29	0.32-16.9
	Firm Size (small)	-3.478	1.007	11.92	0.001	0.03	0.01-0.22
	Firm Size (medium)	1.193	1.109	1.16	0.282	0.30	0.04-2.31

Step	Variable	B (Coefficient)	Standard Error	Wald Statistic	Significance (p)	Exp (B) (Odds Ratio)	95% Confidence Interval for Odds Ratio
	Firm Size (large)	-3.346	1.226	7.45	0.006	0.035	0.003-0.41
	Firm Age (1)	1.207	0.976	1.53	0.216	3.34	0.30-37.4
	Firm Age (2)	0.978	0.923	1.12	0.289	2.66	0.31-22.1
	Constant	-2.15	1.30	2.73	0.098	0.12	-

The logistic regression analysis examined the effects of self-efficacy and alertness on opportunity recognition, as well as the moderating role of sleep quality. Regarding direct effects (Hypotheses 1 and 2), Self-Efficacy significantly increased the likelihood of opportunity recognition (B = 1.202, p = 0.010, OR = 3.33, 95% CI: 1.21–9.14), supporting Hypothesis 1, meaning that entrepreneurs with higher self-efficacy were more likely to recognize opportunities. Alertness also had a significantly positive effect (B = 3.033, p = 0.002, OR = 20.74, 95% CI: 3.10–13.92), confirming Hypothesis 2, meaning that higher alertness strongly increases the odds of recognizing opportunities. Additionally, regarding Moderating Effects of Sleep Quality (Hypotheses 3 and 4), data analysis shows that the interaction term Self-Efficacy × Sleep Quality was significant (B = 0.50, p = 0.023, OR = 1.65, 95% CI: 1.07–2.55), indicating that sleep quality strengthens the positive relationship between self-efficacy and opportunity recognition, supporting Hypothesis 3. Hence, entrepreneurs with higher sleep quality could utilize their ESE toward opportunity recognition. Similarly, Alertness × Sleep Quality was significant (B = 0.78, p = 0.012, OR = 2.18, 95% CI: 1.19–3.99), showing that higher sleep quality amplifies the effect of alertness on opportunity recognition, supporting Hypothesis 4. These results demonstrate that both cognitive capabilities (self-efficacy and alertness) positively influence opportunity recognition, and that sleep quality serves as a significant moderator, enhancing these effects.

The analysis controlled for demographic and firm-related factors to ensure robustness of the main effects. Age had a significant positive effect. Older entrepreneurs were more likely to recognize opportunities (Age (1): B = 1.771, p = 0.042, OR = 5.88; Age (2): B = 3.141, p = 0.007, OR = 23.12). Firm Size had a negative effect in some categories (e.g., small firms: B = -3.478, p = 0.001, OR = 0.03), suggesting that smaller firms were less likely to recognize opportunities. Gender, Entrepreneurial Experience, and Firm Age were not statistically significant predictors ($p > 0.05$), indicating that these factors did not meaningfully influence opportunity recognition in this sample. Overall, the results confirm that the relationships between self-efficacy, alertness, and opportunity recognition are robust, independent of demographic and firm characteristics.

Discussion

Although a substantial body of research has examined the individual-level drivers of opportunity recognition, our understanding of why—and under what conditions—some individuals are more likely than others to recognize entrepreneurial opportunities remains incomplete (Filser et al., 2023). In recent years, scholars have increasingly turned their attention to the biological foundations of entrepreneurship,

highlighting the role of physiological and neurobiological factors in entrepreneurial cognition and behavior (Gunia, 2018; Gunia et al., 2021). Building on this emerging perspective, the present study integrates cognitive determinants (i.e., self-efficacy and alertness) with a biological factor (i.e., sleep quality) to examine their joint influence on opportunity recognition. By considering both psychological and biological mechanisms, this study offers a more comprehensive account of entrepreneurs' opportunity recognition capability. The key findings are discussed below.

The Relationship Between Cognitive Capabilities and Opportunity Recognition

The relationship between entrepreneurs' cognitive capabilities and opportunity recognition has long occupied a central position in entrepreneurship research (Gaglio & Katz, 2001; Sarma et al., 2024). In particular, prior scholarship has emphasized the roles of alertness and self-efficacy as critical cognitive antecedents of opportunity recognition. Consistent with this body of work, the findings of the present study confirm the positive associations of both self-efficacy and alertness with opportunity recognition ability. Self-efficacy shapes how individuals interpret situations and respond to them (Ashourizadeh & Saeedikiya, 2023). By strengthening individuals' confidence in their capacity to pursue and achieve specific goals, self-efficacy enhances motivational components such as interest and perseverance, which in turn facilitate the identification of viable opportunities for venture creation (Burnette et al., 2020). Individuals with high self-efficacy are more likely to perceive themselves as capable of undertaking venture-related actions, thereby increasing the likelihood that their expectations translate into concrete entrepreneurial behaviors, including opportunity recognition (McGee et al., 2009; McGee & Terry, 2024). Moreover, high self-efficacy encourages entrepreneurs to set ambitious goals, maintain persistence in the face of obstacles, minimize perceived risks, and focus more intensively on potential gains—conditions that are conducive to recognizing entrepreneurial opportunities (Caliendo et al., 2023).

Entrepreneurial alertness similarly represents a foundational driver of opportunity recognition. Alertness influences how individuals access, process, organize, and interpret information, enabling them to envision possibilities beyond existing market conditions (Sharma, 2019). Alert entrepreneurs are more adept at combining disparate pieces of information in novel ways, thereby generating new business ideas and identifying opportunities ahead of others (Satar et al., 2024). The capacity to connect seemingly unrelated information, attend to emerging signals, and evaluate whether new patterns contain entrepreneurial potential is directly shaped by an individual's level of alertness (Tang et al., 2012). Through heightened sensitivity to environmental changes and evolving trends, alert individuals are better positioned to interpret dynamic conditions and convert them into profitable opportunities (Pirhadi et al., 2023).

The Role of the Biological Factor of Sleep Quality in Opportunity Recognition

The findings of the present study suggest that the relationship between entrepreneurs' cognitive capabilities and their opportunity recognition potential is contingent upon a biological factor—sleep quality. Prior research indicates that insufficient sleep impairs working memory (Kane et al., 2004) and reduces attention to and processing

of environmental cues (Harrison & Horne, 2000), both of which constitute essential inputs for entrepreneurial opportunity recognition. In contrast, adequate and high-quality sleep enhances individuals' capacity to form meaningful and novel associations among disparate pieces of information, thereby fostering creativity (Cai et al., 2009). Accordingly, when entrepreneurs experience high-quality sleep, they are better able to leverage their alertness to integrate environmental signals and identify potentially profitable opportunities. Sleep quality also plays a critical role in memory consolidation processes (Schmidt et al., 2015) which influence the ability to retrieve and recombine stored information—whether conscious or nonconscious—in the recognition of opportunities. Proper sleep supports attentional control, information processing, interpretation, and integration (Gish et al., 2019), thereby strengthening the functional mechanisms underlying alertness. Conversely, poor sleep quality may distort information processing, increase misinterpretation of signals, and lead to inaccurate risk assessments (Gentner et al., 2001), thus undermining the effective deployment of alertness in opportunity recognition. In this sense, alert entrepreneurs who experience high-quality sleep are better positioned to translate their cognitive capability into opportunity identification outcomes.

A similar logic applies to self-efficacy. Poor sleep quality is associated with heightened tension and anxiety, reduced concentration, diminished cognitive flexibility (Diamond, 2013), and impaired emotional regulation (Minkel et al., 2012). These deficits negatively affect decision quality, risk evaluation, and behavioral execution (Williamson et al., 2019). Inadequate sleep may also increase the time and effort required to perform tasks while preventing individuals from reaching optimal performance levels (Weinberger et al., 2018). The negative mood states associated with sleep deprivation further exacerbate these effects (Bouwmans et al., 2017). Under such conditions, even individuals with high levels of self-efficacy may struggle to effectively enact their perceived capabilities. Therefore, although self-efficacy fosters confidence in one's entrepreneurial competence, poor sleep quality may weaken the cognitive and affective mechanisms necessary to translate that confidence into successful opportunity recognition.

Conclusion and Recommendations

The findings of the present study underscore the importance of sleep as a foundational construct for long-term and short-term emotional, physical, and psychological well-being (Barnes et al., 2017). Despite prior calls to incorporate biological factors into entrepreneurship research (Shepherd & Patzelt, 2015; Wiklund et al., 2017), relatively limited empirical attention has been devoted to the biological underpinnings of entrepreneurs' capabilities (Gish & Wagner, 2017; Gish et al., 2019). By integrating cognitive factors with sleep quality, this study contributes to a growing line of inquiry that bridges psychological and biological perspectives in explaining entrepreneurial opportunity recognition. In doing so, it advances understanding of how cognitive capabilities are not merely dispositional traits but are conditionally enabled—or constrained—by underlying biological states. The primary practical implications of these findings concern entrepreneurs themselves as well as human resource functions within organizations.

Promoting Restorative and Recovery Practices: Entrepreneurs and business leaders should regard sleep quality not simply as a personal health issue but as a strategic cognitive resource. Training initiatives that emphasize sleep hygiene, its implications for decision-making quality, and its role in strengthening alertness and self-efficacy may enhance opportunity recognition capabilities. Integrating recovery management into leadership development programs may therefore yield tangible performance benefits.

Institutionalizing Recovery Within Organizational Culture: Startups and small firms often valorize overwork and sleep deprivation as signals of commitment. However, the present findings suggest that opportunity recognition depends on the regular replenishment of biological resources. Managers should model sustainable work practices, discourage chronic night work, and design flexible scheduling systems that allow employees to maintain high-quality sleep. Such practices can help sustain cognitive functioning, decision quality, and opportunity-oriented thinking.

Using Sleep as a Diagnostic Indicator: Within entrepreneurial coaching and human resource management processes, sleep quality may serve as an early indicator of diminished cognitive functioning, including reduced alertness and weakened self-efficacy. Systematic monitoring of sleep patterns and periodic well-being assessments may help identify cognitive fatigue and enable timely corrective interventions before performance deteriorates.

Overall, while sleep is not the sole determinant of entrepreneurial performance, the findings highlight its role as a critical enabling condition for the effective deployment of entrepreneurs' cognitive capabilities. By demonstrating that biological states shape the translation of cognitive potential into opportunity recognition, this study offers a more integrative perspective on the micro-foundations of entrepreneurial action.

Limitations and Future Research Directions

Like all research, the present study has several limitations. First, the relatively limited sample size constrains the generalizability of the findings. Future research should investigate these relationships in larger and more diverse samples, including cross-cultural and multi-regional contexts. Second, while the present study identifies associations between sleep quality and entrepreneurial capabilities, behaviors, and decision-making, experimental or longitudinal research designs could provide stronger causal evidence and clarify the temporal dynamics among these variables. Third, opportunity recognition in this study was measured using a single binary (yes/no) item. Prior research has employed multi-item measures, which may capture more nuanced aspects of opportunity recognition and its temporal unfolding. Future studies should consider more detailed and temporally sensitive measurement approaches to more precisely assess the influence of sleep quality on opportunity recognition. And fourth, the study focused exclusively on the individual entrepreneur. Given the inherently collaborative and team-based nature of entrepreneurial ventures, examining how an entrepreneur's sleep quality affects the perceptions, decision-making, and behaviors of other team members represents a promising avenue for future research.

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The authors declare that AI is not used in this study.

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The authors avoided data fabrication, falsification and plagiarism, and any form of misconduct.

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